

No Ice is Nice

by Ron Prager

Once again, as I write this, winter is almost upon us. I've been sitting here trying to determine what the most devastating issues affecting retail facility managers during the winter season are. Without question, the most costly seasonal issues are those caused by frozen water in pipes and coils.

I will never forget the first time I experienced the impact of a frozen sprinkler system. I was 18 years old and we had just completed heating system repairs in a Russian night club in Brooklyn, New York. It was six o'clock on a Friday night in February and the temperatures had been in the teens all day. The owner was thrilled that we had restored heat to the space, because he had the entire club booked that night. What he neglected to mention, was the fact that the heat had failed the previous Monday and he waited till Thursday to place a call. Average temperatures had been in the twenties all week. Our crew was sitting at one of the tables enjoying a gratuity of vodka and Chicken Kiev when the patrons began arriving in their suits and gowns. There were approximately 100 people in the club when I noticed the first drips from the ceiling. A sprinkler head fell and landed on a table nearby. After a few minutes you would have sworn it was raining inside. It took us 10 minutes to find the sprinkler shutoff valve and close it. A look above the ceiling revealed hundreds of cracked pipe fittings. The scene in the club was close to a riot. Women were screaming as the deluge ruined their hair and clothing. Everyone was standing because all the chairs and tables were soaked. The bread Baskets were filled with soggy dough balls, and a crowd of angry men surrounded the owner shouting what I assume were obscenities in Russian. Needless to say, while we felt quite successful after making repairs in extremely difficult conditions, we thought it best to leave before people connected the heating system repairs with the thawing of the sprinkler system.

Frozen piping systems, pumps, and coils are the things HVAC contractors and facility managers have nightmares about. Cold weather is insidious, just waiting for someone to make the smallest mistake. When we have a few mild winters in a row, followed by a particularly cold week, I know we are going to be dealing with freeze damage. Something as simple as an outside air damper that does not close completely, or control set-points that have changed can cause hundreds of thousands of dollars in damage. I have seen complete strip malls gutted by a sprinkler main that froze and thawed. The sprinkler system dumped water into that store for hours during a holiday and the water was 4" deep when the owner's representative responded. A frozen water-side economizer coil recently dumped large enough quantities of condenser water into a store in Manhattan to cause close to \$500,000.00 in damage to the store and its neighbors.

In order to avoid catastrophes like these we need to look at what systems in retail stores carry water and where the possibility of this water freezing is present. Then we have to take proactive measures to protect these systems. Finally, we have to be aware of the early warning signs that freezing has occurred so that we can mitigate the damage caused when the system thaws. After all, the ice just damages the system components. When the ice thaws, and the water begins to flow is when the real damage occurs.

Where there's water...

1. Potable and domestic hot water:

All retail stores have piping carrying potable water and domestic hot water for bathroom use. If this piping runs directly below the roof of the building, or if it runs in an exterior wall, the piping may be subject to freezing temperatures. At a minimum, piping in attic spaces and in exterior walls must be insulated. In areas of extreme cold where piping must be located in these areas, the piping should be heat traced with an electric heating element designed to prevent freezing. Bathrooms on exterior walls should be equipped with dedicated electric heaters and the operation of these heaters should be checked before each winter. If you receive a call in winter, from a store complaining of no water in the bathroom you would be well advised to have the water to that part of the building turned off prior to doing anything else. The cause is probably a frozen pipe and when it thaws, watch out!

2. Sprinkler systems:

Most stores are served by wet sprinkler systems that are constantly filled with water under pressure. By its nature, sprinkler piping is located above the ceiling of your stores. If the temperature in the space above the ceiling drops below 32° F, for a number of hours, the water in the piping will freeze. Obviously, this is usually the case when the store is located on the top floor of a building and the ceiling is located directly below the roof. When sprinklers freeze, the fittings such as elbows and tees normally split. When the ice thaws, you end up with the full diameter of the sprinkler piping pouring water into your store. Because frozen sprinklers are caused by any mechanism that lowers the surrounding space below freezing, the cause is often insidious and difficult to determine.

There was a mall store in Willow Grove, PA where the sprinkler piping froze two years in a row. Finally, the cause was found to be an exhaust system issue. During a normal day, mechanical systems were operating and outdoor ventilation air was pressurizing the mall's common space. Excess air was vented to the outdoors via an exhaust fan, through a duct penetrating the roof. At night, the mechanical systems shut down and the fan stopped. As the space was no longer pressurized, this duct now conveyed wind driven outdoor air into the space between the ceiling and the roof. The demising wall of the store in question was not sealed where it met the roof, and the motorized damper that was supposed to close off the ventilation duct at night had a defective actuator. For all intents and purposes, the store had a four foot square opening in the roof located next to one of its demising walls. Evidently, it took more than 12 hours for this situation to cause the piping to freeze solid, because the store only flooded the day after it was closed for a holiday; two years in a row. It is

prudent, when designing, maintaining, and inspecting stores to look at all roof penetrations above or adjacent to your stores to determine if they can become a source of frigid air in winter.

Another possible cause of frozen sprinkler piping is setting your thermostat heating set-point too low. Sometimes, in response to an energy saving initiative, thermostats are programmed with aggressive night setback set-points of 55° degrees or less. While you may save loads of money by reducing the temperature of the sales space from 68°F to 50°F, you need to think about the effect this is having on temperatures above the ceiling and along outside walls. Keep in mind that when the temperature on the floor was 68°, the temperature between the ceiling and the roof may have been 40°. Now the temperature surrounding your potable water and sprinkler piping may be 22°F. You can use all of the money you saved on energy to begin to pay for the damage caused by the frozen piping. Prior to changing the unoccupied temperature of your stores by a significant amount, take a look at how this may affect temperatures in areas exposed to outdoor air.

You really need to look at your stores, think about where the pipes carrying water are located, and then think about what temperatures they are exposed to and what external influence can cause those temperatures to change. When you are notified that the heating system in one of your stores is going to be down for 24 hours or more, you should immediately consider the possibility of this situation causing piping to freeze. Sometimes something as simple as leaving the store lights on overnight, or leaving the bathroom doors open, in a location with an inoperative heating system can mean the difference between water and ice. You may want to ask your contractor to remove some of the ceiling tiles in a store that must be left without heat for a period of time. Remember hot air rises. You need to keep in mind the particular idiosyncrasies of your stores. At an electronics store in Long Island, a 6" sprinkler valve froze, flooding the store. The sprinkler main was located in a car stereo installation center equipped with steel roll up doors. The heating unit that served the area had a cracked heat exchanger and it took the landlord's contractor 5 days to procure the new heat exchanger. No one thought about the fact that this area of the store was subject to huge amounts of outdoor air infiltration due to the roll-up doors. Heat tracing the sprinkler main in an area that was colder than normal retail space would have saved a lot of anguish.

3. HVAC Systems:

The retail facility manager must also be cognizant of the different types of HVAC systems that serve his or her stores and which of these are subject to freezing. Chilled water systems, condenser water systems, hot water heating systems, and steam heating systems can all become victims of freeze damage. Any system that uses a water coil to heat or cool outdoor air is of immediate concern.

Chilled water systems utilize 45° water from a centrally located plant to cool the air within your store. In many malls, these chilled water coils must be drained during winter. In some locations they must be drained, isolated, and filled with an antifreeze

solution. Ask your service contractors about the type of system in each location and speak with the building engineer, if necessary to determine what is considered standard operating procedure within each building.

Sometimes, the same water coil is used to heat and cool the space. This is known as a two pipe hot / chilled water system. As with the chilled water system mentioned earlier, a percentage of the air being heated or cooled is always outdoor air for ventilation purposes. It is imperative that a device called a "Freezestat," be installed on these systems, and that its operation be checked before the heating season. The purpose of a freezestat is to shut down the system if the temperature of a coil containing water drops below 35°F. The freezestat is normally wired to close the outdoor air damper, open the heating valve fully, and shut down the blower. **The object is to do everything possible to prevent the water coil from freezing.** In addition to checking freezestat operation, outdoor air actuators and linkages as well as motorized valves should all be checked thoroughly. When a water coil freezes, the copper tubes actually swell and split. It is as ugly as it sounds, and in most cases the coil must be replaced rather than being repaired.

It is unusual for steam coils to freeze unless some malfunction occurs that prevents condensate (condensed steam) from leaving the coil. Control valves, vacuum breakers, air vents and steam traps must all be inspected prior to the heating season to make certain they are operating properly as these components can prevent condensate drainage. Steam coils, like water coils must be protected by a freezestat.

Some HVAC systems utilize condenser water or loop water to transfer heat from the refrigerant in summer and to the refrigerant in winter. During cooling operation, this condenser water is then cooled by a cooling tower. Cooling towers can be either open type or closed loop type. Open towers are winterized in some fashion, or are drained during the winter. Winterization may take the form of basin heaters and heat traced piping, or the use of an indoor sump. Closed loop towers usually circulate a mix of glycol and water to prevent freezing of the loop water and have sump heaters to keep the spray water sump above freezing temperatures. All sump heaters and heat tracing should be inspected prior to operation at temperatures below freezing. This includes inspection of the components that control these heaters. If cooling towers are to be drained during extreme extremely cold periods, you and the servicing contractor must agree on what dates of draining and filling will be acceptable. The freezing point and the corrosion inhibitor content of glycol systems must be checked annually prior to operation at temperatures below freezing. Most good service contractors will be performing these operations on their own, but diligence on the part of the facility manager as well as the contractor is recommended, especially if the contractor is new to a particular site.

I have attempted to provide a general idea of what precautions should be undertaken to prevent freeze damage. The most important thing to remember is to look at a site with the possibility of freeze damage in mind. You may be accepting a store from construction in August, and it's 90°F outdoors, but when you look at that sprinkler

head in the entrance vestibule, or the hole in the wall between the service corridor and your ceiling plenum, you need to be thinking icicles.