CHECKLIST FOR IMPROVING AIR QUALITY IN ICE ARENAS

Implementing best practices for improving air quality in an ice arena is a multistep process that should consider equipment options, use and maintenance, emission source reduction and removal actions, regular air monitoring, and actions in the event of pollutant concentrations exceeding recommended health-based exposure limits. Outlined below are recommended strategies for maintaining and improving air quality in ice arenas, that should be implemented if possible, to help protect users' health.

ICE RESURFACING AND EDGING

- ❍ Use electric resurfacers and edgers, where possible, to eliminate the main sources of CO and NO_2.
- ❍ Avoid gasoline- and diesel-powered resurfacers and edgers; propane and natural gas are preferred fuel alternatives.
- ❍ Fit ice resurfacers with internal combustion engines with three-way catalytic converters.

EQUIPMENT OPERATION AND MAINTENANCE

- ❍ Follow regular maintenance schedules for ice resurfacers, edgers, heaters located in spectator areas, and all other fuel-burning equipment, as per manufacturer's instructions.
- ❍ Warm up resurfacers outdoors or in a dedicated room with a CO alarm and increased ventilation for five minutes prior to use.
- ❍ Extend the exhaust pipe of the ice resurfacer to above the protective barrier surrounding the ice surface.
- ❍ Limit the number of resurfacings, where possible.
- ❍ Schedule maintenance when there is reduced public activity in the arena.
- ❍ Eliminate vehicle idling near entrances or air intakes of the arena.

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VENTILATION WITH FRESH AIR AND IMPROVEMENT OF AIR CIRCULATION

- Operate ventilation system for at least 10 minutes per hour of operation, ideally continuously during resurfacing.
- Implement two-hour continuous ventilation "flush-outs" overnight to remove pollutants accumulated during daily operations.
- Ensure there is extra ventilation on days where there are increased resurfacings.
- Consider installing an automated ventilation system with programmable timers to schedule daily ventilation events.
- Open gates around the ice surface during resurfacing to increase air circulation.
- If available, run ceiling fans continuously to increase air circulation and updraft, ideally with the fans connected to the arena light switches.

AIR POLLUTANT MONITORING

- Collect samples near centre ice (such as in the timekeeper's box, provided that it is not closed off from the ice surface) and at breathing height (approximately one metre).
- Install and maintain CO alarms throughout the arena and check regularly. Consider choosing an alarm with a digital low-level CO display.
- Consider using continuous monitoring systems for CO and NO_2, and checking and recording levels daily, at a minimum.
- Where possible, couple continuous air monitoring systems with mechanical ventilation to trigger the ventilation system when pollutant concentrations reach action levels.
- If continuous monitoring is not available, conduct one-hour average CO and NO_2 monitoring on a weekly basis at a minimum, on a day and time when there are the most resurfacing events. Levels should be documented.
- Monitor on days with the most resurfacings, during the evening or near the end of daily operations.
- Ensure monitoring equipment meet the resolution, range, and precision specified in the table below.
- Follow manufacturer's instructions for maintenance and calibration of air monitoring equipment.
- Document and store monitoring results.

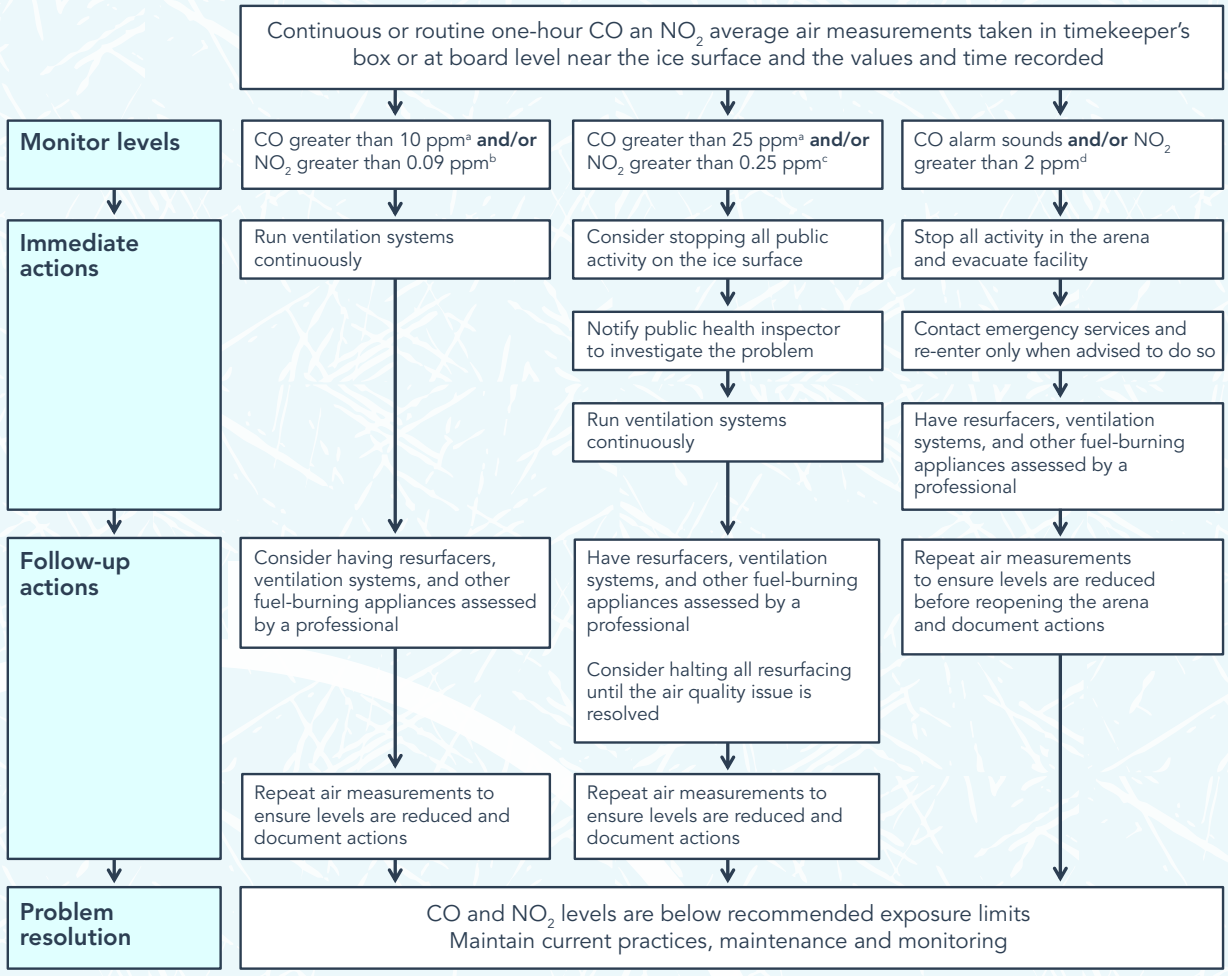
Minimum pollutant monitor requirements for air quality sampling in ice arenas

Pollutant	Resolution	Range	Precision
CO	1 ppm	0–200 ppm	± 5%
NO_2	0.02 ppm	0–10 ppm	± 5%

POLLUTANT LEVELS AND RESPONSE ACTIONS TO ELEVATED CO AND NO_2 LEVELS

- Arenas should attempt to keep pollutant levels as low as possible using the guidance outlined in this checklist.
- Immediate actions outlined in the figure below should be followed when CO and NO_2 levels exceed 25 ppm and 0.25 ppm, respectively.
- Actions taken to reduce levels should be appropriately documented.

RESPONSE ACTIONS TO ELEVATED CO AND NO_2 LEVELS IN ICE ARENAS



[a]Health Canada 2010; [b]Health Canada 2015; [c]Health Canada 1987; [d]Beausoleil et al. 2014