



Air-Handling Units With Freeze-Stat Protection Problems

During the heating season, facility staffs often experience chronic freeze protection shutting down air-handling units within their buildings. This happens because the original heating and ventilating system design did not accommodate the potential for the equipment's freeze-stat safety device becoming a nuisance while doing its intended job. A freeze stat is a temperature-sensing device used to prevent the steam or water coils within the unit from freezing when sensing 38F (adjustable) air temperature upstream of the first coil.

To complicate this heating system phenomena many equipment manufacturers have streamlined their mixed air plenum section of the air-handling unit where the building's return air is suppose to blend with outdoor ventilation. Unfortunately this mixing does not occur as expected because the warm return air does not get a chance to blend together with the cold outdoor air prior to passing over the coil fins and tubing. Instead the capillary freeze-stat cabling, installed in a serpentine configuration, covering the entire face of the coil, senses cold spots of outdoor air hitting the cable resulting in the air-handling unit shutting down.

Now there are averaging capillary cables but these freeze-stats do not always average out the warm spots on the coil with the cold spots on the coil. The inadequate mixing of the two air sources begins with the mixed air plenum upstream of the coils and the unit's air filters. Picture a mixed air box with the return air being ducted into the top of this box passing through an automatic damper device and the cold outside air entering at the rear of this box or possibly at the bottom of the box. The two air sources come together, but they do not entirely mix because of the lack of any turbulence as the air



moves through this box and passes over the first coil where the freeze-stat is located.

Upstream of the first coil is also a mixed air temperature controller that is an automatic temperature control (ATC) device. This device is an averaging sensor or a probe that determines the mixed air temperature, sending a control signal to the return air and outside air dampers to maintain the mixed air set point. Like the freeze-stat, this ATC device does not mean the air has now come together as a blended single temperature either.

Quite often the manufacturer's mixed air box/plenum are standardized and not sized exactly for the specific application. As a result, these dampers tend to be oversized. In addition, it is difficult to introduce turbulence within this air plenum because the two air sources are drawn in under negative pressure analogous to one sipping milk from a straw...there is no turbulence in the glass. Reverse the process and

blow into the glass and there will be turbulence.

The solution can be to have the return air and outdoor air introduced under positive air pressure via inline fans. Another solution is to size the dampers accordingly and introduce baffle(s) within the plenum to create air turbulence that forces the two sources of air to blend versus pass through in almost a parallel air pattern.

The more popular method of creating turbulence and air mixing is to add an air blender device in the airstream between this mixed air plenum and the filter and coil. This is the best solution with the lesser chance of long-term chronic freeze-stat problems continuing. However, there needs to be floor space if the unit is a floor-mounted air-handler to accommodate this approximate 12-inch length device.

Fix or no fix for the chronic freeze alarm problem, the freeze-stat is doing the job it is intended to do whether the building system operator likes it or not. It has been noted in the past that some operators will jump out the perceived nuisance control device rather than routinely responding to the alarm. Another quick fix has been to lower the freeze-stat set point from 38F to a temperature closer to the freezing point of the water within the coil. In time, this strategy can result in a frozen coil splitting the copper tubing within the coil.

A third quick-fix has been to over-ride the mixed air damper controls to set a reduced minimum outdoor quantity across this damper or worse yet, close the outdoor air damper all together during the heating season shutting off code required outdoor air ventilation. Under this condition the facility will eventually go under a negative pressure based on the number of exhaust fans operating within the building. The facility will still need the required make up air to replace exhaust to outdoor air and, with outdoor supply air off, the matching make up air will find its way into the building via the exterior doors opening and closing as people come and go from the building. In addition to the negative pressure with be this air coming into the building from various locations will be cold, untreated and unfiltered versus being conditions

through the air-handling unit.

With a freeze-stat alarm strategy, this will result in the air-handling fan shutting down, the associated outdoor damper closing and the return air damper opening to 100%. The coil's ATC water valve will be commanded open 100% water flow through the coil (if the water pump is on), and an alarm will be sent to the operator requiring manual startup of the unit once the problem is corrected. The unit should not be designed to restart automatically once the ATC device senses warmer temperature to avoid the unit cycling on and off based on the freeze-stat continuing to send its temperature signal to the control panel.

With the freeze-stat control strategy the fan will not continue to draw outdoor air through the unit even if it's a small coil surface area causing the alarm because the potential freezing temperature could lead to the water or steam condensate within the coil freezing and the coil bursting resulting in water damage. An operator needs to review the problem.

There are engineered solutions to nuisance freeze-stat problems. This safety and alarm device is there for good reason and ignoring the problem with quick fixes can result in several operation problems as well as the need to repair the coil and clean up the water damage. The Diocese of Cleveland Facilities Services office has the expertise to assist with engineered solutions when needed.

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