FOG AND SMOKE
Safety Guidelines for the Live Performance Industry in Ontario

DEFINITIONS

Both smoke and fog are suspensions of solid particles or liquid droplets in air. Each may be accompanied by one or more gases.

Smoke. For the purposes of this document the term smoke will refer to a suspension that rises, expanding indefinitely.

Fog. For the purposes of this document the term fog will refer to a suspension that falls, being heavier than air. This includes smoke that has been chilled.

MSDS. Supplier Material Safety Data Sheet that provides comprehensive information on a WHMIS controlled product, relating to its handling, storage, use and known health effects.

REGULATORY REQUIREMENTS FOR CHEMICALS

Regulation 833 entitled Control of Exposure to Biological or Chemical Agents and Workplace Hazardous Material Information System (WHMIS) legislation apply to all the chemicals used for fog and smoke such as glycols, dry ice, liquid nitrogen etc. Regulation 833 prescribes limits for daily and weekly exposure of workers to biological or chemical agents. Exposure is to be controlled using engineering controls, work practices, hygiene facilities and practices and in certain situations personal protective equipment. WHMIS is designed to give employers and workers information about hazardous materials used in the workplace. Under WHMIS, there are three ways in which information on hazardous materials is to be provided:

- labels on the container of hazardous materials;
- material safety data sheets to supplement the label with detailed hazard and precautionary information; and
- worker education.
GENERAL GUIDELINES

1. Dry ice and liquid nitrogen are commonly used and safe-handling procedures must be followed.

2. Only fog/smoke products that have a Supplier Material Safety Data Sheet (MSDS) that meet WHMIS requirements should be used.

3. Some products use proprietary formulas, concealing the identity and proportion of ingredients. Products whose MSDSs clearly identify the chemical ingredients with precautions in safe handling should be preferred.

4. Fog/smoke products should be used exactly as the manufacturer directs and should not be adulterated or altered in any way such as by adding dyes, fragrances or additional chemicals. Coloured fog can be achieved with coloured light.

5. Fog/smoke generating machines should be used and maintained in good condition as required by the Occupational Health and Safety Act.

6. Fog/smoke generating machines or other sources should be located to minimize exposure to the concentrated smoke or fog as it is created.

7. Fog/smoke outlets should be located well out of traffic areas. Residue can be tracked well beyond the area of use and may create a slipping hazard. See Regulation 851, Section 11(a) for Industrial Establishments.

8. The theatre's regular first aid and emergency plan should include response to severe reactions to fog and smoke.

9. Prior to workers’ engagement for any production with fog/smoke effects, the workers should be told the type of chemical fog/smoke product that will be used. The MSDS on the fog/smoke shall be available to workers on request prior to engagement and workers shall be given instruction/training on safe handling and use of the chemicals.

10. High-risk individuals should not be exposed to smoke and fog. This group includes, but is not limited to, children, people with severe lung problems and/or asthma, pregnant women and people with serious illnesses including AIDS.

11. Respirators equipped with appropriate filter cartridges shall be used when circumstances warrant. Filter cartridges should be used according to manufacturers’ recommendations and selected based on the chemical hazards present.

12. Persons should not be assigned to tasks requiring use of respirators unless they are physically able to perform the work and use the equipment. Workers required to wear respirators who experience breathing difficulty while using respirators shall be referred to a physician for evaluation.

13. Exposure to fog and smoke during strenuous physical activity should be minimized.
14. Individuals who experience adverse reactions to fog and smoke exposure should be immediately removed to a well-ventilated area and the theatre’s first aid or emergency providers should be notified.

15. If an adverse reaction occurs, the occurrence should be investigated by the departmental supervisor, stage manager and/or shop steward.

16. A written report of the findings should be made to the Joint Health and Safety Committee or Health and Safety Representative, and appropriate labour and management associations. The individual experiencing the reaction should be given a copy of this report.

SMOKE

One of the most common methods of producing smoke is by passing a fluid under pressure through a heating unit, causing the fluid to vaporize. Only machines designed and manufactured for the generation of stage smoke should be used. The relationship between fluid composition and temperature settings and other internal features of the generating equipment is critical. Under-heating of a fluid may lead to a wet smoke that will leave a residue, and over-heating of the fluid may lead to fluid decomposition.

There are two main types of smoke fluids: Glycol-based products and Oil-based products, and two other, less satisfactory, ways of producing smoke: Fumed Inorganic Chemicals and Burned Organic Chemicals.

A. Glycol-based Products Often called “water based”, although they contain more chemicals than water.

1. Ensure that the generating machine is operating properly;
   - appropriate rate of compression,
   - correct temperature of heating coil.
   (See the effects of under- and over-heating referred to above.)

2. These fluids should be in a secured container while in use.

3. As these smokes condense and settle on surfaces, they leave a minute film of slippery liquid, especially in the immediate area of the smoke outlet. This may produce a hazard. See Regulation 851, Section 11(a) for Industrial Establishments.

4. Propylene Glycol and Butylene Glycol are more commonly used than Monoethylene Glycol and Diethylene Glycol because they are less hazardous.
5. Glycols are hygroscopic, meaning they absorb water out of the atmosphere. This may cause respiratory and eye irritation. People wearing contact lenses are especially vulnerable to eye irritation.

**B. Oil-based Products** “Petroleum based” or organic (vegetable) products. These fluids are less appropriate fog/smoke products than glycol.

1. Any oil in aerosolized form can be combustible - even explosive - at the wrong concentrations. Naked flame and sparks should not be permitted near oil-based smoke.
2. Only 100% food grade organic oils, or highly refined clear mineral oils should be used. Identify any vegetable oils present since there are people who are allergic to certain vegetables.
3. Avoid fluid containing “industrial grade” oils such as fuel oil, cutting oil and paraffin oils. These contain impurities that may cause adverse reactions.
4. Like Glycol-based products, oil aerosols can cause extremely slippery surface conditions. See Regulation 851, Section 11(a) for Industrial Establishments.
5. A Class B portable fire extinguisher shall be located near the location where the oil-based products are used as per section 123(1) of Regulation 851.
6. All electrical equipment that may be affected by the combustible liquid while it is in aerosol or mist form shall meet the requirements of Part 18 of the Ontario Electrical Safety Code for a Class 1 hazardous location. The density of the aerosol or mist cloud will influence the determination as to whether the location is a Division 1 or Division 2 location.
7. Smoke fluid containers and the equipment used to make the aerosol or mist shall be bonded together and to ground as per Section 22(4)(b) of Regulation 851.

**C. Fumed Inorganic Chemicals** Chemicals that fume when heated, creating tiny airborne particles.

1. The majority of smoke products of this type are chlorides, which are all respiratory irritants.
2. Ammonium Chloride (Sal Ammoniac Powder) is considered the least irritating, although heavy exposure should be avoided.
3. All other chlorides should not be used.

**D. Organic Materials** Smoke can be produced by burning frankincense, rosin, charcoal, tobacco, paper, naphthalene, rubber, etc.
1. Any burning materials will produce carbon dioxide, carbon monoxide, and a host of irritating and toxic gases, vapours, and fumes. Exposure should be limited.

2. Smoke from pyrotechnic effects should be treated as burned organic material.

NOTE: PYRO is regulated under Federal regulations. The Explosives Regulatory Division (ERD) of Natural Resources Canada is responsible for the administration of the Canada Explosives Act – an act that regulates matters related to explosives and pyrotechnics. ERD offers a Pyrotechnic Special Effects Course. This one-day course serves to promote the safe use of all pyrotechnics and special-purpose effects as used in entertainment and performing arts. For more information, contact:

Natural Resources Canada
Explosives Regulatory Division
1431 Merivale Road
Ottawa ON K1A 0G1
Attention: John Hendrick
Senior Inspector of Explosives
Tel: (613) 948-5175
Fax: (613) 948-5195

E. A/B Smoke Acid and base smoke.

1. Highly irritating and toxic. Do not use.

2. This smoke is produced when two different chemicals, commonly cyclohexylamine and acetic acid, interact. (This is not to be confused with A/B PYRO.)

FOG

There are two common ways of producing fog. One is by chilling smoke, in which case the SMOKE guidelines apply. The other method is by condensing the natural moisture in the air, using extremely cold materials such as dry ice (frozen carbon dioxide) or liquid nitrogen.

1. Dry ice or any other chilling agent must be handled with caution. Directly exposing skin to dry ice or other chilling agents can cause severe frostbite.

2. Caution should be exercised when breaking up dry ice. Personal protective equipment such as eye protection and gloves shall be used in the handling of dry ice.

3. Dry ice and liquid nitrogen should be transported and stored in the container provided by the supplier or transferred to a suitable container. The container shall be clearly labelled and such labels shall remain plainly visible. The handling and transportation of all
compressed gas cylinders shall meet WHMIS and TDG (Transportation of Dangerous Goods) requirements.

4. Because carbon dioxide and nitrogen displace oxygen, adequate ventilation must be ensured in low-lying areas and confined spaces, including, but not limited to, orchestra pits, trap rooms and stairwells.

MORE INFORMATION

- Ministry of Labour
- Health and Safety Ontario (health and safety association):
  [www.healthandsafetyontario.ca/](http://www.healthandsafetyontario.ca/)
- Workplace Safety & Insurance Board:
  [www.wsib.on.ca](http://www.wsib.on.ca)
- Canadian Standards Association (CSA) standards referenced in occupational health and safety legislation:
  [ohsviewaccess.csa.ca](http://ohsviewaccess.csa.ca)

CALL TOLL-FREE

Call 1-877-202-0008 anytime to report critical injuries, fatalities or work refusals. For general inquiries about workplace health and safety and to report potentially unsafe work conditions, call 8:30 a.m. – 5 p.m., Monday to Friday. In an emergency, always call 911 immediately.

ORGANIZATIONS AND ASSOCIATIONS

Natural Resources Canada
(Contact: Dave McCulloch)
Explosives Regulatory Division
1431 Merivale Road
Ottawa, Ontario
K1A 0G1
Fire Prevention Department
(Contact: Chief Ted Scovel)
New City Hall
100 Queen Street West
Toronto, Ontario
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ACKNOWLEDGEMENTS

The Ontario Advisory Committee for Health and Safety in Live Performance is made up of professionals in live performance from across the province – large and small, commercial and not-for-profit, service organizations and professional associations. We have had input from individual experts both national and international. The Advisory Committee and the Ministry of Labour would like to thank the following people for their help in making this guideline possible

* Indicates a main committee member at the time the sub-committee was active.

- Jim Biros*
- Rick Boychuk*
- Rob Gunn*
- Peter McKinnon*
- Steve Mosher*
- Bob Nicholson
- Shirley Third*

This guideline has been prepared to assist the workplace parties in understanding their obligations under the Occupational Health and Safety Act (OHSA) and the regulations. It is not intended to replace the OHSA or the regulations and reference should always be made to the official version of the legislation.

It is the responsibility of the workplace parties to ensure compliance with the legislation. This guideline does not constitute legal advice. If you require assistance with respect to the interpretation of the legislation and its potential application in specific circumstances, please contact your legal counsel.

While this guideline will also be available to Ministry of Labour inspectors, they will apply and enforce the OHSA and its regulations based on the facts as they may find them in the workplace. This guideline does not affect their enforcement discretion in any way.