Ice arena inspection practice guide for indoor air quality management

National Collaboration Centre for Environmental Health - Webinar

January 30, 2025

Speaker: Vittoria Vecchiarelli, BASc, CIPHI(C)

About the ORFA

Ontario Recreation Facilities Association
Building Community Since 1947

Controlling Ice Arena Indoor Toxic Air Quality

- The ***Ontario Recreation Facilities Association*** is a not-for-profit Association that was created in 1947 as the Ontario Arenas Association.

- **Mission**: To provide leadership in the development and delivery of innovative training and education programs, value-added services, and quality products for the benefit of the recreation facilities profession.

- **Vision**: To be the leader in the recreation facilities profession.

Outline

- ✓Framing the Issue
- ✓An Overview of the Guide
- ✓Survey of Ice Arena Operators
- ✓Strengths, Threats, Opportunities
- ✓Conclusion

Figure 1: "First Zamboni ad in 1950s". Smithsonian Magazine

Framing the Issue

- Ice arenas part of the fabric of the community and Canadian culture
- Enjoyed by all ages recreationally and for competitive sports – hockey, ringette, figure skating
- Frequented by athletes and their spectators
- Place of employment
- However, ice arenas can experience poor indoor air quality (IAQ)

Arena operations expert Terry Piche says many rinks in the province have air quality problems related to poor maintenance of equipment and ventilation systems. (Erik White/CBC)

Figure 2: Arena air quality concerns – 'like running your car in your garage and playing a hockey game' cbc.ca/news

Framing the Issue

- Fuel-powered equipment used indoors to maintain the ice (resurfacers and edgers) emit carbon monoxide (CO) and nitrogen dioxide (NO_2)
- Fuel-powered radiant heaters in the bleachers can also emit CO & NO_2
- Other indoor air pollutant sources: gas-powered furnaces, stoves, etc.
- Inadequate equipment maintenance and ventilation can lead to a build-up of air pollutants to levels causing health impacts to occupants
- Leading to CO poisoning events and triggering asthma symptoms (NO_2)
- Polluted air can become trapped close the ice surface (breathing height) as cold air falls, exposing players as they exert themselves on the ice

Framing the Issue

Figure 3: Coquitlam ice rink evacuated due to dangerously high levels of carbon monoxide. ctvnews.ca

Figure 4: Arena air quality concerns – 'like running your car in your garage and playing a hockey game' cbc.ca/news

Figure 5: 3 kids hospitalized; other hockey players suffer carbon monoxide poisoning after arena leak globalnews.ca

Figure 6: Nearly 80 sought treatment after possible arena gas leak, says health authority' cbc.ca/news

Framing the Issue

- There is a real risk of indoor CO and NO_2 concentrations to rise to dangerous levels from the use of fuel-powered equipment, especially when indoor air quality (IAQ) is left unmanaged, however, there is no public health regulatory framework for inspecting ice arenas and assessing the IAQ in Canada

- The **Ministry of Health Ontario Public Health Standards** (OPHS, 2021) *Health Hazard Response Protocol* states that….
  - *"the boards of health shall inspect and investigate potential public health hazards in the environment, including "facilities with public access…where they might present an elevated risk of exposure to health hazards to the public or priority populations. These facilities may include but are not limited to ice arenas…."*

- Although best practice documents and government guidelines exist, none are developed with a public health inspection lens

Framing the Issue

Sample Canadian Guidelines:

- **Health Canada** - Best practices for improving air quality in ice arenas, 2021
- **ORFA** - Guidelines for Indoor Air Quality in Arenas, 2018
- **Nova Scotia** - Air Quality Guidelines for Arenas in Nova Scotia, 2013
- **Manitoba Health** - Air Quality Guidelines for Arena Operations in Manitoba, 2009
- Carbon monoxide Criteria and Nitrogen dioxide and air quality monitoring in arenas, **Quebec Ministry of Health and Social Services**, 2014

Sample US Guidelines

- **Minnesota Department of Health** – Adopted Permanent Rules Related to Indoor Ice Arenas and Motorsports Arenas
- **Massachusetts Regulation** - Requirements to maintain air quality in indoor skating rinks

The Guide

A project team was established in 2023 to develop a:

Practical Public Health Inspector Guide to Ice Arena IAQ Inspection

ASPHIO
Connect. Collaborate. Advocate.

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DISTRICT HEALTH UNIT

The Guide

- **Primary Goal**: to develop a practical PHI guide to ice arena IAQ inspections

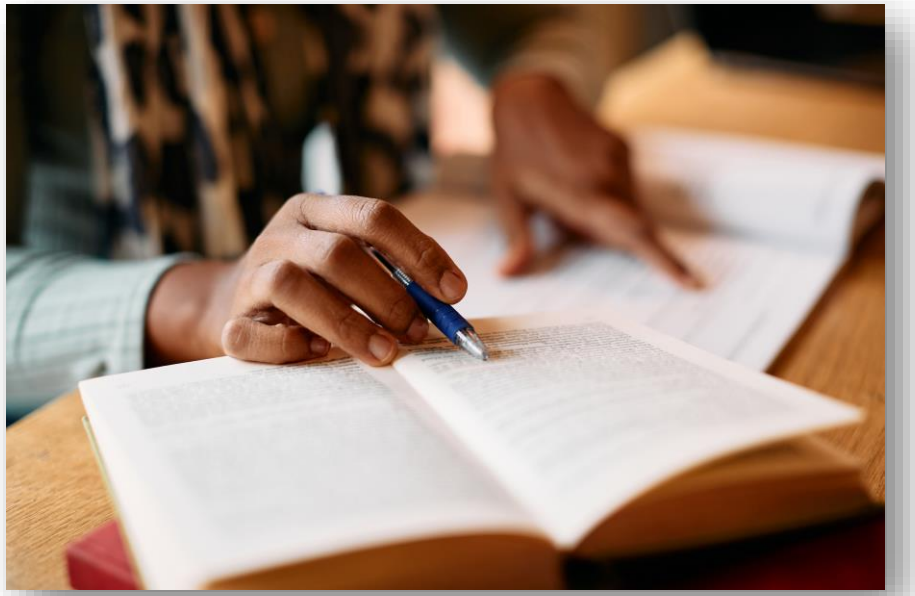
- **Secondary Goal**: to advocate for a consistent approach to inspecting and assessing the operation of indoor ice arenas across Ontario PHUs and educating operators

The Guide

The *Guide* is evidence-informed and includes professional input and expertise from various public health and industry stakeholders

Users should refer to best practice documents by Health Canada and ORFA

Reviewed by *Public Health Ontario*



Disclaimer: This document is intended for educational purposes only and is not intended to provide legal advice or replace regulations or other official documents. The project team takes no responsibility for any modification of the content of this document.

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Ice arena operators should produce a record of the last ice resurfacer emissions test at the time of inspection. See Appendix B for a **Sample Ice Resurfacer Emissions Test**.

Risk Assessment Questions:

Is a fuel-powered or electric-powered ice resurfacer and edger used by the facility?

Is the ice resurfacer serviced at least once a year or as per manufacturer's recommendations and a record available on-site (fuel-powered only)?

Is the edger air filter changed every 3 months or as per manufacturer's guidelines and a record available on-site (fuel-powered only)?

Risk Assessment Question:

Are staff trained on the following areas?

- **Proper use and maintenance of air quality monitoring equipment.**
- **Proper use and maintenance of ice resurfacing equipment.**
- **Maintaining accurate records of air quality data.**
- **Awareness of the symptoms and health impacts associated with exposure to elevated levels of CO and NO_2.**
- **Awareness of the importance of ventilation to improve IAQ and the frequency of its use.**
- **Emergency procedures and evacuation related to high levels of CO and NO_2**

See Appendix C for **Photos of Exhaust Fans** and **Make-up Louvers**. See Appendix D for examples of a **Ventilation System Maintenance Record**.

Risk Assessment Questions:

How is the ventilation system activated?

- Ice resurfacer operation (motion sensor)
- Active during operational hours
- Automated CO sensor
- Timer switch
- Manual switch only
- Opening exterior doors only

Is the ventilation system equipment regularly serviced and maintained and record available on-site?

Does the facility have and maintain an asset management plan for the replacement of aged air handling equipment based on manufacturer's recommendations?

Risk Assessment Questions:

Does the ice arena have an IAQ testing program?

Is CO and/or NO_2 measured with a continuous air monitoring system with digital read-out?

Is CO and/or NO_2 measured with a portable air monitoring equipment on a weekly basis?

Does the facility have a calibration and replacement plan for gas sensors (as per manufacturer's recommendations)?

At what level is the CO and/or NO_2 sensor set to alarm?

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Appendix B: Ice Resurfacer Exhaust Emissions Test

Resurface Corp.
25 Oriole Parkway East
Elmira, Ontario, Canada
N3B 3A9
Tel: 519-669-1694
Fax: 519-669-8896

March 3, 2024

EXHAUST EMISSIONS TEST RESULTS

Customer ABC
RM070970807

MAKE	MODEL	YEAR	HOURS	CO % IDLE	HC PPM IDLE	CO % LOAD	HC PPM LOAD
OLYMPIA	CNG	2007		0.08	70	0.07	32
	LPG			0.08	13	0.13	29

Definitions:

LPG = Liquified Petroleum Gas (propane)

CNG = Compressed Natural Gas

IDLE = Lower Engine RPM, Idling Speed

LOAD = Higher Engine RPM, Operating Speed

Pass/Fail

It is not a simple pass or fail threshold; the goal is to achieve ***the lowest exhaust emissions possible***.

The following factors must also be considered:

- volume of space in the building,
- extent of the air make-up system in the building,
- typical daily usage of the ice resurfacer, and
- building standards for air quality.

However, technicians try to achieve **less than 0.10 – 0.20% CO** and **less than 100 HC** (under **LOAD**).

Note: To convert CO% to PPM, multiple by 10,000, (i.e., 0.10% = 1,000 PPM).

Troubleshooting High CO or HC:

- **High CO** – Rich fuel mixture, defective oxygen sensor, defective fuel control valve, defective computer, defective catalytic converter.

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Appendix D: Ventilation Maintenance Record

Date yyyy/mm/dd	Time	Staff Name	Exhaust Fan (turns) ✓ / ✗	Make-up Louvers (open) ✓ / ✗	Correction Action

Appendix E: Air Quality Monitoring Log Sheet

Date yyyy/mm/dd	Time	Staff Name	Ice Pad # / Name	CO Level (ppm)	NO_2 Level (ppm)	Recommended (R) Action (A) Evacuation (E)	Corrective Actions Taken (A or E Levels)	CO Resampling Level (ppm)	NO_2 Resampling Level (ppm)

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Appendix F: Response Actions to Elevated Air Pollutant Levels

PHUs will need to invest time in researching the most current information regarding safe exposure levels to CO and NO_2. The following information is provided as an example of recommended, action, and evacuation levels for CO and/or NO_2 that might trigger a public

Appendix G: CO and NO_2 Exposure Limits

Exposure Limits of CO			
Recommended	**Action**	**Evacuation**	**Agency Name**
< 10 ppm (24-hour)	> 25 ppm (1 hour)		Health Canada RIAQG Health Canada Ice Arena Guide

Survey of Ice Arena Operators

Survey of Ontario Ice Arena Operators

The project team partnered with Conestoga College, *Bachelor of Environmental Public Health* (BEPH) Program to survey Ontario ice arena operators and develop the survey questions, disseminate the survey, analyze the results and write the final report

Survey of Ontario Ice Arena Operators

Survey Purpose:

- To better understand the challenges faced by operators and the practices associated with maintaining IAQ in ice arenas

Survey Questions:

- 27 in total, ranging from demographics, current air quality sampling strategies, policies and training, current equipment and practices related to air quality

Survey Distribution:

- ORFA, CIPHI ON and ASPHIO listservs
- 158 respondents

Survey of Ontario Ice Arena Operators

Demographics

Majority of respondents operated ice arenas that were:

- **Municipally-run (89%)** vs. privately
- **1 - 2 ice pads (77%)** vs. 3 - 4 ice pads
- **Opened seasonally (60%)** vs. year-round
- **41 – 60 years old (35%)**, followed by 11-20 yrs old (29%) and 21-40 yrs old (19%)

Size of Municipality

- Good distribution of small (41%), medium (24%) and large (35%)

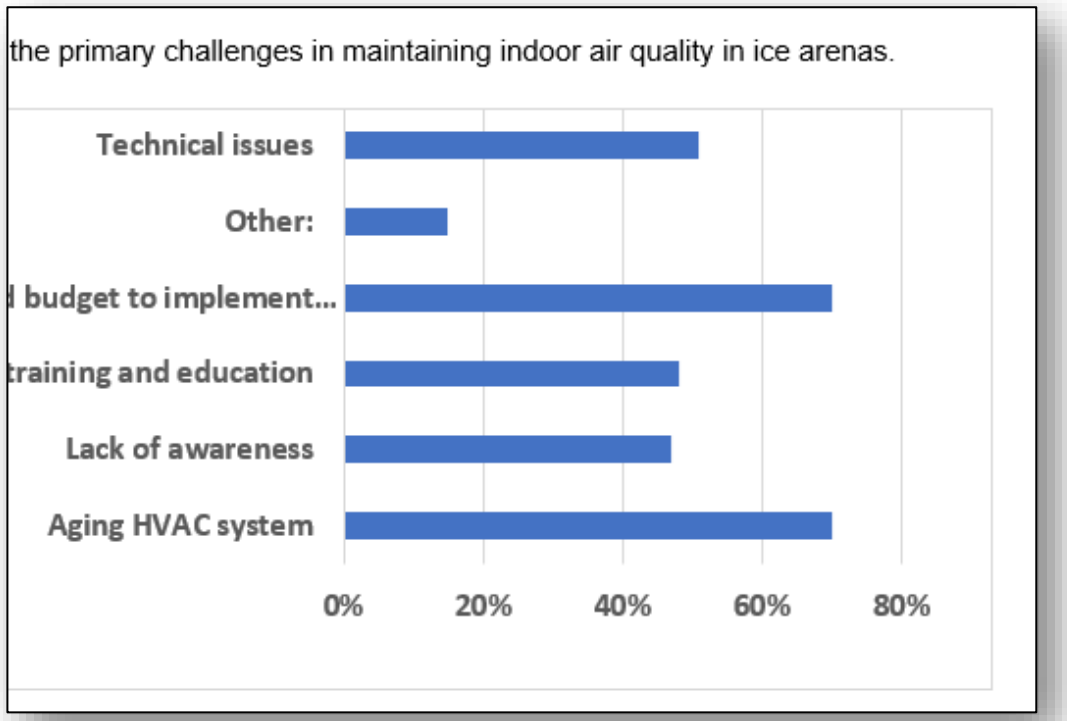
Survey of Ontario Ice Arena Operators

What's Most Important to IAQ:

1. Resurfacing equipment fuel-type **(80%)**
2. Inadequate ventilation systems **(65%)**
3. Age and maintenance of ice resurfacing equipment **(44%)**

Challenges to Maintaining Good IAQ:

1. Aging HVAC system **(70%)**
2. Limited budget to implement practices **(70%)**



A Survey Of Ontario Ice Arena Operators

Making the Switch to Electric-Powered Equipment

Question	Ice Resurfacers	Edgers
Use EV Equipment	18%	60%
Plan to Make the Switch < 5 Years	45%	46%

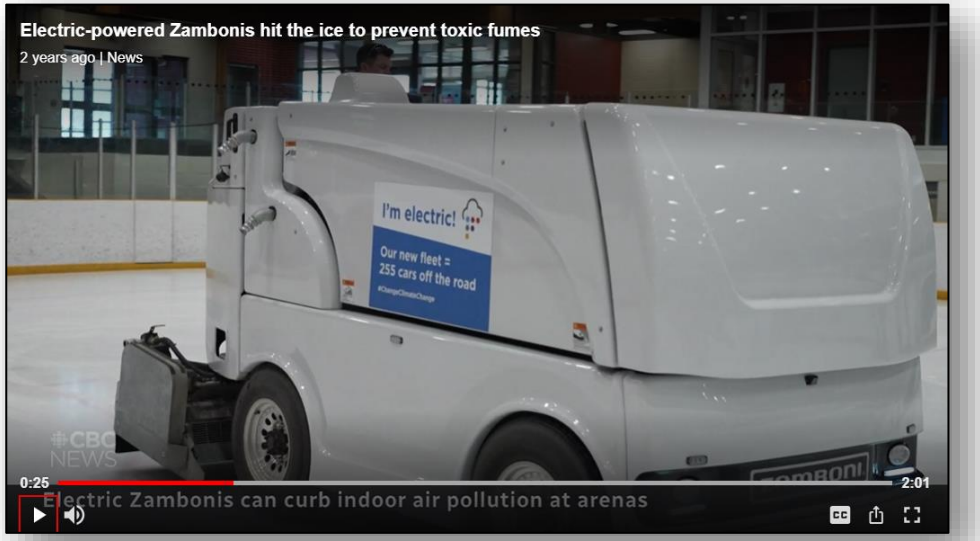


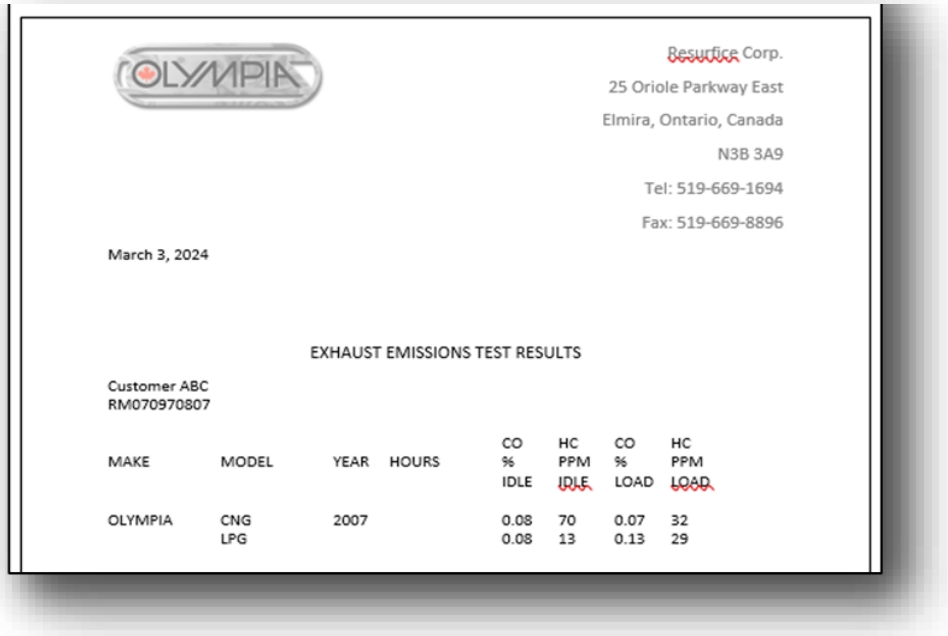
Figure 7: Electric-powered Zambonis hit the ice to prevent toxic fumes cbc.ca

A Survey Of Ontario Ice Arena Operators

Frequency of Ice Resurfacer Maintenance

54% service ice resurfacer *annually*

26% service every *6 months*



OLYMPIA

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	LPG			0.08	13	0.13	29

Survey Of Ontario Ice Arena Operators

Methods of Monitoring IAQ Levels:

Majority use *continuous air monitoring systems* vs. portable equipment

19% do not measure CO

43% do not measure NO_2

Of those who did not measure NO_2, **15%** indicated it was not measured as it was a redundancy to measuring CO

Figure 8: cGas Detector Digital Transmitter Critical Environment Technologies

Figure 9: GrayWolf Sensing Solutions

Survey Of Ontario Ice Arena Operators

Method of Activating Ventilation System (Fans/Louvers):

43% use a combination of ice resurfacer operation, automated CO sensor, activating during operational hours

23% use a manual switch only (least preferred method).
Note: this method was associated with older arenas

Survey Of Ontario Ice Arena Operators

Frequency of Activating the Ventilation System (Fans/Louvers):

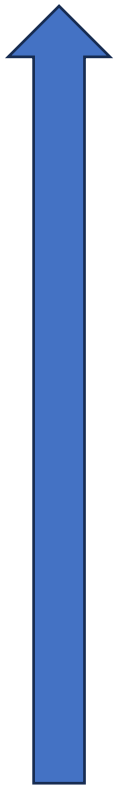
59% during flooding activities and 15 min after

11% once per day

31% ‘other’

‘Other’ textbox answers = as needed, as indicated by air quality monitors, no fans available, only at the end of the season and never

Survey Of Ontario Ice Arena Operators



Staff Training Areas of Focus (Most to Least Common):

89% proper use and maintenance of ice resurfacing equipment/ edgers

78% proper use of the ventilation system

67% facility emergency response procedures for poor IAQ incidents

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67% proper calibration of air quality monitoring equipment

54% accurate records of air quality measurements

40% how and when to use air quality monitoring equipment

Discussion - Strengths

Many ice arena operators are…

- Conducting routine maintenance of ventilation equipment and ice resurfacing equipment
- Operating ventilation systems during and after ice flooding activities
- Installing continuous air quality monitoring equipment
- Adopting electric-powered ice resurfacing equipment

Discussion - Threats

- Not all ice arenas have adopted best practices around **routine maintenance of ice resurfacing and ventilation equipment**. Routine maintenance helps prevent equipment malfunctions which could result in elevated emissions of air pollutant gases.
- Gaps in **air quality monitoring does exist in some arenas**. Routine air sampling is a critical step in determining if standard operating procedures are effective in achieving acceptable IAQ levels or detecting elevated levels and activating action plans to reduce exposure to occupants.
- Ice arena operators are often faced with **budgetary constraints, aging infrastructure**, and a **lack of comprehensive training of staff**
- Arenas continue to rely on **fuel-powered ice resurfacing equipment** and **radiant heaters**

Discussion - Opportunities

Advocacy to at the provincial and/or Ministries of Health for:

- the development of a public health regulatory framework,
- more research (i.e. the feasibility of installing, monitoring and maintaining NO_2 sensors in all ice arenas),
- incentives to switch to electric-powered ice resurfacing equipment,
- grants for infrastructure upgrades, and
- collaborations among public health and industry leaders.

Conclusion

- It is imperative that public health units/authorities enhance education efforts in a consistent manner and to conduct regular inspections and/or risk assessments of indoor ice arenas using best practice documents and the Practical Guide

- The need for ongoing support and research to promote healthier environments in Canada's ice arenas.

Link to the Guide

A Practical Public Health Inspector Guide to Ice Arena Indoor Air Quality Inspections

Enhancing indoor air quality in ice arenas: Insights from a survey of operators

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Contact Vittoria Vecchiarelli:

Email: Vittoria.Vecchiarelli@york.ca

Phone: 1-877-464-9675 ext. 74556

THANK YOU

Ontario Recreation Facilities Association:

- *John Milton, Terry Piche, Brad Putnam*

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Public Health Ontario

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- Figure 3. “Coquitlam ice rink evacuated due to dangerously high levels of carbon monoxide”, September 13, 2024, CTV News. Retrieved from: https://www.ctvnews.ca/vancouver/article/coquitlam-ice-rink-evacuated-due-to-dangerously-high-levels-of-carbon-monoxide/, January 24, 2025

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