

# Winter Is Coming. Turn Up The Heat

By Ron Prager

You can tell that the cold weather is upon us. Temperatures in Dallas haven't topped a hundred degrees in days. Cold weather and Holiday Season shopping will soon be here. It's time to make certain that your HVAC is prepared to deal with both. Facility managers must prepare on three fronts. First, it's time to make certain that all heating systems are in good operating order. Next, it's time to make certain that the systems that provide winter cooling are in good shape. Operating air conditioning equipment at reduced outdoor temperatures can actually be more detrimental to equipment than operation at 95°F temperatures. Last, HVAC systems and store exteriors must be winterized to prevent damage due to exposure to freezing temperatures.

## Heating System Maintenance:

### Gas Fired Hot Air:

Most retail store in the United States are heated with natural gas hot air furnaces. These furnaces are usually an integral part of packaged rooftop heating and cooling units. They may be attached to a fan and suspended from a ceiling, in which case they are known as unit heaters. They may be installed in ductwork that is attached to an air handler. These are called duct furnaces. The operation of these furnaces may differ in the type of ignition and the method used to move flue gases through the heat exchangers, but aside from these minor differences, the operation of the furnace remains the same.

On a call for heat from the thermostat, an electrically operated valve opens slightly. This valve allows a small flow of natural gas to be ignited by a spark or by a hot ceramic surface. Once this pilot flame is sensed by a device which proves that ignition has been established, another valve opens allowing gas to flow into the burner or burners. Burners allow the correct quantity of air to mix with the gas and provide a controlled clean burning flame.

A clean burning gas flame should be blue with little or no yellow in it. The flame should never appear orange or smoky. A blue flame is a sign of complete combustion. The flue gases will contain Carbon dioxide and water vapor and excess air. An orange flame is a sign of incomplete combustion. The flue gases will contain carbon dioxide, carbon monoxide, and soot in extreme cases. This is an extremely dangerous condition due to the health hazard presented by carbon monoxide. Furnaces should never be allowed to operate in this condition.

The burner injects the flame into the interior of a group of steel pipes or a steel drum that is called a heat exchanger. The burning gases travel through the interior of the heat exchanger and air from the store is blown over the exterior of the heat exchanger. Heat from the burning gases in the interior of the heat exchanger is transferred to the air passing over the outside of the heat exchanger. The temperature of the air is normally raised between 20°F and 40°F as it passes over the heat exchanger.

The burning gases leave the heat exchanger and are vented to the outdoors. Draft is the difference in pressure measured between the burner inlet and the flue gas outlet, which causes the flue gases to flow. Most furnaces located in packaged rooftop units utilize a draft inducer or a forced draft burner to pull or push the gases through the furnace. Some older furnaces are called natural draft furnaces where the flue gases flow due to a combination of the temperature of the gases and the height of the flue stack or chimney.

At the beginning of each heating season, it is imperative to have your HVAC service contractor inspect and test certain components of the hot air furnaces that heat your stores. The following scope of work is the minimum that should be performed prior to the heating season.

- The furnace should undergo a full operational test. During this test, the technician will observe that the draft inducer is operating at full speed and the inducer blower wheel and housing has not corroded. He will check to see that the pilot gas valve does not open until the inducer comes up to speed and draft is

proven. He will make certain that the main gas valve does not open until the pilot flame is proven. He will observe the flame and make certain that the air to fuel mixture is correct and that the flame is steady and not wavering. A wavering flame, or a flame that appears to be blowing out of the burner compartment is a sign of a cracked or holed heat exchanger. This is a dangerous condition.

- The technician should inspect and clean the burners. He should also inspect the heat exchanger for corrosion and clean away and rust or debris that has fallen into the burner chamber.
- The technician should check the blower components that force air from the store over the exterior of the heat exchanger.
- The temperature rise of the air entering and leaving the heat exchanger should be checked.
- The operation of the ignition safety controls should be checked by turning off the gas to the unit and seeing how quickly the electric gas valve closes.
- The operation of the fan switch or time delay relay should be checked to make certain that the blower is being brought on automatically.
- The unit should be inspected physically to make certain that there is no way that flue gases from the unit can find their way into the outdoor air intake of other units and visa versa.
- Any components that are not 100% should be replaced now. It's a lot easier to replace a heavily rusted draft inducer now in 50°F temperatures than it is to replace it when there's three feet of snow on the roof on a cold night in December.
- Operation of outdoor air dampers should be checked to make certain that these dampers are closing fully when the blower shuts down or when power to the unit is interrupted. Anyone who has experienced the damage caused by a frozen sprinkler system can appreciate the wisdom of controlling the amount of outdoor air that enters the ceiling plenum.

While the vast majority of stores are heated with gas furnaces, we should touch on the other common heating methods and the maintenance checks that are required.

#### **Electric Heat:**

Some stores are heated with electric resistance coils. These are basically overgrown toaster elements strung between porcelain insulators that are placed in the blower discharge of the air conditioning unit that serves the store. As with gas furnaces, operation of electric heating elements should be thoroughly checked, as should outdoor air damper position and blower components. In addition, the technician should confirm that all heating elements are operating by checking the current drawn by each energized element. Elements and terminals should be inspected for loose or burned wiring. Contactors should be inspected for pitted or overheated contact points. Once again, temperature rise across the heating element should be checked. Facility managers should note that when electric heating elements are energized for the first time each season, some smoke may be produced as dust burns off the elements. It is a good practice to notify the fire alarm company prior to start-up of electric heating elements to prevent fire department response to a false ring-off. This is especially true when there is a duct mounted smoke detector located downstream of the electric heating element.

#### **Heat Pumps:**

In some areas of the United States, retail stores are heated with packaged heat pumps. Heat pumps are nothing more than reverse-cycle air conditioning units. In the cooling mode, like most air conditioners, heat is removed from the 75°F indoor air, lowering the temperature of this air to approximately 55°F before

discharging it into the store. This heat is then transferred to the 95°F outdoor air, raising the temperature of the air discharged to the outdoors to approximately 110°F

During heating operation, a heat pump reverses the refrigerant flow using a device called a reversing valve. Heat is removed from the outdoor air at temperatures as low as 35°F. This heat is then transferred to the indoor air, raising the 70°F air in the store to approximately 90°F. Due to the fact that the capacity of a heat pump drops as outdoor air temperatures drop, most heat pumps are equipped with auxiliary electric resistance heating coils to provide additional heating capacity.

The heating season checkout procedure for a heat pump is the same as the cooling season checkout with the addition of checking and testing the operation of the electric heating components. At minimum, compressor operation, blower operation, refrigerant charge, operation of reversing valve, operation of defrost cycle, and cleanliness of coils should all be examined

### **Steam Heat:**

If your stores are heated using steam, this is the time to check the steam heating components. For the purposes of this article, we will assume that the boilers that provide the steam supply are not your problem, as boiler maintenance is a lengthy and complex subject. Steam heat is used to heat retail stores via two methods. Either steam is allowed to condense in finned tubes which run around the perimeter of the store, or steam is allowed to condense in a coil that is located in the HVAC system air handler. In either case, a thermostat controls the flow of steam by operating a valve. Most commercial steam systems use a device called a steam trap that separates the steam within the radiation or coil from the condensate. (condensed steam)

Pre-season check-out of steam heating systems should be performed as soon as the building is providing steam to its tenants. Operation of steam valves and steam traps should be verified. Operation of vacuum breakers, which allow the condensate to drain from inoperative steam coils should be checked and verified. Most important, the operation of freeze-stats should be checked and verified. In the event that the temperature downstream of the steam coil drops below 35°F, a freeze-stat shuts the unit down in order to prevent the water within the steam coil from freezing and rupturing the coil.

### **Hot Water Heat:**

Similar to steam heating systems, hot water is utilized to heat retail space via perimeter radiation and via hot water coils located within the air handler that provides the store with air conditioning. Hot water systems also contain motorized valves, thermostats, and freeze-stats that require attention. In addition, your hot water system may contain pumps that must be lubricated and checked for proper operation. It is often necessary to bleed air from the high points in a hot water heating system at the beginning of each heating season to assure full flow and quiet operation.

### **Winter Air Conditioning:**

Almost every facility manager has heard the term “economizer” used. Due to the high internal heat generated in retail stores by lighting and people, most retail stores require cooling at outdoor air temperatures as low as 25°F. Rather than operating compressors to cool the air within the store, an economizer cycle exhausts warm air from the store and delivers a mixture of outdoor air tempered with store air at a temperature of 55°F to cool the space. Winter is when economizers pay for themselves. They reduce the electric consumption required to cool the store and reduce the number of hours the compressors must operate under adverse conditions. For this reason, it makes sense to have a service tech check economizer operation thoroughly in all air conditioning units prior to the winter cooling season.

Some systems are not equipped with economizer cycles, however the stores utilizing these systems also require winter cooling. Air conditioning systems that use mechanical refrigeration to provide winter cooling must be equipped with low ambient control accessories. These controls allow the air conditioning equipment to maintain acceptable pressures and temperatures during operation at reduced outdoor temperatures. If low ambient accessories are not installed the end result is frozen coils and ruined compressors. Therefore it is necessary to have the operation of low ambient accessories checked and

verified and the refrigerant charge checked on equipment that will be operating at reduced outdoor temperatures.

**Winterize Your Systems:**

There are two things to remember about winterizing systems. The first thing to remember is that water freezes at 32°F and when it freezes it expands. The second thing to remember is that temperatures below freezing have been recorded in all 50 States at one time or another. You must protect your systems to whatever degree possible against freeze damage.

I recommend the following:

- On systems that use chilled water coils for summer cooling, have a technician drain these coils, close the valves that isolate the coils from the building system, and fill the coils with a 50% mixture of propylene glycol. (Nontoxic antifreeze)
- On systems that use cooling towers that are required to operate throughout the winter, make certain that the towers are equipped with basin heaters and that the piping around the tower is heat traced, and verify the operation of these heating elements.
- On systems that use cooling towers, or landlord furnished condenser water, the towers and pumps should be completely drained. Water cooled condensers in each tenant's units should be drained, isolated, and filled with a propylene glycol solution.
- Proper closure of all outdoor air dampers including the dampers located downstream of exhaust fans should be checked. Infiltration of cold air into a building is often the cause of a frozen sprinkler system and the subsequent water damage.
- Inspect stores that had freeze damage last year to make certain that the cause of the freezing temperatures was identified and that the situation cannot reoccur.
- Inspect stores that complained of insufficient heat last winter, to determine if there are areas where outdoor air is infiltrating that must be dealt with.
- If your stores employ unit heaters or indoor furnaces, send a memo to all managers warning them of the danger of allowing merchandise to be piled too close to this heating equipment.
- As you visit stores, look around for sprinkler lines and water piping that runs through unheated spaces, or runs in areas where excessive infiltration is present. Better to insulate this piping now than to clean up the mess later.
- Make certain that stores are not turning off circuit breakers at night that may be supplying power to heating equipment.
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