



RECOMMENDATIONS FOR ENCLOSED ICE ARENA MANAGEMENT

PURPOSE

Properly designed and operated indoor ice arenas can provide a safe environment for many recreational activities. However, indoor air quality problems may occur if equipment and air handling systems are not functioning properly.

Indoor ice arenas use many machines to create high-quality skating conditions. Exhaust from these machines can produce high levels of carbon monoxide (CO) and nitrogen dioxide (NO₂). High levels of CO and NO₂ can build up inside the arena if there is poor ventilation, the machines are not working correctly, or both. These high levels can cause sickness in skaters and spectators very quickly.

This document includes guidelines for minimizing levels of CO and NO₂ and protecting the health of arena participants and spectators.



CONTACT INFORMATION

Wisconsin Department of Health Services
Division of Public Health
Bureau of Environmental and Occupational Health
1 West Wilson Street | Madison, WI 53701
608-267-3227

OUTLINE OF RECOMMENDATIONS

VENTILATE.

Ensure the ventilation system is the right size and design for the arena. It should be turned on when the arena is in use.

MONITOR.

Equipment. Ensure resurfacing equipment is performing properly.

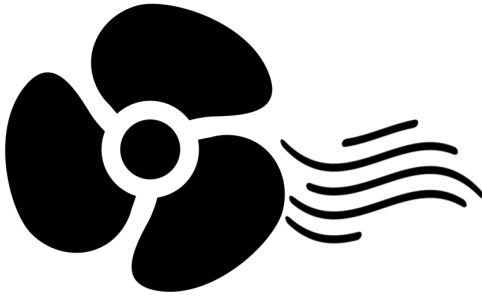
Air quality. Perform frequent air monitoring using proper equipment.

Health. Staff should know the symptoms of CO and NO₂ poisoning and take action when they see them.

TAKE ACTION.

If air monitoring tests reveal high levels of CO or NO₂ or there are complaints of illness, take action immediately to halt emissions, increase ventilation, and evacuate if necessary.

VENTILATE THE ARENA



ENSURE APPROPRIATE DESIGN

The ventilation system should be the right size for the arena and properly designed, especially with regard to the number and location of fresh air supply intakes and exhaust outlets. For assistance in determining if a system is appropriate, consult with an HVAC specialist or building inspector.

FOLLOW PROPER STANDARDS

At a minimum, American Society of Heating, Refrigeration, and Air-conditioning Engineers Standard 62.1-2013, [*Ventilation for Acceptable Indoor Air Quality*](#), should be followed for the playing area.

KEEP FRESH AIR INTAKES AWAY FROM VEHICLE EXHAUST

Vehicles should not be idling by fresh air intakes. Fresh air intakes should be checked regularly to ensure they are not blocked.

ENSURE CONSTANT OPERATION

The ventilation system should be in constant operation when the arena is in use. It should be strong enough to create air movement at ice level to achieve mixing between the air at ice level and the surrounding air in the arena.

CREATE BETTER CIRCULATION DURING RESURFACING

Open arena gates or bay doors during resurfacing to allow for better air circulation.

REGULARLY MAINTAIN THE SYSTEM

Ensure the ventilation system is operating properly. Schedule regular maintenance and keep good records of any service performed on the system.

ENSURE THE SYSTEM IS ON WHEN ARENA IS IN USE

Ensure the ventilation system is turned on when ice arena is in use. This is a simple procedure that is often neglected. Security procedures should be in place to serve as a warning when the system malfunctions or when inadvertent mistakes are made. For example, install a light to indicate when the system is on or off.

MONITOR EQUIPMENT



REGULARLY MAINTAIN EQUIPMENT

Maintain all gas-powered equipment, such as resurfacers, edgers, forklifts, water pumps, and auxiliary generators, with a preventative maintenance schedule. At a minimum, an annual tune-up is recommended for each piece of equipment. Template logs can be downloaded [from our website](#).

WARM UP EQUIPMENT IN WELL-VENTILATED AREAS

All resurfacing equipment that runs on fossil fuels (such as natural gas, propane, gasoline) should be warmed up in a well-ventilated room or one equipped with a local exhaust system. Fans should be on when the engine is running and a door to the outside should be opened, if possible. Another option is to attach a flexible hosepipe to the exhaust pipe to vent pollutants outdoors as the engine heats up.

INSTALL A CATALYTIC CONVERTER AND VERTICAL EXHAUST PIPE

All resurfacers should have catalytic converters installed. Catalytic converters remove some pollution from the exhaust.

The temperature differences between the ice and air can trap pollutants at board height. To prevent pollutants from being trapped, a vertical exhaust pipe that extends 8 feet above ice level should be installed to project exhaust.

MINIMIZE USE OF ICE EDGERS

Use ice edgers only when the ventilation system is on.

CONSIDER ELECTRIC EQUIPMENT

When it comes time to replace an ice resurfacer, arena operators should consider purchasing an electric resurfacing machine. Electric resurfacers cost more at the time of purchase, but they cost less over time since they do not require fuel or as frequent maintenance. Using electric resurfacers can also reduce ventilation costs.

MONITOR AIR QUALITY



USE AIR MONITORING EQUIPMENT WITH THE PROPER RANGE OF DETECTION

- Carbon monoxide (CO) monitors should measure CO in the air at a range of 0 to 100 parts per million (ppm) in increments of 1 ppm.
- Nitrogen dioxide (NO₂) monitors should measure NO₂ in the air at a range of 0 to 5 ppm in increments of 0.1 ppm.

The Minnesota Department of Health has [recommendations for air quality measuring devices](#). This document can provide area managers additional guidance on types of measuring devices. For more help, call your [local](#) or [state health department](#).

MAINTAIN AIR MONITORING EQUIPMENT

Each air monitoring device is different. Equipment should be properly maintained and calibrated according to the manufacturer's instructions. Template logs can be downloaded [from our website](#).

PERFORM AIR MONITORING CORRECTLY

Pollution levels can fluctuate, so a one-hour, time-weighted average is used to assess whether or not contaminant levels are too high. To calculate a time-weighted average, stand inside the rink on the center line. Hold the monitor at board height and follow these three simple steps:

1 Record the air quality measurement every five minutes for an hour, starting at zero minutes and ending at 60 minutes.

2 Add together the 13 measurements taken. Divide this number by 13 (the total number of measurements taken).

3 This number is your time-weighted average. Record it on an air quality testing log ([template](#)). Ensure the levels do not require action ([see page 6](#)).

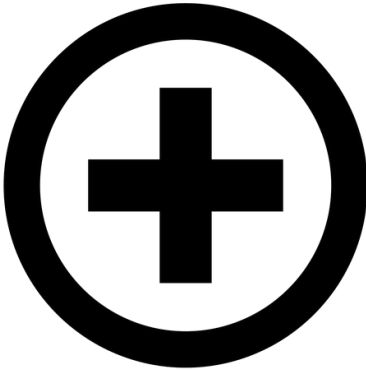
PERFORM FREQUENT AIR MONITORING

Air monitoring should be performed at least twice per week, during and after ice resurfacing and/or edging. It is recommended that testing take place on the weekend and the next busiest weekday.

REQUEST HELP IF NEEDED

Request outside help if needed from the [local health department](#) or a [private environmental consulting firm](#).

MONITOR HEALTH



TRAIN STAFF ON THE SYMPTOMS OF CO AND NO₂ POISONING

Provide an orientation and training program for all arena personnel, covering the potential signs and symptoms of carbon monoxide and nitrogen dioxide poisoning. Keep a sign-in sheet with the names of staff who attended training and the training date.

CO Poisoning Symptoms

- Shortness of breath
- Headache
- Impaired coordination
- Nausea/vomiting
- Dizziness
- Loss of consciousness

NO₂ Poisoning Symptoms

- Eye, nose, or throat irritation
- Breathing problems (especially in those with asthma)
- Coughing up blood

Fact sheets on [CO](#) and [NO₂](#) are available on the DHS website.

POST INFORMATION ABOUT SYMPTOMS

It is recommended a flyer on signs and symptoms be posted on bulletin boards and employee break areas within the arena. These flyers can be found on [pages 8 and 9](#).

TAKE ACTION



HAVE AN ACTION PLAN IN PLACE

Be prepared to take action if pollution exceeds the recommended levels.

Complaints. Respond promptly with all available data, information, and records. Indicate what corrective actions will be taken. Keep good records. A corrective action log can be downloaded [on our website](#).

Corrective action. Immediately increase the ventilation rate and suspend the use of all gas-powered equipment. Discuss plans for future improvements (such as ventilation system modifications and tune-ups of gas-powered equipment).

Evacuation. An evacuation plan should be developed and drills should be conducted regularly with arena personnel.

TRAIN STAFF ON THE ACTION PLAN

Once your plan is in place, ensure all staff are familiar with its procedures. Include the action plan as part of new staff orientation.

KNOW THE LEVELS THAT REQUIRE ACTION

Some states and many Canadian provinces have laws and regulations on the allowable levels of carbon monoxide (CO) and nitrogen dioxide (NO₂) in ice arenas because high levels can make people sick.

DHS recommends corrective action be taken if the one-hour time-weighted average for CO exceeds 25 parts per million (ppm). It is also recommended that an arena be evacuated if **any** measurements exceed 125 ppm.

For NO₂, corrective action should be taken if the one-hour time-weighted average for NO₂ exceeds 0.30 ppm. It is also recommended that an arena be evacuated if **any** measurements exceed 2.0 ppm.

For instructions on how to take a time-weighted average, see the “Monitor Air Quality” section on [page 4](#).

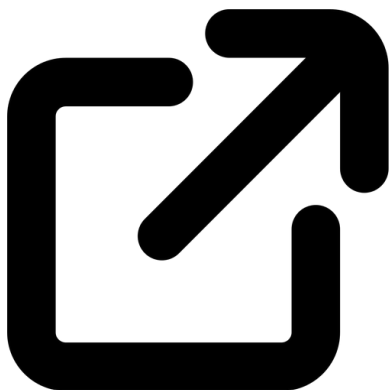
CORRECTIVE ACTION	25 ppm for CO
	0.30 ppm for NO ₂

Immediately increase ventilation and stop the use of gas-powered equipment.

IMMEDIATELY EVACUATE	125 ppm for CO
	2.00 ppm for NO ₂

Remove all people from the facility and into fresh air immediately.

TOOLS, TEMPLATES, AND LINKS



TOOLS AND TEMPLATES

CO AND NO₂ POISONING SIGNS AND SYMPTOMS

Flyer to hang in employee areas and on bulletin boards as appropriate

[PAGE 8](#) | [PAGE 9](#)

AIR QUALITY MEASUREMENT DEVICE MAINTENANCE AND CALIBRATION LOG

Template for logging the maintenance and calibration of air quality measurement devices

[DOWNLOAD](#)

ICE ARENA EQUIPMENT MAINTENANCE LOG

Template for logging resurfacing equipment maintenance and calibration

[DOWNLOAD](#)

LOG OF ICE ARENA AIR QUALITY

Template for logging results of ice arena air quality testing

[DOWNLOAD](#)

ICE ARENA LOG OF POLLUTANT EXCEEDANCE

Template for logging corrective action taken

[DOWNLOAD](#)

LINKS TO MORE RESOURCES

ADDITIONAL INDOOR ICE ARENA GUIDANCE

Fact sheets and guidance from the Minnesota Department of Health's Indoor Ice Arena page. Please note Minnesota is one of three states that require ice arena air quality testing. Wisconsin does not require this testing.

[READ MORE](#)

THE AIR WE BREATHE

Article published by *USA Hockey Magazine* in 2011 about the importance of air monitoring and resurfacer maintenance.

[READ MORE](#)

AIR QUALITY MEASUREMENT DEVICE GUIDANCE

Guidance on types of air quality measuring devices from the Minnesota Department of Health.

[READ MORE](#)

INDOOR AIR QUALITY AND ICE RINKS

Web page on indoor air quality from Serving the American Rinks (nonprofit organization for individuals, facilities, and vendors in the American ice rink industry).

[READ MORE](#)

KNOW THE SIGNS AND SYMPTOMS OF CARBON MONOXIDE POISONING

IF YOU SEE SKATERS OR SPECTATORS EXPERIENCING THESE SYMPTOMS, MOVE THEM TO FRESH AIR AND CALL 911



SHORTNESS OF BREATH



HEADACHE



IMPAIRED COORDINATION



NAUSEA/VOMITING



DIZZINESS

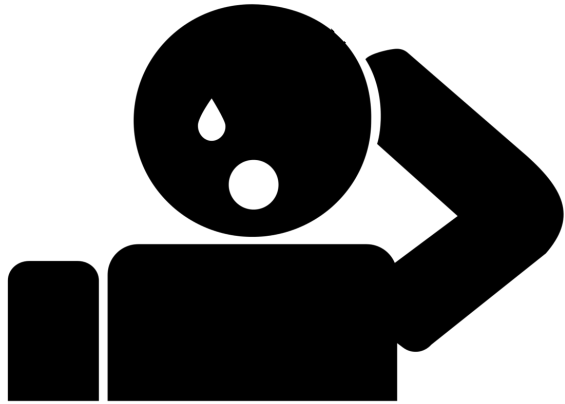


LOSS OF CONSCIOUSNESS

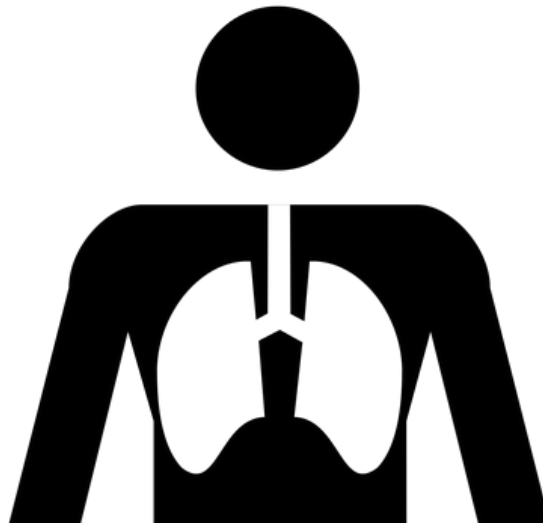


KNOW THE SIGNS AND SYMPTOMS OF NITROGEN DIOXIDE POISONING

IF YOU SEE SKATERS OR SPECTATORS EXPERIENCING THESE SYMPTOMS, MOVE THEM TO FRESH AIR AND CALL 911



**EYE, NOSE, OR
THROAT IRRITATION**



BREATHING PROBLEMS



COUGHING UP BLOOD





State of Wisconsin
Department of Health Services
Division of Public Health
Bureau of Environmental and Occupational Health
dhs.wisconsin.gov | June 2015 | dhsenvhealth@wi.gov
