Breathing Easy

MITIGATING HVAC SYSTEM LOSSES IN HEALTHCARE FACILITIES

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HVAC (Heating, Ventilation and Air Conditioning) systems are a common fixture in everyday life, whether they're in your home, businesses or even hospitals. You may think of HVAC as sweet, cold, relief from a hot summer's day, but what are the functioning and necessary differences between these systems from space to space? What special considerations and requirements are needed when ventilating and cooling spaces where health and safety are paramount? What kinds of losses can arise when these systems aren't installed, maintained, or operated properly?

Before diving into these critical questions, it's important to have a fundamental understanding of a common central air conditioning system you may find in a home. Homes with central air conditioning are typically configured with an indoor air handling unit, which houses a blower, a heat source (gas or electric), and a cooling coil, and an outdoor condensing unit. Refrigerant piping is run between the condensing unit and the cooling coil which facilitates heat transfer and allows the system to cool the house. This cooling process is referred to as the refrigeration cycle, and while an explanation would be a great read, for these purposes it's important to know that it helps move heat out of a space. Filters are installed on the indoor unit to collect dust, pet hair, and other airborne particulates before they are spread throughout the home.

Heating, ventilation and air conditioning systems serve an even more important role in hospitals. They do this by maintaining comfortable temperature and humidity levels and, importantly, by maintaining

a clean environment, reducing the risk of exposure to contaminants and thus contributing to the well-being of patients.

Several factors influence the potential for HVAC systems to contribute to infections in hospitals:

1. **Design and Maintenance:** Well-designed HVAC systems with appropriate ventilation and filtration are less likely to contribute to infections. Routine cleaning and disinfection of HVAC components (such as filters, ducts, and coils) are crucial.
2. **Airborne Pathogen Transmission:** Certain pathogens, such as those causing tuberculosis or influenza, can be transmitted through the air. HVAC systems can potentially spread these pathogens if not properly controlled.
3. **Air Pressure Relationships:** Hospitals use HVAC systems to maintain different air pressure zones to prevent the spread of airborne infections between areas. Surgical rooms are positively pressurized meaning that they push clean, filtered air outside the room, so that contaminants from outside the sterilized environment are not pulled into the surgical space. Proper management of these pressure differentials is essential.
4. **Filter Efficiency:** The efficiency of air filters in HVAC systems plays a significant role in removing airborne particles, including pathogens. High-efficiency filters are typically used in critical areas like operating rooms and isolation rooms.

Hospital HVAC requirements are outlined in the International Mechanical Code as well as ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Standard 170, Ventilation of Healthcare Facilities, and are typically based on room type and room volume. An operating room is going to require more ventilation than a typical patient's room, for example. Special consideration is given to temperature and humidity requirements, as ASHRAE 170 specifies ranges for both.

HVAC components in a hospital are surprisingly similar to what one may find at home, however in lieu of an indoor air handling unit or furnace, hospitals can have massive air handling units. These units can often be found installed on a dedicated floor, with large shafts of ductwork spread throughout the building. These units use chilled water to cool the air down, but still have provisions for heat and filtration. Sizing these systems is critical, as undersized units can contribute to higher than required temperature and humidity in the space, while oversized units prevent the system from dehumidifying properly due to short cycling. This can create a favorable environment for the development of mold. Keeping these systems operating correctly is paramount, as excessive temperature and humidity can lead to damage to sensitive instrumentation, medical supplies, or even the decommissioning of operating rooms used for surgeries.

Hospitals take air filtration very seriously. With many units containing two sets of filters, there are extra considerations that must be made on the maintenance side. Most residential HVAC units are configured with the filter upstream of the cooling coil. This has several benefits, one of which being that it prevents any condensation on the cooling coil from being blown into the filter by the fan, often called "blow-by." Having a set of final filters, as seen in many hospital systems, presents a challenge to reduce the risk of blow-by, not only from the cooling coil, but from humidifiers as well. Designers and operators must work to keep the velocities inside these units down to reduce the amount of blow-by, as wet filters are potential breeding grounds for mold, bacteria and other potentially harmful organisms.

Dealing with losses in healthcare facilities can often turn into a monumental effort. The costs of medical equipment, supplies, and loss of revenue as a result of a failure can quickly rack up. There are many different types of commons claims that could occur:

1. **Water Damage:** Frozen coils, improperly operating humidifiers, leaking hot or chilled water piping, as well as leaky plumbing, can all cause substantial water damage. Additionally, elevated levels of moisture via a leak or excessive humidity can result in potential mold and pathogen growth. Water damage can result in direct damage to the building structure and its contents, as well as indirect damage due to the inability to utilize a space until remediation has taken place.
2. **Fire Damage:** Malfunctions of mechanical and electrical components of HVAC systems, such as control panels, gas fired equipment, and wiring can lead to fires.
3. **Equipment Breakdown:** Failures of mechanical heating and cooling systems such as boilers, chillers, pumps, and air handling units can result in significant repair or replacement costs. Additionally, equipment that is non-operational can result in the inability to utilize systems in the facility until repairs have taken place.
4. **Liability Claims:** Improper operation of mechanical systems can result in bodily injury or property damage, which may lead to liability claims against the building owner, installer or operator. Special consideration is given to space temperature and humidity requirements to ensure patient safety. These claims could be driven by improper design or installation of the facilities HVAC system.

Due to the important nature of safety and health, engaging a mechanical engineer with direct HVAC experience in healthcare facilities is crucial when dealing with these types of claims. The complex nature of these systems and the claims associated with them will often dictate a multi-disciplined approach from fire investigation to civil or structural engineering needs. Engaging an expert early on will best allow for the documentation and preservation of evidence to ensure the best outcomes for the proper and efficient handling of claims.

While HVAC systems play a crucial role in both residential homes and healthcare facilities, the demands placed on them are markedly different. In homes, the focus is primarily on comfort, energy efficiency, and cost-effectiveness. In contrast, HVAC systems in healthcare facilities must meet stringent requirements to ensure patient safety, infection control, and regulatory compliance. These systems are designed to maintain precise temperature, humidity, and air quality levels, and they must be highly reliable to avoid any disruption to critical medical services. Understanding the unique requirements is essential for effective HVAC system design, maintenance, and loss prevention. As technology advances, HVAC systems will continue to evolve, but the emphasis on safety and reliability in healthcare settings will always remain paramount.

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