

Prevention of Indoor Air Quality Problems:

Through Proper Design and Maintenance of HVAC Systems

Poor indoor air quality (IAQ), can lead to employee complaints of headaches, eye irritations, respiratory problems, and drowsiness. In extreme cases, these symptoms can lead to excessive absenteeism, loss of productivity, and poor morale.

The quality of air, in a non-industrial work environment, is affected by a number of variables. These include ventilation rates, number of building occupants, activities of the occupants, temperature, relative humidity, concentration of carbon dioxide and carbon monoxide (as well as other sources of air contaminants), and microbiological growth.

Many indoor air quality problems are preventable through proper design and maintenance of heating, ventilation, and air conditioning (HVAC) systems. HVAC systems include the mechanical equipment used to heat and cool, ductwork to move air around building, and the filtration media used to clean air. These systems have a significant impact on how pollutants are distributed and removed.

The topic of this bulletin is the prevention of indoor air quality problems, through proper design and operation of HVAC systems in non-industrial buildings.

Information in this bulletin is taken from documents and guidelines published by the Environmental Protection Agency (EPA), National Institute for Occupational Safety & Health (NIOSH), and the American Society of Heating, Refrigerating, & Air Conditioning Engineers (ASHRAE).

HVAC System Design Considerations

Research conducted by NIOSH has shown that there is a correlation between a lack of adequate outdoor air supplied into buildings and increased employee complaints of “stuffiness” or “stale air”, discomfort, and respiratory issues. Due to concerns for energy efficiency, some building HVAC systems have been designed with inadequate ventilation rates of outdoor air.

An adequate supply of outdoor air, delivered through the HVAC system, is necessary to dilute pollutants that are normally released by equipment, building materials, furnishings, products, and people.

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Carbon dioxide (CO₂) is a normal constituent of human exhaled breath. It is used as an indicator of whether sufficient quantities of outdoor air are being introduced into a building area.

ASHRAE recommends maintaining the concentrations of indoor CO₂ to less than 700 parts per million (ppm) above the outdoor concentration. Outdoor air CO₂ concentrations can vary from 300 to 500 ppm.

The ASHRAE standard 62.1-2007 “Ventilation for Acceptable Indoor Air Quality” provides specific details on ventilation rates for outdoor air, to maintain acceptable CO₂ levels. They recommend specific outdoor supply rates, based upon occupancy use and occupant load. For example, for a normal office space they recommend 17 cubic feet per minute (cfm) of outside air per occupant. There is a “default” occupancy load published of 5 persons per 1,000 sq. ft. of area. Other ventilation rates are published for conference rooms, classrooms, lobbies, cafeterias, etc.

When changes occur to occupancies, HVAC system modification may need to be made (e.g., when a storage area is converted into a conference room).

The proper location of outside air intakes is critical to maintaining indoor air quality. The location of air intakes in close proximity to truck loading areas or next to vents/chimneys can result in carbon monoxide, other pollutants, and/or odors being brought into the building. ASHRAE publishes guidelines for minimum separation distances of air intakes and sources of contamination. These include the following:

OBJECT	MINIMUM DISTANCE (FT)
Vents, chimneys, flues from combustion Appliances and equipment	15
Truck loading area or dock	25
Garbage dumpsters, pickup areas	15
Cooling tower intake or basin	15
Cooling tower exhaust	25

HVAC Operation and Maintenance

A formal preventive maintenance program for HVAC equipment is essential to ensure adequate indoor air quality. The preventive maintenance (PM) program should be established and delivered by a well qualified building engineer,

or contracted out to an HVAC or mechanical contractor. The program should be in writing and well documented. Regular scheduled PM activities should include, but not be limited, to the following:

1. Outdoor air intakes should be inspected on a scheduled basis. Open all intakes that are closed. Adjust or repair those that are not working properly. Regardless of the air flow required to maintain temperature or humidity requirements, the minimum outdoor air flow required by ASHRAE must be maintained. Make sure there is no ponding water, excessive vegetation, bird droppings, or other sources of contamination in the vicinity of the air intakes.
2. HVAC system filters should be inspected, on a frequency determined by either the equipment manufacturer or installer. The frequency of inspection should be adjusted, if needed, based on the condition of filters noted during inspections. Use the most efficient filters possible, while maintaining an adequate ventilation rate. “Pleated filters are far more efficient than “woven fiberglass” ones. Follow manufacturer’s or installer’s recommendations on filter selection. Ensure that filters are of the proper size, are orientated properly to the air flow, and are seated in the filter rack correctly.
3. Inspect and clean AC system coils and drip pans on a regular scheduled basis. Microbial growth can result from infrequent cleaning and disinfection. There are commercially available products for proper cleaning and disinfection this equipment.
4. Maintain proper water quality in any cooling towers, if present. Improperly maintained cooling towers can result in microbial growth, including the organism responsible for Legionnaires’ Disease. An outside chemical supplier should be consulted on proper chemical treatment and water quality monitoring for this equipment.
5. Install a bird screen on some types of rooftop outdoor air intakes in some HVAC units. Ask your unit’s installers if you need one. Inspect it on a schedule basis.
6. Inspect other system components as necessary, to ensure that they conform to operational guidelines.
7. If feasible, use less conservative cycle times for the HVAC system. Start the system earlier in the morning before workers arrive, to reduce temperature fluctuations and control humidity levels. In highly humid climates or seasons, don’t completely shut down system. Elevated humidity levels in the building can lead to mold growth.

8. When plumbing or roof leaks occur, repair immediately. Remove any water damaged materials or furnishings (capable of supporting mold growth) within 48 hrs. to avoid mold growth. Mold spores can be spread through the building through the HVAC system.
9. Maintain recommended temperature and relative humidity levels, to prevent mold growth and maintain employee comfort. Employee or building occupant perceptions about indoor air quality can be influenced by thermal discomfort. ASHRAE publishes guidelines in their standard 55-2004, "Thermal Environmental Conditions for Human Occupancy".

For additional information on IAQ problems, please see The Hartford Loss Control TIPS titled "A Primer on Indoor Air Quality".

References

1. Environmental Protection Agency. "Building Air Quality: A Guide for Building Owners and Facility Managers" http://www.epa.gov/iaq/largebldgs/baq_page.htm
2. National Institute for Occupational Safety & Health. "Indoor Environmental Quality: Building Ventilation" http://www.cdc.gov/niosh/topics/indoorenv/Building_Ventilation.html
3. *American National Standard for Ventilation for Acceptable Indoor Air Quality*, (ANSI/ASHRAE standard 62.1-2007), American Society of Heating, Refrigerating and Air-conditioning Engineers, Atlanta, GA.
4. *American National Standard for Thermal Environmental Conditions for Human Occupancy*, (ANSI/ASHRAE standard 55-2004), American Society Heating, Refrigerating and Air-conditioning Engineers, Atlanta, GA

Copies of ASHRAE standards may be purchased at: <http://www.ashrae.org/publications/>

For more information, contact your local Hartford agent or your Hartford Loss Control Consultant. Visit The Hartford's Loss Control web site at <http://www.thehartford.com/corporate/losscontrol/>

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