Fluid Cooler Cold Weather Operation

Closed circuit fluid coolers are a great solution for a variety of applications ranging from water source heat pumps to process cooling. They combine the functionality of a cooling tower and plate and frame heat exchanger into one piece of equipment which keeps process fluids in a clean closed loop, and minimizes risk of fouling other system components. Preparing a fluid cooler for cold weather operation or shutdown season is similar to an open cooling tower, but with additional requirements. This paper discusses special considerations needed for cold weather operation and freeze protection for fluid coolers. For more detailed information on cooling tower cold weather operation, refer to **"Cold Weather Operation of Cooling Towers"** Technical Report TR-015 .

Coil Freeze Protection

Coils are the most expensive components in a fluid cooler and must be protected from freezing and bursting. Industry best practice and SPX recommendation is to use an industrial inhibited glycol process fluid of appropriate concentration to provide freeze protection. The two most common fluids used are Propylene Glycol (PG) and Ethylene Glycol (EG). PG has higher viscosity and thus has a larger efficiency penalty than EG, but PG's lower toxicity makes it preferable for most HVAC applications. Reference the glycol manufacturers' datasheet to determine the appropriate concentration for freeze protection (different than burst protection) at the lowest ambient temperature (including a safety factor) expected at the installation location – typically 20-60% concentration. Higher glycol concentrations penalize the heat transfer efficiency and pumping energy more than lower concentrations. Be sure to consider concentration when making fluid cooler and process-fluid pump selections. Below are some tips for dealing with glycol solutions:

- Glycol protection is needed in freezing climates from the time the system is filled to the time it is drained and/or retired. Even 24-hour operations are recommended to have glycol protection to prevent freezing during down times.
- Do not simply displace partial system volume with the required amount of glycol. Proper mixing and circulation is needed to distribute glycol evenly throughout the process fluid. Use quality water and mix according to glycol manufacturer instructions.
- Only use inhibited industrial glycols, do not use automotive or other-grade anti-freeze. Note minimum concentration for inhibitor effectiveness. Do not mix glycol from multiple manufacturers.

- Check system glycol concentration regularly, especially before cold weather.

If an industrial inhibited glycol solution of appropriate concentration is not in place, sufficient flow rate (minimum tube fluid velocity greater than 1 ft/s) and sufficient heat load (minimum coil exit temperature of 45°F - 50°F) must be maintained AT ALL TIMES DURING FREEZING CONDITIONS. This possibly includes weekends, holidays, power outages, planned or unplanned shutdowns, or any other inconvenient time.

Though some operators may choose to drain fluid cooler coils as a method to prevent freezing, SPX does not typically recommend draining as a standard operating procedure for freeze protection due to higher risk of complications. When conducting seasonal or periodic draining, proper system modifications must be in place to ensure quick, complete, and safe draining. Avoid draining (or re-filling) during freezing conditions. Draining galvanized coils is not acceptable unless in an emergency - the coil interior is bare steel and will corrode quickly. Stainless steel and copper coils can typically be drained without accelerating corrosion.

Basin Freeze Protection

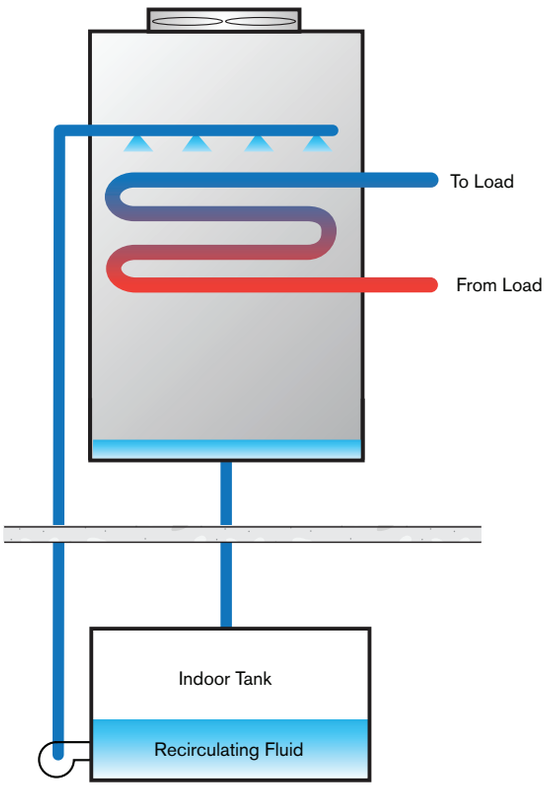
The open recirculating water system of a fluid cooler is separate from the process fluid loop and requires its own freeze protection measures. If the recirculating water basin won't be drained in the winter, it may be necessary to implement resistive-electric basin heaters to protect the recirculating water system from freezing when the fluid cooler is not in operation. Just as the use of glycol process fluids does not protect the open recirculating

water basin from freezing, optional electric basin heaters do not protect the coil from freezing. Fluid coolers with integral recirculating water pumps (typical) often include pump heat trace and insulation to complement electric basin heater options.

Alternatively, gravity draining the open recirculating fluid to an indoor storage tank (remote sump) below the frost line or into a heated building can be used to prevent freezing of the open recirculating water. This arrangement can be particularly advantageous for installations using coil-only fluid cooler products with seasonal dry operation capability – the fluid cooler collection basin drains automatically to the remote sump when recirculating pumps are turned off and the water is retained for future use.

Dry Operation

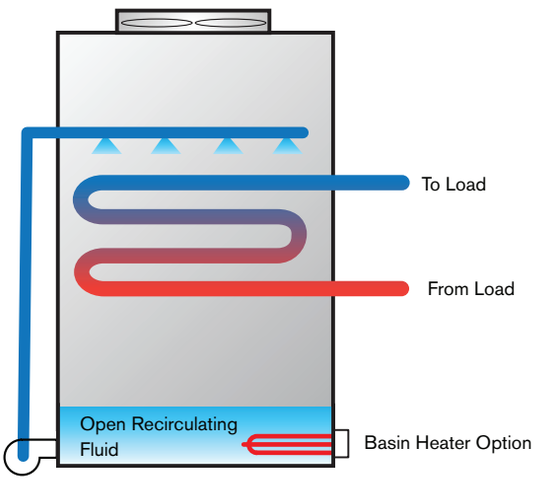
Depending on application, prevailing load conditions and fluid cooler type, operating dry (no recirculating water) may be a preferred cold weather operating mode. Switching between wet and dry mode operation should be minimized in order to minimize the potential for scaling of the heat transfer surface. The collection basin should always be drained completely for dry mode operation, which can complicate operation in shoulder seasons when daily temperatures may fluctuate widely - remote sump installation may be preferred in this scenario. Dry operation does not exempt the system from glycol freeze protection. It is important to note that different fluid cooler types have significantly different dry operation capacities - a factor which must be considered during equipment selection phase.



Fluid Cooler with Indoor Storage Tank

Additional Considerations for WSHP (or Similar) Applications

Due in large part to the complexities and risks associated with draining, certain applications such as HVAC Water Source Heat Pump (WSHP) systems commonly circulate process fluid through fluid cooler coils year-round, even when the system is not in cooling mode. Fluid coolers in WSHP systems typically incorporate optional Positive Closure Dampers to restrict air circulation and limit heat loss when the fluid cooler is turned off, in order to minimize wasted boiler energy when the system is in heating mode. Dampers may be located on air inlet(s) or fan discharge(s) and are typically two-position (open or closed) and not continuously variable. Note that fluid cooler type affects heat loss rating significantly – fluid coolers with higher dry operation capacity also have much higher heat loss potential – and should be considered when selecting equipment for WSHP or similar systems.



Fluid Cooler with Basin Heater

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