DEFINITIONS, DESIGNATION AS HAZARDOUS SUBSTANCES, AND GENERAL INFORMATION REQUIREMENT

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

CONTAINERS AND STORAGE

FLAMMABLE AND COMBUSTIBLE SUBSTANCES

SUBSTANCES UNDER PRESSURE

CONTROLLING EXPOSURE

VENTILATION

INTERNAL COMBUSTION ENGINES

HAZARDOUS WASTES AND EMISSIONS

PERSONAL HYGIENE

EMERGENCY WASHING FACILITIES

EMERGENCY PLANNING

G5.1.1 Designation of biological agents as hazardous substances

Issued February 1, 2008; Editorial Revision to include February 1, 2011 regulatory amendment

Regulatory excerpt
Section 5.1.1 of the *OHS Regulation* ("*Regulation*") states:

> For the purposes of sections 5.2 and 6.33 to 6.40 and Part 30, the following biological agents are designated as hazardous substances:
>
> (a) a liquid or solid material that is contaminated with a prion, virus, bacterium, fungus or other biological agent that has a classification given by the Public Health Agency of Canada as a Risk Group 2, 3 or 4 human pathogen that causes an adverse health effect;
>
> (b) a biological toxin that causes an adverse health effect.

Purpose of guideline
This guideline provides information on Risk Groups 2, 3, and 4 human pathogens that cause adverse health effects.

Risk Groups
Risk Groups 2, 3, and 4 are a component of a universally agreed to classification system as adopted by the Public Health Agency of Canada. This system is based on the biosafety containment classification system of the Public Health Agency of Canada.

The following provides an overview of each Risk Group.

Risk Group 2: A pathogen that can cause human or animal disease but under normal circumstances is unlikely to be a serious hazard to healthy laboratory workers, the community, livestock, or the environment. Laboratory exposures rarely cause infection leading to serious disease; effective treatment and preventive measures are available and the risk of spread is limited. They are considered to represent a moderate risk to individuals and a limited risk to the community. Examples of Risk Group 2 pathogens include the Hepatitis B and Hepatitis C viruses, salmonella, and E. coli bacteria.

Risk Group 3: A pathogen that usually causes serious human or animal disease, or which can result in serious economic consequences but does not ordinarily spread by casual contact from one individual to another, or that can be treated by antimicrobial or antiparasitic agents. They are considered to represent a high risk to individuals but a low risk to the community. Examples of Risk Group 3 pathogens include the human immunodeficiency virus (HIV), and the pathogens causing Creutzfeldt-Jacob disease, hantavirus, and tuberculosis.

Risk Group 4: A pathogen that usually produces very serious human or animal disease, often untreatable, and may be readily transmitted from one individual to another, or from animal to human or vice-versa directly or indirectly, or by casual contact. They are considered to represent a high risk to both the individual and the community. Examples of Risk Group 4 pathogens are the hemorrhagic fever viruses such as Ebola, Marburg, and Lassa fever.

G5.3-1 WHMIS application

Issued August 1999; Editorial Revision January 2005; Editorial Revision May 9, 2014; Editorial Revision consequential to February 1, 2015 Regulatory Amendment; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 1.1(1) of the *OHS Regulation* ("*Regulation*") states, in part:

> (1) In this Occupational Health and Safety Regulation
>
> *"hazardous product"* means any product, mixture, material or substance that is classified in accordance with the regulations made under section 15 (1) of the *Hazardous Products Act* (Canada) in a category or subcategory of a hazard class listed in Schedule 2 of that Act;

Section 5.3 of the *Regulation* states:

> (1) Subject to subsections (2) to (4), sections 5.4 to 5.18 (the WHMIS Requirements) apply to employers and workers with respect to hazardous products used, stored or handled at a workplace.
>
> (2) The provisions concerning a supplier label and SDS do not apply if the hazardous product is
>
> (a) an explosive as defined in section 2 of the *Explosives Act* (Canada),
>
> (b) a drug, food or cosmetic device within the meaning of the *Food and Drugs Act* (Canada),
>
> (c) a pest control product as defined in section 2(1) of the *Pest Control Products Act* (Canada),
>
> (d) a nuclear substance as defined in section 2 of the *Nuclear Safety and Control Act* (Canada), that is radioactive, or

(e) a consumer product as defined in section 2 of the *Canada Consumer Product Safety Act*.

(3) The provisions do not apply if the hazardous product is

(a) wood or a product made of wood,

(b) tobacco or a tobacco product as defined in section 2 of the *Tobacco Act* (Canada),

(c) a manufactured article, or

(d) being transported or handled pursuant to the requirements of the *Transportation of Dangerous Goods Act, 1992* (Canada) or the *Transport of Dangerous Goods Act*.

(4) The provisions do not apply to a hazardous waste, except that the employer must ensure the safe storage and handling of a hazardous waste generated at the workplace through the combination of worker training and the information required by this Regulation.

Purpose of guideline
The purpose of this guideline is to clarify the meaning of "hazardous product."

Hazardous products
A hazardous product is defined in section 1.1(1) of the *Regulation* as any product, mixture, material, or substance listed in Schedule 2 of the federal *Hazardous Products Act*. Schedule 2 sets out the following classes of hazardous products:

Physical Hazard Classes

1. Explosives
2. Flammable gases
3. Flammable aerosols
4. Oxidizing gases
5. Gases under pressure
6. Flammable liquids
7. Flammable solids
8. Self-reactive substances and mixtures
9. Pyrophoric liquids
10. Pyrophoric solids
11. Self-heating substances and mixtures
12. Substances and mixtures which, in contact with water, emit flammable gases
13. Oxidizing liquids
14. Oxidizing solids
15. Organic peroxides
16. Corrosive to metals
17. Combustible dusts
18. Simple asphyxiants
19. Pyrophoric gases
20. Physical hazards not otherwise classified

Health Hazard Classes

1. Acute toxicity
2. Skin corrosion/irritation
3. Serious eye damage/eye irritation
4. Respiratory or skin sensitization
5. Germ cell mutagenicity
6. Carcinogenicity
7. Reproductive toxicity
8. Specific target organ toxicity — single exposure
9. Specific target organ toxicity — repeated exposure
10. Aspiration hazard
11. Biohazardous infectious materials
12. Health hazards not otherwise classified

The contents of these classes are set out in Parts 7 and 8 of the federal *Hazardous Products Regulations*.

G5.3-2 Fire extinguishers

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.8(1) of the *OHS Regulation* ("*Regulation*") states:

> Subject to any exemptions from labelling requirements in the Hazardous Products Regulations and this Part, an employer must ensure that a hazardous product or the container of a hazardous product received at a workplace is attached or printed with a supplier label.

Section 5.14(1) of the *Regulation* states:

> Subject to subsection (6), an employer who acquires a hazardous product for use, handling or storage at a workplace must obtain a supplier SDS in respect of that hazardous product that complies with the requirements of the Hazardous Products Regulations.

Purpose of guideline
The purpose of this guideline is to clarify the requirements for labelling and safety data sheets (SDS) with respect to fire extinguishers.

Fire extinguishers
Any fire extinguisher pressurized to more than 200 kPa (1.97 atmospheres or 29 psi at 20°C) meets the criteria for inclusion in Workplace Hazardous Materials Information System (WHMIS) Class Gases under Pressure, pursuant to Part 7 Subpart 5 of the federal *Hazardous Products Regulations*. Some retardants (or performance additives to prevent effects such as freezing or corrosion) may meet criteria for inclusion in WHMIS Class Acute Toxicity established by Part 8 Subpart 1 of the *Hazardous Products Regulations*. Older soda-acid extinguishers are included as WHMIS Classes, Skin Corrosive/Irritation and Serious Eye Damage/Irritation under Part 8 Subparts 2 and 3 of the *Hazardous Products Regulations*.

Section 13(1)(b) of the federal *Hazardous Products Act* (HPA) requires that a supplier apply a label to a hazardous product intended for use in a workplace, or to the container in which the hazardous product is packaged. The label must disclose the required information and display applicable hazard symbols.

A fire extinguisher is not exempted as a manufactured article under section 5.3(3)(c) of the *Regulation* (section 12(i) of the HPA) because workers are exposed to the hazard of a pressurized container or other hazardous products under normal conditions of use.

Where a fire extinguisher is intended for use in the workplace and is included as a WHMIS hazardous product the following must occur:

- Suppliers who sell extinguishers intended for use in the workplace must apply a WHMIS supplier label to the extinguisher and provide an SDS.
- A firm which recharges a fire extinguisher for an employer must apply a WHMIS supplier label to the extinguisher and provide an SDS, if these are not already applied and provided. Where an employer recharges extinguishers "in-house," a workplace label will suffice if a supplier label is not already on the extinguisher.
- A detachable pressurized cartridge used to pressurize a dry chemical extinguisher must be provided with a WHMIS label in addition to the label on the extinguisher unless the cartridge is immediately installed on the extinguisher after the cartridge is pressurized. Suppliers who pressurize such cartridges must provide a supplier label; employers who pressurize their own cartridges must provide, at minimum, a workplace label. Labels must be applied to individual cartridges unless an alternative acceptable arrangement is used. An example of an acceptable alternative is to provide a WHMIS label on the container of individual cartridges as long as cartridges are immediately installed on the extinguisher after being removed from the container. Where a supplier and employer wish to adopt this alternative or any arrangement in which the employer undertakes to apply supplier labels to cartridges contained in an outer container, the employer should establish the arrangement in writing.
- A generic SDS covering both the cartridge and the extinguisher will be considered acceptable for the purposes of providing an SDS on the cartridge.

G5.3-3 Cylinders of breathing air

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment; Editorial Revision consequential to August 22, 2022 Regulatory Amendment

Regulatory excerpt
Section 5.7(1)(a) of the *OHS Regulation* ("*Regulation*") states:

> (1) An employer must ensure that a worker who works with a hazardous product or may be exposed to a hazardous product in the course of the worker's work activities is trained in the following:
>
> (a) the content required on a supplier label and workplace label, and the purpose and significance of the information contained on those labels;

Section 5.8(1) of the *Regulation* states:

> Subject to any exemptions from labelling requirements in the Hazardous Products Regulations and this Part, an employer must ensure that a hazardous product or the container of a hazardous product received at a workplace is attached or printed with a supplier label.

Section 5.8(3) of the *Regulation* states:

> Subject to any exemptions from labelling requirements in the Hazardous Products Regulations and this Part, an employer must replace the label with either a supplier label or a workplace label if a supplier label applied to a hazardous product or a container of a hazardous product becomes illegible or is accidentally removed from the hazardous product or the container.

Section 5.14(1) of the *Regulation* states:

> Subject to subsection (6), an employer who acquires a hazardous product for use, handling or storage at a workplace must obtain a supplier SDS in respect of that hazardous product that complies with the requirements of the Hazardous Products Regulations.

Purpose of guideline
The purpose of this guideline is to clarify the requirements for providing labels, safety data sheets (SDS), and worker training specific to compressed gas cylinders of breathing air.

Compressed air cylinders
Compressed air cylinders used in self-contained breathing apparatus (SCBA) are included as WHMIS Class Gases under Pressure pursuant to Part 7 Subpart 5 of the federal *Hazardous Products Regulations*.

Provincial requirements for cylinders filled in-house

- *Safety Data Sheets:* An SDS must be provided for synthetic mixtures of breathing gases. An SDS is not required for cylinders of compressed respirable atmospheric air as this air must meet the air quality required by section 8.37 of the *Regulation*.
- *Labels:* Workplace labels specifying the product identity and making reference to the SDS are required on synthetic mixtures of breathing gases. Safe handling instructions must be provided through the worker education and training program. For cylinders of respirable atmospheric air which are identifiable to workers by size and shape, for which an SDS is not required, and where worker instruction in the safe use of the SCBA is in place as required by part 8 of the *Regulation*, further labelling or means of identification is not necessary.

Federal requirements for pressurized cylinders sold, imported, or filled on contract

- Suppliers who provide cylinders with compressed synthetic mixtures for breathing purposes for use in a workplace must apply supplier labels and provide an SDS
- Suppliers who provide cylinders of breathing air for use in the workplace are not required to provide an SDS or a reference to the SDS on the supplier label provided the supplier label meets the following:
  - Includes the following six elements of a WHMIS supplier label: the product identifier, supplier identifier, hazard pictogram, signal word, hazard statement, and precautionary statements (which include first aid measures)
  - Includes a precautionary statement advising users to ensure the cylinder is filled with air meeting the quality standards of the local regulatory agency

Where cylinders are refilled by an outside contractor who is not the original supplier of the cylinder, the contractor must provide a supplier identifier. If the original supplier label becomes illegible or is accidentally removed from the hazardous product, the supplier must provide a supplier label.

G5.3-4 Exemptions

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.3 of the *OHS Regulation* ("*Regulation*") states:

> (1) Subject to subsections (2) to (4), sections 5.4 to 5.18 (the WHMIS Requirements) apply to employers and workers with respect to hazardous products used, stored or handled at a workplace.
>
> (2) The provisions concerning a supplier label and SDS do not apply if the hazardous product is
>
> (a) an explosive as defined in section 2 of the *Explosives Act* (Canada),
>
> (b) a drug, food or cosmetic device within the meaning of the *Food and Drugs Act* (Canada),
>
> (c) a pest control product as defined in section 2(1)of the *Pest Control Products Act* (Canada),
>
> (d) a nuclear substance as defined in section 2 of the *Nuclear Safety and Control Act* (Canada), that is radioactive, or
>
> (e) a consumer product as defined in section 2 of the *Canada Consumer Product Safety Act*.
>
> (3) The provisions do not apply if the hazardous product is
>
> (a) wood or a product made of wood,
>
> (b) tobacco or a tobacco product as defined in section 2 of the *Tobacco Act* (Canada),

> (c) a manufactured article, or
>
> (d) being transported or handled pursuant to the requirements of the *Transportation of Dangerous Goods Act, 1992* (Canada) or the *Transport of Dangerous Goods Act*.
>
> (4) The provisions do not apply to a hazardous waste, except that the employer must ensure the safe storage and handling of a hazardous waste generated at the workplace through the combination of worker training and the information required by this Regulation.

Purpose of guideline
The purpose of this guideline is to clarify requirements for information, education, training, labelling, and safety data sheets (SDS) for hazardous products that are partially or completely exempted from Workplace Hazardous Material Information System (WHMIS).

Hazardous products exempt from WHMIS legislation
Where a hazardous product is used or produced in a workplace, workers must know the hazard, how to protect themselves in normal work and in emergency situations, and where to find more information when it is needed. This is required regardless of whether the hazardous product is included fully in the WHMIS program or is partially or completely exempted. The information required for partially and completely exempted hazardous products and wastes include hazards (e.g., toxicity, fire, explosion, or reactivity), storage information, safe work procedures, protective equipment, spill, leakage, firefighting information, and first aid measures.

Partial exemptions
Partially exempt hazardous products, specified in section 5.3(2) of the *Regulation* and labelled under federal legislation other than WHMIS, can be sold without a WHMIS label or SDS. When these hazardous products are used in the workplace, sections 5.6 and 5.7 of the *Regulation* require worker education and training. Workplace labels must be applied if the hazardous product is not in the original container.

Complete exemptions
Hazardous products specified in section 5.3(3) of the *Regulation* are excluded from both federal and provincial WHMIS requirements. General occupational health and safety requirements governing workplace education and training, as well as the general information requirement set out in section 5.2 of the *Regulation* must be met. The provision of an SDS by suppliers will assist employers in meeting their obligations under these sections.

Hazardous wastes
An employer must provide worker training and information sufficient to ensure the safe storage and handling of a hazardous waste generated at the workplace, pursuant to section 5.3(4) of the *Regulation*. Information from an SDS for waste components or precursors, combined with the employer's firsthand knowledge about the process which generated the hazardous waste, will form the basis of the information given to employees.

G5.3-5 Leaded surface coating materials

Revised April 9, 2009; Editorial Revision March 7, 2011; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.3(2)(e) of the *OHS Regulation* ("*Regulation*") states:

> (2) The provisions concerning a supplier label and SDS do not apply if the hazardous product is
>
> (e) a consumer product as defined in section 2 of the *Canada Consumer Product Safety Act*.

Purpose of guideline
The purpose of this guideline is to highlight the federal requirements applicable to leaded surface coating materials.

Health Canada requirements
The federal *Surface Coating Materials Regulations ("SCMR")* prohibits the advertising, sale, and importation of surface coating materials containing a lead concentration exceeding 90 mg/kg (0.009% w/w). Surface coating materials that are used for any of the applications listed in section 4(2) of the *SCMR* exempt from this restriction, but specific labelling requirements apply if their lead content does exceed 0.009% w/w. These regulatory requirements are enforced by Health Canada.

G5.3-6 "For industrial use only" labels

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.3(2) of the *OHS Regulation* ("*Regulation*") states:

> The provisions concerning a supplier label and SDS do not apply if the hazardous product is
>
> (a) an explosive as defined in section 2 of the *Explosives Act* (Canada),
>
> (b) a drug, food or cosmetic device within the meaning of the *Food and Drugs Act* (Canada),

> (c) a pest control product as defined in section 2 (1) of the *Pest Control Products Act* (Canada),
>
> (d) a nuclear substance as defined in section 2 of the *Nuclear Safety and Control Act* (Canada), that is radioactive, or
>
> (e) a consumer product as defined in section 2 of the *Canada Consumer Product Safety Act*.

Purpose of guideline
The purpose of this guideline is to clarify WorkSafeBC's interpretation of product labelling that specifies industrial or professional use of hazardous products labelled "for industrial use only."

Industrial use
Statements on the label of a hazardous product which identify a product for industrial use imply intent for product use in the workplace. This includes statements such as "for industrial use only" or "for professional use only." Where the product is a hazardous product as defined in section 1.1(1) of the *Regulation*, the Workplace Hazardous Materials Information System (WHMIS) requirements apply.

G5.3-7 Warehousing of hazardous products

Issued February 27, 2001; Revised September 21, 2012; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.3 of the *OHS Regulation* ("*Regulation*") states:

> (1) Subject to subsections (2) to (4), sections 5.4 to 5.18 (the WHMIS Requirements) apply to employers and workers with respect to hazardous products used, stored or handled at a workplace.
>
> (2) The provisions concerning a supplier label and SDS do not apply if the hazardous product is
>
> (a) an explosive as defined in section 2 of the *Explosives Act* (Canada),
>
> (b) a drug, food or cosmetic device within the meaning of the *Food and Drugs Act* (Canada),
>
> (c) a pest control product defined in section 2(1) of the *Pest Control Products Act* (Canada),
>
> (d) a nuclear substance as defined in section 2 of the *Nuclear Safety and Control Act* (Canada), that is radioactive, or
>
> (e) a consumer product as defined in section 2 of the *Canada Consumer Product Safety Act*.
>
> (3) The provisions do not apply if the hazardous product is
>
> (a) wood or a product made of wood,
>
> (b) tobacco or a tobacco product as defined in section 2 of the *Tobacco Act* (Canada),
>
> (c) a manufactured article, or
>
> (d) being transported or handled pursuant to the requirements of the *Transportation of Dangerous Goods Act, 1992* (Canada) or the *Transport of Dangerous Goods Act*.
>
> (4) The provisions do not apply to a hazardous waste, except that the employer must ensure the safe storage and handling of a hazardous waste generated at the workplace through the combination of worker training and the information required by this Regulation.

Purpose of guideline
The purpose of this guideline is to clarify the application of the WHMIS requirements in the *Regulation* relative to federal requirements when a hazardous product is "handled" in a warehouse.

Application of WHMIS requirements
Section 5.3(3)(d) of the *Regulation* states, in part, that the WHMIS requirements "do not apply if the hazardous product is being transported or handled pursuant to the requirements of the *Transportation of Dangerous Goods Act, 1992* (Canada) or the *Transport of Dangerous Goods Act*."

The *Transportation of Dangerous Goods* (TDG) *Act* defines *handling* as "loading, unloading, packing or unpacking dangerous goods in a means of containment for the purposes of, in the course of or following transportation and includes storing them in the course of transportation." Handling in this context does not include actual *use* of a hazardous product. TDG requirements deal primarily with acute exposures and the use of symbol alerts and placards. Transportation workers should not be exposed to hazards associated with the hazardous product unless there is an emergency, short-term circumstance such as a transport vehicle accident and spill. Conversely, worker exposure to hazardous products in a workplace can occur in a wider variety of circumstances and over a longer period of time. Hence, WHMIS requirements are more extensive than TDG and include the use of explicit labels and safety data sheets (SDS).

Application of WHMIS or TDG depends on the flow of goods through commerce as outlined in the following flow chart. WHMIS requirements are meant to apply at points of sale or use rather than during shipment. Transportation generally means to and from workplaces.

WHMIS, both federal (labels and SDS) and provincial (education and training, workplace labels), applies where hazardous products are used, processed, or repackaged in a warehouse. When warehoused, hazardous products can be:

- In "transshipment" (held in temporary storage between points of shipment)
- Repackaged (assembled, packaged, labelled, or relabelled)
- Used

Sections 5.2(c) and 5.2(d) of the *Regulation* are non-WHMIS "general information requirements" that apply to a transshipment warehouse where in the case of an emergency or spill of a hazardous product, an emergency response system must be established. This emergency response system requires written emergency and spill cleanup procedures, and effective supervisor and worker training in these procedures.

A hazardous product that is repackaged or used is subject to the WHMIS section of the *Regulation* since workers may be exposed to the hazards of the product.

The following table sets out the legislation and resources that apply to hazardous products in a warehouse:

	Federal	**Provincial - Regulation**	**Other**
Transshipment	TDG	Non-WHMIS sections [5.2(c) & 5.2(d)]	CANUTEC*
Repackaging	HPA/HPR**	WHMIS sections (5.3 – 5.18)	
Used	HPA/HPR	WHMIS sections (5.3 – 5.18)	

Notes to table:
* CANUTEC (Canadian Transport Emergency Centre), part of the TDG Directorate, Transport Canada, provides hazard information in case of transport-related emergency situations. Phone: (613) 996-6666.
** HPA/HPR *(Hazardous Products Act/Hazardous Products Regulations)*

G5.3-8 The application of WHMIS in agriculture

Issued January 1, 2005; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.3(1) of the *OHS Regulation* ("*Regulation*") states:

> Subject to subsections (2) to (4), sections 5.4 to 5.18 (the WHMIS Requirements) apply to employers and workers with respect to hazardous products used, stored or handled at a workplace.

Purpose of guideline
The purpose of this guideline is to provide information to farmers, ranchers, and agriculture workers on the general framework of the Workplace Hazardous Materials Information System (WHMIS), the application of regulatory requirements to partially and completely exempt products, and the means of forwarding concerns to WorkSafeBC about products for which suppliers are not providing information meeting WHMIS requirements.

Application to suppliers and workplaces
WHMIS was developed in 1988 as a major step in helping to ensure that employers and workers would be provided with information on the

hazards and control measures for hazardous materials (termed "hazardous products") in the workplace. The requirements were made applicable to agriculture in 1993.

Broadly speaking, WHMIS applies on the following two levels:

- Suppliers: The suppliers of hazardous products are required, under federal legislation, to provide information to employers for hazardous products used in the workplace. Typically, the information must be provided in two ways: container labels, and safety data sheets (SDS).
- Workplace: Employers are required, under provincial legislation, to ensure hazardous products received in the workplace have the necessary labels and SDS, and to ensure that workers are educated and trained in the safe use of the products. Other obligations apply. For example, if a hazardous product is transferred from the supplier container to another container in the workplace it is necessary to label or identify the workplace container. Sections 5.3 to 5.18 of the *Regulation* cover the provincial WHMIS requirements.

Partially and completely exempt products
As shown in section 5.3 of the *Regulation*, there are different degrees to which hazardous products are covered by WHMIS.

Many industrial products are fully covered by WHMIS, meaning the supplier requirements for labels and SDS apply, and the employer must ensure that workplace obligations under WHMIS are also met. Examples of such hazardous products in agriculture include compressed gas cylinders used in welding operations, fuel products on site, and some acids and caustics.

Some hazardous products are partially exempt. Examples include pesticides and drugs (including some sterilants and disinfectants). In these cases there is no federal requirement for WHMIS labels and SDS, but typically the hazardous products must meet other federal labelling and information requirements specific to them. In the case of pesticides and some other partially exempt products, suppliers will often provide an SDS, and the buyer should obtain an SDS wherever available. The employer must meet provincial WHMIS requirements for information, education, and training of workers and other matters such as workplace labels, as covered in sections 5.3-5.18 of the *Regulation*. Refer to OHS Guideline G5.3-4 for more information on partially exempt hazardous products.

Also, note that section 6.75 of the *Regulation* requires that employers make readily available to workers an SDS or its written equivalent for pesticides used at the workplace. Obtaining an SDS from the pesticide supplier will help ensure that the requirement is met. An SDS compliant with WHMIS will include information on the following categories:

- Identification
- Hazard identification
- Composition/information on ingredients
- First aid measures
- Firefighting measures
- Accidental release measures
- Handling and storage
- Exposure controls/personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information

If the pesticide SDS does not fully meet WHMIS standards, but has sufficient information to ensure the health and safety of workers using, transporting, or storing the hazardous product, the SDS may be considered acceptable. Refer to OHS Guideline G6.75 for a list of the information that would be considered equivalent.

Some hazardous products such as welding rods, which are manufactured articles, are completely exempt from both the federal and provincial WHMIS requirements. In such cases, where the article contains a hazardous material, the employer is encouraged to obtain an SDS if available. Section 5.2 of the *Regulation* addresses general information requirements for any chemical or biological substance that could cause an adverse health effect; which would apply in this case. Section 5.2 covers general responsibilities to identify the hazards of the substance, educate the worker, and implement and follow safe work procedures. Refer to OHS Guideline G5.3-4 for more information on completely exempt products.

What if a supplier is not providing adequate labels or SDS where required by WHMIS?
Where an agricultural workplace is unable to get the proper WHMIS information for a hazardous product from the supplier or distributor, the farmer or rancher is encouraged to contact WorkSafeBC at (604) 276-3100 (long distance toll free at 1-888-621-7233), or the nearest WorkSafeBC Regional Office. Many of WorkSafeBC's occupational hygiene officers are designated to enforce federal WHMIS requirements on suppliers and distributors in this province. Where a distributor is providing product from elsewhere in Canada, WorkSafeBC will forward the concern to the responsible jurisdiction for its follow-up with the supplier. For more information on the application of WHMIS, refer to the WorkSafeBC publication, *WHMIS at Work*, which is available on the WorkSafeBC website at www.worksafebc.com.

G5.5 WHMIS program — Consultation on WHMIS education and training

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.5 of the *OHS Regulation* ("*Regulation*") states:

> If hazardous products are used in the workplace the employer, in consultation with the joint committee or health and safety representative as applicable, must establish and maintain an effective WHMIS program, as part of the overall workplace health and safety program, which
>
> (a) addresses applicable WHMIS Requirements including education and training,
>
> (b) is reviewed at least annually, or more frequently if required by a change in work conditions or available hazard information, and
>
> (c) provides for the periodic evaluation of the knowledge of workers using suitable means such as written tests and practical demonstrations.

Purpose of guideline
The purpose of this guideline is to clarify the meaning of the phrase "in consultation with the joint committee or health and safety representative," as it applies to the development and implementation of Workplace Hazardous Materials Information System (WHMIS) education and training.

Consultation
An employer has consulted with the joint committee or health and safety representative regarding WHMIS education and training if the following two conditions are met:

- Prior to the finalization of the WHMIS education and training, the joint committee or health and safety representative has the opportunity to review and provide information or advice on the entire education and training component, including its content, structure, and means of implementation. Content means education in "how WHMIS works," education in the hazards of hazardous products, and training in work procedures as itemized in section 5.7(1) of the *Regulation*. Means of implementation includes the choice of instructors and the use of any in-course evaluation.
- After initial implementation of WHMIS education and training, and at the time of each annual review of the WHMIS program, the employer asks for information and advice from the joint committee or health and safety representative on the effectiveness of the education and training.

Where a number of committees have been established by a large employer, an acceptable arrangement is for the central committee, where there is one, to review the employer's general plan for WHMIS education and training in all workplaces, and for local committees to review the WHMIS education and training in the areas of their respective responsibilities.

G5.6 Worker education and training

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment; Editorial Revision consequential to August 22, 2022 Regulatory Amendment

Regulatory excerpt
Section 5.6(1) of the *OHS Regulation* ("*Regulation*") states:

> (1) An employer must ensure that general WHMIS education, as it pertains to the workplace, is provided to workers on the
>
> (a) elements of the WHMIS program,
>
> (b) major hazards of the hazardous products in use in the workplace,
>
> (c) rights and responsibilities of employers and workers, and
>
> (d) content required on labels and SDSs, and the significance of this information.

Section 5.7(1) of the *Regulation* states:

> An employer must ensure that a worker who works with a hazardous product or may be exposed to a hazardous product in the course of the worker's work activities is trained in the following:
>
> (a) the content required on a supplier label and workplace label, and the purpose and significance of the information contained on those labels;
>
> (b) the content required on an SDS and the purpose and significance of the information contained on the SDS;
>
> (c) procedures for the safe use, storage, handling and disposal of the hazardous product;
>
> (d) procedures for the safe use, handling and disposal of the hazardous product contained or transferred in

> (i) a pipe or a piping system including valves,
>
> (ii) a process or reaction vessel, or
>
> (iii) a tank car, tank truck, ore car, conveyor belt or similar conveyance,
>
> (e) procedures to be followed where fugitive emissions are present if workers may be exposed to those fugitive emissions;
>
> (f) procedures to be followed in case of an emergency involving the hazardous product.

Purpose of guideline
The purpose of this guideline is to provide a way to assess the effectiveness of a worker's Workplace Hazardous Materials Information System (WHMIS) education and training as it pertains to the workplace and the hazardous products to which that worker may be exposed.

Education and training assessment questions

What are the hazards of the hazardous product?
The worker's answer must reflect the possible adverse effects of the products or materials in question. This demonstrates an understanding of generic hazard information (education).

How are you protected from those hazards?
The answer must demonstrate the worker's understanding of proper procedures to follow for the use, storage, handling, or disposal of the product and the proper use of personal protective equipment. The answer must demonstrate knowledge of adequate workplace control of the hazard through engineering, administrative means, or the use of personal protective equipment.

What do you do in case of an emergency?
The answer must show the worker's understanding of procedures to follow in the event of a spill, release, fire, or poisoning involving the hazardous product, and include the use of personal protective equipment where applicable.

Where can you get further hazard information?
This question focuses on the worker's ability to gain access to the significant information provided on labels and safety data sheets (SDS). Workers must know how to interpret the supplier label, workplace label, and other means of identification applicable to the use of the product and how to obtain information significant to health and safety from the SDS.

G5.8-1 Supplier label

Issued August 1999; Retired May 9, 2014

G5.8-2 Supplier label: Labelling on leased or rented chemical application units

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.8(1) of the *OHS Regulation* ("*Regulation*") states:

> Subject to any exemptions from labelling requirements in the Hazardous Products Regulations and this Part, an employer must ensure that a hazardous product or the container of a hazardous product received at a workplace is attached or printed with a supplier label.

Section 5.8(3) of the *Regulation* states:

> Subject to any exemptions from labelling requirements in the Hazardous Products Regulations and this Part, an employer must replace the label with either a supplier label or a workplace label if a supplier label applied to a hazardous product or a container of a hazardous product becomes illegible or is accidentally removed from the hazardous product or the container.

Purpose of guideline
The purpose of this guideline is to clarify the supplier responsibilities for labelling of hazardous products contained within an application unit, such as a solvent spray parts washer, where the unit is leased or rented to an employer and the supplier periodically empties the holding tank on the unit and recharges it with a hazardous product.

Supplier labelling responsibilities
Sections 13(1)(b) and 14(b) of the federal *Hazardous Products Act* (HPA) requires that a supplier apply a label to a hazardous product intended for use in a workplace, or to the container in which the hazardous product is packaged. The label must disclose the required information and display applicable hazard symbols.

An application unit is not exempted as a manufactured article under section 5.3(3)(c) of the *Regulation* (section 12(i) of the HPA) because workers are likely to be exposed to the hazardous product during normal conditions of use. The supplier must provide and apply a supplier label on the leased or rented unit. If the label becomes illegible or is accidentally removed from the application unit, the employer must provide and apply a workplace label or a supplier label as required by section 5.8(3) of the *Regulation*. The supplier should be asked to provide a new supplier label as soon as practicable.

G5.8-3 Laboratory sample shipments containing at least two different hazardous products

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.8(1) of the *OHS Regulation* ("*Regulation*") states:

> Subject to any exemptions from labelling requirements in the Hazardous Products Regulations and this Part, an employer must ensure that a hazardous product or the container of a hazardous product received at a workplace is attached or printed with a supplier label.

Purpose of guideline
The purpose of this guideline is to clarify the requirements for laboratory sample shipments containing at least two different hazardous products.

Laboratory samples
Part 5 of the *Hazardous Products Regulations* specifies, amongst other requirements, the packaging of a laboratory sample of a hazardous product which may be exempt from the application of paragraph 13(1)(b) or 14(b) of the *Hazardous Products Act*. Section 3.5 of the *Hazardous Products Regulations* provides an exemption for the labelling of at least two different hazardous products in a single outer container.

The following procedures will satisfy supplier and employer responsibilities for labelling sample shipments containing at least two different hazardous products to an outside laboratory:

- The supplier ensures the outer container bears a Workplace Hazardous Materials Information System (WHMIS) supplier label. The label must provide, in addition to other required information items, the identity of *all* hazardous products known or suspected to be contained in the enclosed samples.
- The supplier ensures the container is provided with a lab analysis requisition form or equivalent which describes which inner containers contain, or are suspected to contain, hazardous products. If a requisition form does not call for analysis of the hazardous product in question, specific information on the ingredient must still be provided. For example, a blood sample submitted for a white cell count from a patient infected with hepatitis, must be accompanied by information on the microorganism.
- The supplier and employer establish an agreement in writing which covers the above two points and provides the employer's assurance of the following:
    - Neither the samples nor any supplier information will be removed from the outer container prior to physical receipt by the lab department within the organization which receives shipment
    - An information system is established in the lab, which ensures that each lab worker who could be exposed to a hazardous product in any inner container knows the information, which would otherwise be required on a WHMIS label applied to the inner container. This could be accomplished, for example, by informing the worker about the supplier identifier and emergency number combined with a means of identifying the specific hazardous ingredient in the lab sample.

G5.14-1 Supplier safety data sheet (SDS)

Issued August 1999; Retired May 9, 2014

G5.14-2 Fees

Issued August 1999; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.14(2) of the *OHS Regulation ("Regulation")* states:

> When a supplier SDS obtained under subsection (1) for a hazardous product is 3 years old, the employer must obtain from the supplier an up-to-date supplier SDS in respect of any of that hazardous product in the workplace at that time.

Purpose of guideline
The purpose of this guideline is to clarify when suppliers are not permitted to charge a fee for a safety data sheet (SDS).

Where fees are prohibited
If, under sections 13 or 14 of the *Hazardous Products Act*, a supplier is required to provide an SDS as a condition of sale or importation to a workplace, a supplier may not charge the purchaser a fee for the SDS. This applies to the SDS sent out with the first shipment or where an employer requests an updated SDS, in conformity with section 5.14(2) of the *Regulation*.

Where fees are not prohibited
However, where an employer is required to obtain an SDS for a hazardous product purchased prior to a supplier compliance point, legislation does not prohibit the supplier from charging a fee for an SDS. In addition, a fee may be legally charged where a supplier provides an SDS to an employer for product partially or completely exempt from Workplace Hazardous Materials Information System (WHMIS) pursuant to section 12 of the *Hazardous Products Act* (e.g., pesticides or restricted products being sold as consumer products). However, WorkSafeBC does not condone the practice of charging fees for an SDS in any circumstance. All instances of fees for an SDS are to be brought to the attention of the

WHMIS Coordinator.

G5.15 Laboratory SDS

Issued August 1999; Editorial Revision May 9, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.15(2) of the *OHS Regulation* ("*Regulation*") states:

> For the purpose of subsection (1), "produces" does not include the escape of a hazardous product from equipment or from another product nor does it include intermediate products undergoing reaction within a reaction or process vessel.

Purpose of guideline
The purpose of this guideline is to clarify the circumstances in which safety data sheets (SDS) are required for hazardous products produced and used by an employer in a laboratory.

Hazardous products used in laboratories

- Hazardous products produced for immediate use in a reaction or which are produced and consumed in a reaction do not require production of an SDS. Such hazardous products must be used immediately, be used in total, and be consumed entirely during the reaction.
- An SDS must be available as required by legislation on all hazardous products which are components of mixtures produced in laboratories.
- For mixtures other than those intended for immediate use, a new SDS for the mixture must be produced if either of the following occur:
  - The hazard of the mixture is different from the hazard of the ingredients separately
  - The precautionary information reported on the SDS for ingredients is in conflict (for example, a different type of protective gloves or respiratory protection is recommended for each individual component of the mixture)

A new SDS will not be required for dilutions with water and mixtures in which hazards and precautions are generally unchanged from those of the ingredients.

G5.22 Covers

Issued August 1999; Editorial Revision August 2004; Editorial Revision April 6, 2020; Editorial Revision February 3, 2022

Regulatory excerpt
Section 5.22 of the OHS Regulation ("*Regulation*") states:

> If an open container of a hazardous substance could pose a hazard, the container must be kept sealed or covered when not in use.

Purpose of guideline
The purpose of this guideline is to outline that if an open container of a hazardous substance (as defined in section 13 of the *Workers' Compensation Act*) could pose a hazard, section 5.22 of the *Regulation* provides that the container must be kept sealed or covered when not in use.

Determination if a hazard is present
To determine if a hazard is present, an assessment should be conducted which takes into consideration the substance's chemical properties (such as flammability, stability, reactivity, incompatibility, corrosivity, and/or volatility) and physical properties (such as physical state — liquid vs. solid — boiling point, and/or freezing point). The container's stability should be considered (refer to section 5.25 of the *Regulation* and OHS Guideline G5.25), as well as the volume of the material relative to the room space.

Substances to cover
In general, the following substances should be covered when not in use:

- Flammable solvents
- Oxidizing agents
- Reducing agents
- Strong acids and caustics
- Volatile and toxic solvents
- Combustible liquids

G5.25 Storage practices

Issued August 1999; Editorial Revision January 1, 2009; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.25 of the *OHS Regulation* ("*Regulation*") states:

> A hazardous substance must be stored in a designated area, in a manner which ensures that it will not readily fall, become dislodged, suffer damage, or be exposed to conditions of extreme temperature.

Purpose of guideline
The purpose of this guideline is to clarify the requirements for the storage of hazardous substances.

Storage requirements
Section 5.25 of the *Regulation* requires that a hazardous substance be stored "in a designated area, in a manner which ensures that it will not readily fall, become dislodged, suffer damage, or be exposed to conditions of extreme temperature." The term "suffer damage" includes damage to the substance resulting from chemical instability such as peroxidation, as well as exposure to light, shock, or vibration. Under section 5.24, incompatible substances must not be stored "in a manner that would allow them to mix in the event of container leakage, breakage or other such circumstance." For information on chemical stability and incompatibilities, the appropriate safety data sheet (SDS) should be referenced.

The general training and work procedure requirements of section 5.2(d) of the *Regulation* also apply.

G5.27 Ignition sources - Combustible liquid normally used as fuel

Issued consequential to December 1, 2021 Regulatory Amendment

Regulatory excerpt
Section 5.27 of the OHS Regulation ("*Regulation*") states:

> (1) When a combustible liquid normally used as fuel, a flammable gas or a flammable liquid is handled, used or stored, all sources of ignition must be eliminated or adequately controlled.
>
> (2) For the purposed of subsection (1) sources of ignition include open flame, spark-producing mechanical equipment, welding and cutting processes, smoking, static discharge and any electrical equipment or installation that is not permitted under the B.C. Electrical Code for use in hazardous locations.
>
> (3) If the work involves more than one employer, the prime contractor or, if there is no prime contractor, the owner must ensure that sources of ignition resulting from the work of one employer are eliminated or adequately controlled in any work area where a combustible liquid normally used as fuel, a flammable gas or a flammable gas or a flammable liquid is handled, used or stored by any other employer.

Purpose of guideline
The purpose of the guideline is to provide examples of "combustible liquid normally used as fuel" that when handled, used, or stored, must have all sources of ignition eliminated or adequately controlled in accordance with section 5.27 of the *Regulation*.

Examples of "combustible liquid normally used as fuel"
"Combustible liquid" is defined in section 1.1 of the *Regulation* as a liquid that has a flash point at or above 37.8°C and below 93.3°C. Requirements of section 5.27 apply to a combustible liquid normally used as fuel because of its risk of fire or explosion given its relatively low flash point that is approaching the flammable range.

Some common examples of combustible liquids normally used as fuel and their flash points ranges taken from safety data sheets of manufacturers include the following:

Combustible liquids normally used as fuel	Approximate flash point ranges
Diesel	>40°C
Kerosene	38-72°C
Jet fuel	38-62°C

To determine if a liquid is a "combustible liquid normally used a fuel," the flash point of the liquid is within the definition of combustible liquid and its use is normally as fuel. If a combustible liquid is normally used as fuel, then the requirements of section 5.27 would apply to that liquid regardless of how it is being used at that particular workplace.

For example, section 5.27 would apply to diesel fuel even when it is being used as a cleaning solvent because it is normally used as fuel.

Combustible liquids such as lubricants and frying oil are not included in the scope of this requirement because they are not normally used as fuel. These substances have a higher flash point and, therefore, a lower risk to cause a fire or explosion.

G5.27(2) Electrical Safety Act *repealed*

Issued August 13, 2008; Retired November 2, 2016

This guideline is no longer required.

G5.28 Bonding or grounding of containers - Ensuring effectiveness

Issued consequential to December 1, 2021 Regulatory Amendment

Regulatory excerpt
Section 5.28 of the OHS Regulation ("*Regulation*") states:

> If a metallic or other conductive container is used to transfer a combustible liquid normally used as fuel, a flammable liquid or a flammable gas to another metallic or other conductive container, the containers must be electrically bonded to each other or electrically grounded while the liquid or gas is being transferred.

Purpose of guideline
The purpose of the guideline is to provide examples of methods used to ensure that the bonding or grounding methods are effective when transferring combustible liquids normally used as fuel, or flammable liquids or gases.

Metallic or other conductive containers
In accordance with section 5.28 of the *Regulation*, metallic or other conductive containers used to transfer combustible liquid normally used as fuel, as well as a flammable gas or liquid, must be bonded to each other or grounded while the liquid or gas is being transferred.

Grounding and bonding
Grounding and bonding are ways to safely dissipate static charge to control the hazard of an ignition of gases and vapours. There are differences between these hazard controls.

Bonding is the use of an additional independent connection method — such as the use of a steel wire — between two conductive objects when this cannot otherwise be ensured. Bonding equalizes the electrostatic charge between the conductive objects, preventing potentially dangerous static sparks between them.

Grounding is a type of bonding where the conductive object is connected to the earth, usually with a conductive wire. Unlike bonding, grounding equalizes the electrostatic charge to that of the earth, which is generally considered to have zero potential, therefore preventing a spark discharge to a grounded object.

Ensuring that bonding and grounding are effective
In accordance with section 5.27 of the Regulation, employers are required to ensure that ignition sources are eliminated or adequately controlled in workplaces where combustible liquids normally used as fuel and flammable gas or liquids are stored, handled, or dispensed. Bonding and grounding are ways to adequately control static discharge.

Confirmation is essential to ensure that the bonding and grounding are effective. Employers should use an electrical continuity tester to verify that the bonding or grounding connections are made and exist before work begins. There have been explosions where a bonding system was not checked for continuity and led to a fatality.

Methods to verify continuity include the following:

- Ensure permanent systems are designed and installed by a competent person, such as an electrical engineer or manufacture representative. The systems are applicable to large, fixed facilities that store, handle, transport and dispense large quantities of flammable liquids or fuels on a regular basis. These systems usually include fail-safe or self-checking equipment that will monitor continuity and arrest the process if grounding and bonding are lost.
- Use an electrical continuity tester to ensure that continuity exists in the grounding and bonding systems. A continuity test must be conducted by a qualified person in accordance with accepted industry practices and standards.

Employers should seek advice of a qualified person to ensure bonding and grounding are effective in controlling the ignition hazard associated with static electricity.

G5.30 Dispensing

Issued August 1999; Retired March 31, 2015

This guideline is no longer required.

G5.32 Manual cleaning - Work procedures

Issued June 26, 2014; Revised consequential to December 1, 2021 Regulatory Amendment

Regulatory excerpt
Section 5.32 of the *OHS Regulation* ("*Regulation*") states:

> A flammable liquid must not be used as a manual cleaning solvent unless
>
> (a) a thorough review of alternative solvents by the employer indicates that a suitable non-flammable substitute is not available,
>
> (b) appropriate written safe work procedures are implemented to effectively control flammability and health hazards,

> (c) the quantity of liquid used is minimized,
>
> (d) the worker is instructed and trained in the safe work procedures, and
>
> (e) the work procedures have been submitted to the Board.

Purpose of guideline

This guideline provides guidance on development of safe work procedures to WorkSafeBC under section 5.32 of the *Regulation*.

Content of safe work procedures

If a thorough review of alternative solvents shows that no suitable non-flammable substitute is available, the employer may use a flammable liquid as a manual cleaning solvent and must develop and implement safe work procedures that effectively control flammability and health hazards.

Safe work procedures should address the following applicable factors:

- Required storage location and conditions for the solvent, including transportation from one work site to another
- Labelling and signage requirements for storage and working containers
- Minimizing the quantities of flammable solvent used for manual cleaning
- Reference to the availability of the safety data sheet
- Means of elimination or control of all ignition sources during use and storage of the solvent, including ignition sources in workplaces of other employers where the solvent is being used
- Potential for migration and flashback of solvent vapours
- Requirements for bonding and grounding during storage and dispensing
- Control of hazards described in the safety data sheet, including:
    - means of ensuring control of worker exposures to the solvent (e.g., exposure monitoring, ventilation, respiratory protection)
    - required personal protective equipment (e.g., gloves, goggles, face shield, respirator)
- Instructions for safe use of the solvent, including prep work, location of use, means and method of application of the solvent, cleanup procedures, and waste disposal
- The procedures should also address how workers are educated on the hazards and trained on protective measures (e.g., fit-testing, drills, WHMIS)
- Incident response (e.g., spills, failure of ventilation, fire)
- Locations and availability of emergency supplies (e.g., fire control, spill control, eye-wash, first aid supplies and service)

These factors do not address all workplace hazards, and employers need to ensure that the health and safety program addresses all hazards. The procedures need to include consideration of protection for workers of the employer as well as any other workers present at a workplace where the flammable cleaning solvent is used.

The *Regulation* requires that workers are instructed and trained in the safe work procedures.

G5.38 Handling and securing containers

Issued August 1999

Regulatory excerpt

Section 5.38 of the *OHS Regulation* ("*Regulation*") states:

> (1) A compressed gas cylinder must not be hoisted by a sling or magnet, dropped, subjected to impact, handled by the regulator or used as a roller or work support.
>
> (2) A compressed gas cylinder must be secured to prevent falling or rolling during storage, transportation and use, and where practicable, must be kept in the upright position.

Purpose of guideline

The purpose of this guideline is to outline that section 5.38(2) of the *Regulation* requires that a compressed gas cylinder be secured to prevent falling or rolling during storage, transportation and use. Where practicable, the cylinder must be kept in the upright position.

Achieving compliance

Compliance with this section can be achieved by either of the following:

- Chaining the cylinders to a secure object (a method typically used by welding shops, machine shops, and other employers handling cylinders in relatively small numbers)
- Using the "interlock" method of storing cylinders (a method used by gas manufacturers, distributors, transfill depots, subdivisions and company depots, or other member companies of the Compressed Gas Association)

As shown in the Figure below (this is an overhead or "bird's eye" view), the interlock method consists of dovetailing the cylinders into a cohesive unit. This method is acceptable when cylinders are in an area shipping or receiving a large number of cylinders.

G5.48-1 Table of exposure limits - Background information

Issued October 29, 2003; Revised February 11, 2004; Revised February 4, 2005; Revised September 1, 2010; Retired September 25, 2019

This guideline is retired as it was merged with G5.48-2.

G5.48-2 Exposure limits and the review process

Issued October 29, 2003; Revised February 11, 2004; Revised February 4, 2005; Revised April 29, 2005; Revised November 28, 2008; Revised July 1, 2009; Revised September 1, 2010; Revised May 1, 2013; Revised September 25, 2019

Regulatory excerpt
Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Section 5.1 of the *Regulation* defines ACGIH as follows:

> "ACGIH" means
>
> (a) the American Conference of Governmental Industrial Hygienists publication entitled *Threshold Limit Values and Biological Exposure Indices, dated 2002*, as amended from time to time, or
>
> (b) The American Conference of Governmental Industrial Hygienists publication entitled *Documentation of the Threshold Limit Values and Biological Exposure Indices*, as amended from time to time;

Purpose of guideline
This guideline provides background information on exposure limits as well as outlines the review process WorkSafeBC follows for reviewing and revising exposure limits of chemical substances.

Background information
An exposure limit is a maximum allowed airborne concentration for a substance that no worker is to be exposed above it. These exposure limits may include an 8 hour time-weighted average concentration, a short-term (15-minute) exposure limit, or a ceiling limit.

An exposure limit is not intended to represent a fine line between safe and harmful conditions. In determining an exposure limit, it is not possible to take into account all factors that could influence the effect that exposure to the substance may have on an individual worker. Therefore, for all hazardous substances, regardless of any assigned exposure limit, the guiding principle is elimination of exposure or reduction to the lowest level that is reasonably achievable below the exposure limit.

Due to a wide variation in individual susceptibility, some workers may experience discomfort from some substances at concentrations at or below the exposure limit. Others may be affected more seriously by aggravation of a pre-existing condition, or by development of an occupational disease. Furthermore, other workplace contaminants may affect an individual's response. The effects of combined chemical exposures are often unknown or poorly defined.

Exposure limit review process
The ACGIH conducts scientific reviews of chemical substances with the purpose of confirming or revising existing Threshold Limit Values (TLVs). ACGIH publishes a list of new or revised TLVs annually. WorkSafeBC generally uses the TLVs established by ACGIH to determine exposure limits. Exposure limits that differ from the ACGIH TLVs are presented on the Table of Excluded Substances in OHS Policy Item: R5.48-1 which includes the following:

- Those substances for which a TLV is currently not considered feasible for B.C. workplaces
- Those substances, previously listed in the former Table 5-4 of the *Regulation* (prior to 2002), that had lower exposure limits than the corresponding ACGIH TLV at the time
- Those substances, previously listed in the former Table 5-4 of the *Regulation* (back in 2002), that the ACGIH does not currently have a TLV for

For general information on how WorkSafeBC determines exposure limits, refer to Regulating Chemical Exposure.

The procedure for adopting new or revised exposure limits is described in WorkSafeBC's Exposure Limit Review Process for Chemical Substances. For questions about the exposure limit review process, contact WorkSafeBC's Policy, Regulation and Research division.

WorkSafeBC maintains a Table of Exposure Limits for Chemical and Biological Substances which lists all substances with a B.C. exposure limit prescribed under section 5.48 of the *Regulation*. This table has been created for convenience to promote public awareness; however, it does not represent the official version of the exposure limits and designations. Although WorkSafeBC regularly updates the table as necessary, it does not guarantee the accuracy or completeness of the information in this table since the contents of the table are constantly being revised by ACGIH or International Agency for Research on Cancer (IARC). For questions about the Table of Exposure Limits, email WorkSafeBC's Prevention Practice, Quality, and Engineering department.

G5.48-3 Normal 8-hour work period

Issued originally as G5.48-2 August 1, 1999; Revised October 29, 2003

Regulatory excerpt
Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Section 5.1 of the *Regulation* defines "8-hour TWA limit:"

> "8-hour TWA limit" means the time weighted average (TWA) concentration of a substance in air which may not be exceeded over a normal 8 hour work period.

Purpose of guideline
The purpose of this guideline is to explain a normal 8-hour work period as it applies to section 5.48 of the *Regulation*.

Computation of an 8-hour work period
For an 8-hour TWA, a normal 8-hour work period will generally refer to a routine shift length of no more than 8 hours, over which exposure to an air contaminant occurs. In computing the TWA breaks should be included if there is significant exposure during the breaks, but not otherwise. For example, in the case of a routine shift length of 8 hours with an additional half-hour or three quarter-hour lunch break, the 8-hour work period is the TWA period, if there is no significant exposure over the lunch break. If significant exposure occurs during the lunch break, then the work period should be considered more than 8 hours and the exposure reduction factors stipulated in section 5.50 need to be applied. Note that 15-minute paid breaks (such as coffee breaks) should be included in the exposure period.

Refer to OHS Guideline G5.50 for assistance in applying the reduction factors.

G5.48-4 Conversions for ppm and mg/m^3

Issued originally as G5.48-3 August 1, 1999; Revised February 11, 2004; Editorial Revision September 21, 2012

Regulatory excerpt

Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Purpose of guideline
This guideline explains how to convert exposure limits between ppm and those in mg/m^3.

Exposure limit conversions
The ACGIH's *Threshold Limit Values and Biological Exposure Indices* provides instructions for converting the exposure limit (8-hour TWA limit or STEL or ceiling) for gases and vapours from parts per million (ppm) to milligrams per cubic metre (mg/m^3). This might be used in situations where a substance in measured or listed in milligrams per cubic metre and the Table of Exposure Limits for Chemical and Biological Substances lists that substance in parts per million.

To convert a known exposure limit in ppm to the equivalent exposure limit in mg/m^3, use the following formula:

$$\text{Exposure limit in mg/m}^3 = \frac{\text{(limit value in ppm)(gram molecular weight of substance)}}{24.45}$$

Conversely, the following formula converts a known exposure limit in mg/m^3 to the equivalent exposure limit in ppm:

$$\text{Exposure limit in ppm} = \frac{\text{(limit value in mg/m}^3\text{)(24.45)}}{\text{gram molecular weight of substance}}$$

Molecular weights can be found in the *NIOSH Pocket Guide to Chemical Hazards*, chemical supplier lists, the *NIST Chemistry WebBook* or other online databases.

The numeric value of 24.45 in both formulae is the molar volume of air in litres at normal temperature and pressure (NTP), which is considered to be 25°C and 1 atmosphere (101.325 kPa or 760 mm Hg or 760 torr). Note that this is not the same as *standard* temperature and pressure (STP), which is 0°C and 1 atmosphere.

If when dealing with measurements at NTP then it is necessary to calculate the molar volume of air for a temperature and pressure other than NTP and substitute this calculation for 24.45. Methods for calculating molar volumes can be found in standard occupational hygiene reference books such as those listed in OHS Guideline G5.53-4.

G5.48-5 Welding fumes

Issued originally as G5.48-4 August 1, 1999; Revised February 11, 2004; Revised August 3, 2006; Editorial Revision January 1, 2009; Editorial Revision consequential to August 4, 2015 Regulatory Amendment; Revised March 14, 2024

Regulatory excerpt

Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Purpose of guideline

This guideline explains that welding fumes are of variable composition and provides information on substances that may be present. It also discusses the sources of information on welding fumes and how to determine applicable exposure limits. The term "welding" includes thermal cutting and allied processes such as brazing.

Welding fume composition

Establishing a workerâ€™s exposure to hazardous substances in welding fumes is not a simple matter since this depends on the material being welded as well as the process and electrodes being used. Welding fumes may contain fluoride, and metals or oxides of metals such as aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, hexavalent chromium, cobalt, copper, iron, lead, manganese, nickel, silver, tin, titanium, vanadium, and zinc.

Apart from welding fumes, hazardous levels of gases — including carbon monoxide, oxides of nitrogen, or ozone — may also be present during welding. In addition, there may be a risk of asphyxiation when shielding gases such as argon are used, particularly in an enclosed or confined space. Decomposition products such as phosgene can form when coatings or residues on or near the object being welded are heated.

Sources of information on welding fumes

To determine the potential level of exposure to welding fumes, a systematic review of the base metal, consumables, and type of process is required. Typically, information on consumables is identified by reviewing documents such as the safety data sheets (SDSs) from the manufacturer. Other information, such as the composition of the metal(s) being welded or cut, the specific type of welding process, and other relevant information (e.g., current and voltage) should be gathered to assess the hazardous ingredients and expected products of reaction and decomposition.

Exposure limits

Once the information on possible exposures has been determined, the Table of Exposure Limits for Chemical and Biological Substances should be consulted for the applicable exposure limit(s).

The employer must comply with the exposure limit for each of the individual constituents in the welding fume. The exposure limits for Particles Not Otherwise Classified (PNOC) of 8-hour TWA of 10 mg/m^3 and respirable fraction of 3 mg/m^3 do not apply as total welding fume exposure limits since welding fumes are not considered to be â€œnuisance dust.â€ For more information, refer to OHS Guideline G5.48-7 Nuisance dusts. An additive exposure limit, as established in section 5.51 of the *Regulation*, may apply if two or more of these hazardous substances demonstrate similar toxicological effects. Refer to OHS Guideline G5.51 for further information.

Note that sections 12.115 (Coatings on metals) and 12.117 (Silver solder) of the *Regulation* address issues respectively of coatings on metals, and cadmium in silver solder.

Controlling exposure to designated substances

The International Agency for Research on Cancer (IARC) has categorized welding fumes as a Group 1 carcinogen since there is sufficient evidence of carcinogenicity (cancer causing) of welding fumes in humans. Among the findings, the IARC determined that exposure to welding fumes and ultraviolet (UV) radiation from welding are carcinogenic to humans. This includes exposures to mild steel welding fumes that can cause lung cancer and possibly kidney cancer. Section 5.57(1) of the *Regulation* refers to a substance identified as an IARC 1 carcinogen to be a designated substance.

The employer must replace substances identified as a designated substance, if practicable, with a material that reduces the risk of exposure to workers. If it is not practicable to substitute a material, then the employer must implement an exposure control plan in accordance with section 5.54 to maintain workersâ€™ exposure as low as reasonably achievable below the exposure limit.

Some of the individual constituents of welding fumes are also designated substances. Some of the common designated substances in welding fumes are listed below:

Material	Health effects
Hexavalent chromium oxide	Sensitizer
Beryllium oxides	Carcinogen, sensitizer
Manganese oxides	Reproductive toxin
Cadmium oxide	Carcinogen
Nickel - soluble and insoluble inorganic compounds	Carcinogen

G5.48-6 Allergenic species of wood dust

Issued originally as G5.48-5 August 1, 1999; Revised February 11, 2004

Regulatory excerpt
Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Purpose of guideline
The purpose of this guideline is to clarify the types of wood species considered to be allergenic for the purposes of wood dust â€“ allergenic species as referenced in Policy Item R5.48-1.

Allergenic species of wood dust
The Table of Exposure Limits for Excluded Substances in Policy Item: R5.48-1 of the OHS Policies includes a listing for wood dust — allergenic species. (As noted in OHS Guideline G5.48-2, substances with exposure limits that are *not* the current ACGIH TLVs are listed in the Table of Exposure Limits for Excluded Substances in this policy. They are included in the Table of Exposure Limits for Chemical and Biological Substances.) For the purposes of Policy Item R5.48-1, the following table of wood species should be considered allergenic for the purposes of "wood dust — allergenic species."

Wood Species Considered to be Allergenic

Common name	Species name
Softwood	
Western red cedar	Thuja plicata
California redwood	Sequoia sempervirens
Cedar of Lebanon	Cedra libani
Eastern white cedar	Thuja occidentalis
Hardwood	
Oak, European	Quercus robur
Beech	Fagus spp.
Ash	Fraxinus americanum
Tropical Wood	
Abirucana	Pouteri
African maple	Triplochiton scleroxylon
African zebra	Microberlinia
Cabreuva	Myrocarpus fastigiatus
Central American walnut	Juglans olanchana
Cocabolla	Dalbergia retusa
Common name unavailable	Tanganyika aningre
Ebony, African	Diospyros crassiflora
Iroko or Kambala	Chlorophora excelsa
Fenambouk	Caesalpinea echinata
Kejaat	Pterocarpus angolensis
Kobite	Nesorgordonia papaverifera
Mahogany, African	Khaya spp.
Makore	Tieghemella hecklii
Quillaja bark	Species name unavailable
Pau Marfim	Balfourodendron riedelianum
Ramin	Gonystylus bancanus

This list is derived from Chan-Yeung, M, Malo, J-L, "Aetological Agents in Occupational Asthma," *European Respiratory Journal*, Volume 7, 1994 (pp. 346-371).

G5.48-7 Nuisance dusts

Issued August 16, 2000; Revised February 11, 2004; Revised November 23, 2005; Editorial Revision October 28, 2019

Regulatory excerpt
Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

(TWA refers to time-weighted average, and ACGIH refers to American Conference of Governmental Industrial Hygienists.)

Purpose of guideline
The term "nuisance dust" has been used for years to describe a group of dusts with similar effects on people. Nuisance dusts are insoluble or poorly soluble in water and do not cause toxic effects on humans other than by inflammation of the respiratory tract or by accumulation of material in the lung (lung overload).

Exposure limits for nuisance dusts involve additional terms such as "total dust," "respirable dust," and "Particles not otherwise classified PNOC)." This guideline explains the use of these terms. It also provides information on the exposure limits for PNOC and various nuisance dusts.

In addition, the guideline provides some technical information on a relatively new term that has begun to be used to describe dusts - "inhalable" particulate.

Total and respirable dusts
Historically, particulates in the air have been measured as "total dust." This term refers to dusts with a wide range of particle sizes capable of being deposited in the various regions of the human respiratory tract, from the nose and throat down into the gas exchange area of the lung.

Dusts have also been measured as "respirable dusts," which refers to the portion of total dust that is capable of passing through the upper respiratory tract and then being deposited in the gas exchange area of the lung.

Many nuisance dusts have an 8-hour TWA exposure limit of 10 mg/m^3 for total dust, as shown in the Table of Exposure Limits for Chemical and Biological Substances (the Table). Examples include aluminum oxide, calcium sulfate, cellulose, emery, gypsum and Portland cement.

Such substances also have an 8-hour TWA of 3 mg/m^3 for the respirable fraction of the dust. These substances are flagged in the Table with an End Note (N) which explains that an exposure limit based on the respirable fraction also applies.

PNOC (Particles not otherwise classified)
PNOC are nuisance dusts that have not been assigned individual exposure limits. PNOC may arise in various circumstances, for example, some roadwork operations, grinding acrylics and buffing nails. PNOCs are assigned a TWA of 10 mg/m^3 for the total dust, and a TWA of 3 mg/m^3 for the respirable fraction.

Additional technical information - Inhalable particulate
Exposure limits adopted by WorkSafeBC are based in part on the threshold limit values of the ACGIH. The concept of "inhalable dust," which has been developed by the ACGIH, refers to dusts that can be deposited anywhere in the respiratory tract. Although it is similar to the concept of "total dust," it is considered to more accurately describe the range of particle sizes that are deposited.

Substances that have been reviewed by the ACGIH, and for which exposure limits based on "inhalable" dust have been adopted by WorkSafeBC, include magnesium oxide, molybdenum (metal and insolubles), and silicon carbide (non-fibrous). Over time, the ACGIH will continue to review the application of "inhalable" to other substances. As changes are adopted by WorkSafeBC they will be reported in the Table of Exposure Limits for Chemical and Biological Substances.

G5.48-8 Simple asphyxiants - Inert gases or vapours

Issued October 29, 2003; Revised February 11, 2004

Regulatory excerpt
Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Regulatory excerpt
The purpose of this guideline is to define asphyxiants as they apply to section 5.48 of the *Regulation*.

Simple asphyxiants
A number of gases and vapours, such as acetylene, argon, and nitrogen, when present in high concentrations in air, act primarily as simple asphyxiants without other significant physiological effects. (A simple asphyxiant is a substance that can displace oxygen in the air, resulting in suffocation from lack of oxygen.) The ACGIH does not assign a TLV, or exposure limit, because the limiting factor is the available oxygen in air, not the toxic nature of the substance itself. These substances are identified as "simple asphyxiants" in the STEL column of the Table of Exposure Limits for Chemical and Biological Substances.

Oxygen-deficient atmosphere
An "oxygen-deficient" atmosphere is defined in section 1.1 of the *Regulation* as air with less than 19.5% oxygen by volume, or where the partial pressure of oxygen is less than 16.3 kPa (122 mm Hg). Oxygen-deficient atmospheres do not provide adequate warning, and most asphyxiants are odourless. Note that several of the simple asphyxiants are highly flammable and can present explosion hazards, and under section 5.31 of the

Regulation employers must take account of this factor in limiting the concentration of the asphyxiant. Also note that the requirements of sections 5.27, 5.13, and 5.56 of the *Regulation* apply.

G5.48-9 Measuring compliance with the exposure limits

Issued originally as G5.48-6; August 1, 1999; Revised October 29, 2003

Regulatory excerpt
Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Purpose of guideline
The purpose of this guideline is to outline the protocol for WorkSafeBC prevention officers in establishing compliance with this section and is based largely on operating procedures previously practiced by prevention officers. These follow recognized occupational hygiene principles. For further guidance on workplace monitoring, walkthrough surveys, and monitoring worker exposure, refer to OHS Guidelines G5.53-1 to G5.53-3.

Sampling
Prevention officers will not normally perform sampling if the employer has an acceptable workplace monitoring program in place indicating that exposures are within the applicable exposure limits. In addition, prevention officers will normally not sample for compliance purposes during temporary or emergency conditions, where exposures may be higher than normal. Prevention officers may elect to conduct air sampling if they suspect that a problem exists and the employer has failed to conduct an exposure assessment or has an inadequate exposure-monitoring program. Additional circumstances under which a prevention officer may be required to sample are outlined in OHS Guidelines G5.53-1 to G5.53-3.

Typically, the prevention officer will select the worker or workers with the highest suspected exposures and conduct sampling during worst-case scenarios, such as during periods when activities or activity levels expected to result in the highest exposure are underway. In accordance with established occupational hygiene principles, compliance with exposure limits is determined by comparing the 95% upper and lower confidence limits of the mean exposure of a similarly exposed group to the exposure limit. The 95% upper and lower confidence limits represent a range of reasonable values that are intended to contain the average exposure level with 95% confidence. That is, one can be 95% confident that the upper and lower confidence limits will cover the mean exposure.

If only one sample is collected, sampling and analytical error must be accounted for. Use the coefficient of variation specified for the sampling method and follow the confidence limit guideline as described below. Contact the Risk Analysis Unit of WorkSafeBC at riskanalysisunit@worksafebc.com for information regarding the coefficient of variation for the analytical method of interest.

Exposure limits
Formulae for calculating the upper and lower confidence limits can be found in standard occupational hygiene references. The references that are acceptable to WorkSafeBC are listed in OHS Guideline G5.53-4.

The guidelines for compliance with the exposure limits using the 95% confidence limits are outlined below.

- If the average exposure does not exceed the exposure limit and the upper confidence limit (UCL) is less than the exposure limit, then there is more than 95% confidence that the employer is in compliance.
- If the average exposure is greater than the exposure limit and the lower confidence limit (LCL) is also greater than the exposure limit, then there is more than 95% confidence that the employer is in non-compliance.
- If the average exposure does not exceed the exposure limit, but the upper confidence limit exceeds the exposure limit, there is not 95% confidence that the employer is in compliance. Similarly, if the measured exposure exceeds the exposure limit, but the lower confidence limit is below the exposure limit, there is not 95% confidence that the employer is in non-compliance. For both of these situations, there is a "possible over-exposure." Note that the closer the lower confidence limit comes to exceeding the exposure limit, the more probable it becomes that the results are not in compliance. To more definitely determine whether the exposure levels are within compliance, further sampling is needed.

Background
An officer may elect to sample on the employer's behalf or may require the employer to conduct the sampling under the provisions of section 5.53 of the *Regulation*. Refer to OHS Guidelines G5.53-1 to G5.53-3 for further information.

Guidelines for compliance are shown schematically in the figure below.

G5.48-10 Use of indicator tubes to measure compliance

Issued originally as G5.48-7 August 1, 1999; Revised February 11, 2004; Editorial Revision September 28, 2022

Regulatory excerpt

Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Purpose of guideline

The purpose of this guideline is to provide guidance on using colourimetric indicator tubes for assessing worker exposure.

Colourimetric indicator tubes

These devices are limited with regard to applicability, specificity, and accuracy. Their primary intention is for screening exposures and the user must be familiar with these critical limitations if proper judgments are to be made, particularly in the matter of assessing compliance. Indicator tubes should meet the criteria established by ANSI/ISEA 102-1990 (R2015). An independent testing agency, the Safety Equipment Institute (SEI), is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC). The SEI certifies a manufacturer's indicator tube if it meets the minimum requirement set out in the standard, as follows:

± 35% accuracy at one-half the exposure limit, and

± 25% at one, two, and five times the exposure limit.

Adherence to a quality assurance plan is verified by testing samples obtained from the supplier. Users of these indicator tubes should take into consideration potential interferences identified by the manufacturers that can affect the results. Contact the Risk Analysis Unit of WorkSafeBC at riskanalysisunit@worksafebc.com for further information.

Exposure limits

When reading an indicator tube, it should be interpreted with ±25% of the indicated reading if the reading is in the vicinity of the exposure limit unless several grab samples are taken to increase the statistical confidence, in accordance with acceptable occupational hygiene statistical practice. Indicator tubes can be used to measure non-compliance with either short-term exposure limits or ceiling limits. In the case of a single grab sample by detector tube, if the reading exceeds either the short-term exposure limit or the ceiling limit by 25%, there is sufficient evidence of non-compliance with the exposure limit. If the indicator tube reading is close to the short-term exposure limit or ceiling limit (within 25±% of the limit), and if it appears that an overexposure may exist, other more reliable sampling methods should be used before a decision is made. Refer to OHS Guideline G5.48-9 for additional information on determining whether there is compliance with the exposure limits.

When reading an indicator tube ±25% of the indicated reading if the exposure level is in the vicinity of the exposure limit unless several grab samples are taken to increase the statistical confidence, in accordance with acceptable occupational hygiene statistical practice. Indicator tubes can be used to measure non-compliance with either short-term exposure limits or ceiling limits. In the case of a single grab sample by detector tube, if the reading exceeds either the short-term exposure limit or the ceiling limit by 25%, there is sufficient evidence of non-compliance with the exposure limit. If the indicator tube reading is close to the short-term exposure limit or ceiling limit (within 25±% of the limit), and if it appears that an overexposure may exist, other more reliable sampling methods should be used before a decision is made. See also OHS Guideline G5.48-9 for guidelines on determining whether there is compliance with the exposure limits.

Readings from a short-term indicator tube should be compared to the appropriate short-term exposure limits in the Table of Exposure Limits for Chemical and Biological Substances (such as a short-term exposure limit or a ceiling limit). They should not be compared to 8-hour TWA limits. In addition, 8-hour time-weighted averages must not be calculated from results obtained using short-term indicator tubes.

Long-term indicator tubes connected to a sampling pump may be used to determine 8-hour time-weighted averages. These averages are then compared to the appropriate 8-hour TWA limit in the Table of Exposure Limits for Chemical and Biological Substances.

G5.48-11 Sampling of thoracic fraction of sulfuric acid mist

Retired on July 6, 2007

G5.48-12 Establishing exposure limits for certain refined hydrocarbon mixtures

Issued July 1, 2009; Revised February 4, 2010; Editorial Revision consequential to August 4, 2015 Regulatory Amendment; Editorial Revision October 28, 2019

Regulatory excerpt

Section 5.48 of the *OHS Regulation* ("*Regulation*") states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

(TWA refers to time-weighted average, and ACGIH refers to American Conference of Governmental Industrial Hygienists.)

Purpose of guideline

This guideline provides an explanation of the means to determine exposure limits for certain refined hydrocarbon solvent mixtures such as rubber solvent and VM ; P Naphtha. Hydrocarbon solvents affect the central nervous system and can cause a variety of symptoms including dizziness, drowsiness, and eye and respiratory tract irritation.

Note: Due to the complexities inherent in the use and interpretation of the Reciprocal Calculation Procedure (RCP), it will usually be necessary for an occupational hygiene professional to be involved in its application. The ACGIH publication *Threshold Limit Values and Biological Exposure Indices* should be consulted during application of this procedure.

Background

The majority of WorkSafeBC exposure limits (EL) are for single substances (e.g. toluene) or for substances containing a common element (e.g. tungsten metal and insoluble compounds). These exposure limits are those prescribed by ACGIH or as otherwise determined by WorkSafeBC. They are shown in the WorkSafeBC Table of Exposure Limits for Chemical and Biological Substances.

Refined hydrocarbon solvents, such as Rubber Solvent and VM ; P Naphtha, are complex mixtures produced by the distillation of petroleum over a particular boiling range. They consist of aliphatic (alkane), cycloaliphatic (cycloalkane), and aromatic hydrocarbons ranging from 5 to 15 carbon atoms in each molecule. The use of the mixture formula expressed in *Regulation* section 5.51, which takes additive effects into consideration, is difficult in these cases because these petroleum mixtures contain a large number of unique compounds and isomers, many of which do not have specific exposure limits. Because there are very many possible combinations of the various alkane, cycloalkane, and aromatic mixtures, it is necessary to calculate an exposure limit for each combination rather than list all possible calculated exposure limits in the Table of Exposure Limits for Chemical and Biological Substances.

The ACGIH has developed a means to calculate an exposure limit for specific refined hydrocarbon solvents, and has published the method (RCP) in Appendix H of the ACGIH publication *Threshold Limit Values and Biological Exposure Indices*, since 2009. The remainder of this guideline explains WorkSafeBC's adoption of this method and provides example calculations.

Reciprocal Calculation Procedure

The RCP is a method for deriving exposure limits (EL) for refined hydrocarbon solvents. This method is applicable if the toxic effects of the individual chemical components are additive (e.g., similar effects on the same organ or system).

The RCP calculation can only be applied to petroleum-based hydrocarbon solvents containing saturated aliphatics (alkanes and cycloalkanes) and aromatics with 5 to 15 carbon atoms and boiling points between 35°C and 329°C. Substances in the Table of Exposure Limits (e.g., refer to Rubber Solvent, VM ; P Naphtha) for which the RCP calculation applies are identified with an "(H)." The procedure would not apply for petroleum fuels, lubricating oils, solvents, or solvent mixtures that already have an EL (e.g., benzene has its own EL and would have to be considered separately).

The RCP formula calculates an EL based on the following:

- The mass composition of the mixture
- Hydrocarbon group "guidance values"
- Substance-specific ELs, where applicable

Note: The RCP does not apply to benzene, n-hexane, or methylnaphthalene, which have individual ELs significantly less than the guidance values to which they would belong and have unique toxicological properties. Whenever present in the mixture, these components should be measured individually.

Guidance values have been developed by a number of researchers, groups, and regulatory authorities, based on the chemical and toxicological properties of various hydrocarbon groups (e.g., C5 - C6 alkanes and C7 - C8 aromatics). The guidance values adopted by WorkSafeBC (Table 1) were developed by the UK Health and Safety Executive, a recognized health and safety authority.

Table 1: Hydrocarbon Guidance Values

Hydrocarbon Group	Number of Carbon Atoms	Guidance Value (mg/m^3)
	C5 - C6	1800

Normal and branched chain alkanes	C7 - C8	1200
	C9 - C15	1200
Cycloalkanes	C5 - C6	1800
	C7 - C8	800
	C9 - C15	800
Aromatics	C7 - C8	500
	C9 - C15	500

Note: Substances within each Hydrocarbon Group with exposure limits that are below their group Guidance Value (e.g. hexane isomers other than n-hexane; nonane isomers; toluene; xylene isomers; etc.) should have their exposure limit values (rather than the guidance values) entered into the RCP (refer to toluene in example below).

The reciprocal calculation mixture formula is

* Vapour mass fraction should be used if the vapour composition differs significantly from the liquid mass composition.

The resulting calculated $EL_{solvmix}$ value should follow established recommendations regarding rounding. For calculated values <100 mg/m^3, round to the nearest 25. For calculated values between 100 and 600 mg/m^3, round to the nearest 50, and for calculated values >600 mg/m^3, round to the nearest 200 mg/m^3.

Example
The safety data sheet (SDS) for a solvent showed the following percentages and chemical composition:

Component	Percent Hydrocarbon Composition	Guidance Value (mg/m^3)
C7 - C8 alkanes	45%	1200
C9 - C10 alkanes	40%	1200
C7 - C8 aromatics	9%	500
Toluene	6%	75 (EL)
Benzene	<1%	Not applicable

The RCP calculation for this mixture is:

The EL for this particular solvent mixture is 600 mg/m^3. However, benzene must be evaluated separately at the current EL for benzene.

Limitations of the reciprocal calculation procedure
Care in the use of the $EL_{solvmix}$ should be observed where the mixture in question is known to have significant toxicokinetic interactions of components that are manifested at or below the guidance values.

The use of the RCP should be restricted to applications where the boiling points of the solvents in the mixture are relatively narrow, within a range of less than 45°C (i.e., vapour pressure within approximately one order of magnitude).

The guidance values apply only to vapours and do not apply to mists or aerosols. The calculation does not apply to mixtures containing olefins or other unsaturated compounds or polycyclic aromatic hydrocarbons (PAHs).

Further reading

ACGIH *Threshold Limit Values and Biological Exposure Indices*, Appendix H (2009)

European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC). *Occupational exposure limits for hydrocarbon solvents*. Special Report No. 13. Brussels, Belgium (1997).

Farmer TH: *Occupational hygiene limits for hydrocarbon solvents*. Annals of Occupational Hygiene 40: 237-242 (1995).

McKee RH; Medeiros AM; Daughtrey, WC: *A proposed methodology for setting occupational exposure limits for hydrocarbon solvents*. J of Occ and Env Hygiene 2: 524-542 (2005).

UK Health and Safety Executive (UKHSE) EH40/2000. Occupational Exposure Limits (2000).

G5.48-13 Monitoring worker exposure to sulfur dioxide

Retired on September 1, 2010

G5.49 Application of excursion limits

Issued January 1, 2007

Regulatory excerpt
Section 5.1 of the *OHS Regulation* ("*Regulation*") contains the following relevant definitions:

> *"ACGIH"* means the American Conference of Governmental Industrial Hygienists publication entitled "Threshold Limit Values and Biological Exposure Indices", dated 2002, as amended from time to time;
>
> *"8-hour TWA limit"* means the time weighted average (TWA) concentration of a substance in air which may not be exceeded over a normal 8 hour work period;
>
> *"short-term exposure limit"* or *"STEL"* means the time weighted average (TWA) concentration of a substance in air which may not be exceeded over any 15 minute period, limited to no more than 4 such periods in an 8-hour work shift with at least one hour between any 2 successive 15 minute excursion periods;
>
> *"ceiling limit"* means the concentration of a substance in air which may not be exceeded at any time during the work period;

Section 5.48 of the *Regulation* states:

> Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

Section 5.49 of the *Regulation* states:

> If a substance referred to under section 5.48 is provided only with an 8-hour TWA limit, the employer must, in addition to the requirement of section 5.48, ensure that a worker's exposure to the substance does not exceed
>
> (a) three times the 8-hour TWA limit for more than a total of 30 minutes during the work period, and
>
> (b) five times the 8-hour TWA limit at any time.

Section 5.50(1) of the *Regulation* states:

> If the work period is more than 8 hours in a 24 hour day, the 8-hour TWA limit must be reduced by multiplying the TWA limit by the following factors:

Factor	Length of work period (in hours)
0.7	More than 8, but not more than 10
0.5	More than 10, but not more than 12
0.25	More than 12, but not more than 16
0.1	More than 16

Purpose of guideline
The purpose of this guideline is to explain, and provide examples of the application of excursion limits in section 5.49.

Background Information
Threshold Limit Values (TLVs) refer to airborne concentrations of chemical substances and represent conditions under which it is believed that

nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects. There are three categories of TLVs: time-weighted average ("TWA") over an 8-hour period; short-term exposure limit ("STEL"), and a ceiling limit. Some chemical substances have been assigned values for a TWA and either a STEL or a ceiling limit, while other substances have been assigned TWA or ceiling limits only. (See also OHS Guidelines G5.48-2 to G5.48-4 for general information on exposure limits).

Section 5.49 of the *Regulation* establishes excursion limits for hazardous substances which have only been assigned a TWA by applying a formula to the assigned 8-hour TWA value. The purpose of excursion limits is to ensure workers are not exposed to excessively high short bursts of hazardous substances which could cause acute health effects.

Excursion limits are based on the premise that the maximum excursion should be related to the variability generally observed in actual industrial processes. Research has shown that if the variation of short-term exposure values is very high (greater than three times the average), it is an indication that the process is not under good control.

In order to be assured of satisfactory control of the industrial process and associated exposure values, a factor of three times the TWA is used. This ensures that only a small percentage of exposure values will exceed this value. If this excursion limit is exceeded, there is a high likelihood that further control measures are required.

Excursion limits apply only when neither a STEL nor ceiling value has otherwise been assigned to the substance. Section 5.49 is not meant to supersede any assigned STEL or ceiling limit.

Examples of Application of Excursion Limits

Elemental mercury has a TWA of 0.025 mg/m^3 (No STEL or Ceiling limit)

The principle of excursion limits applies in this case since there is only a TWA for this substance. As per section 5.49(a), an employer must ensure that a worker's exposure to elemental mercury does not exceed 0.075 mg/m^3 for more than a total of 30 minutes during the work period.

A worker exposed to a concentration of 0.080 mg/m^3 for 15 minutes and to 0.060 mg/m^3 for 15 minutes, is exposed, on average, to 0.070 mg/m^3. This average value is less than 0.075 mg/m^3 and is therefore in compliance with section 5.49(a).

As per section 5.49(b), the employer also must ensure that a worker's exposure to elemental mercury does not exceed 0.125 mg/m^3 at any time during the work period. For example, a direct reading measurement of 0.15 mg/m^3, taken with a calibrated mercury monitor, is a determination of non-compliance.

Acetic acid has a TWA of 10 ppm and a STEL of 15 ppm

The principle of excursion limits does not apply in this case because there is a STEL assigned for acetic acid. A worker is protected by the 8-hour TWA and is protected from high short burst exposures of acetic acid by the 15 minute STEL.

Chloroacetone has a ceiling limit of 1 ppm (No TWA or STEL)

The principle of excursion limits does not apply in this case because there is a ceiling limit assigned for chloroacetone. A worker is protected by setting a maximum permissible concentration in air, which must not be exceeded at any time during the work period.

Ethylene Oxide has a TWA of 0.1 ppm and a STEL of 1 ppm

The principle of excursion limits does not apply in this case because there is a STEL assigned for ethylene oxide. A worker is protected by the 8-hour TWA and is protected from high short burst exposures of ethylene oxide acid by the 15 minute STEL. Although there is no ceiling limit for ethylene oxide, the STEL also provides significant protection against very short, momentary high bursts - these bursts must not raise the 15 minute average concentration to higher than the STEL and must be limited to no more than 4 such periods in an 8 hour work shift with at least one hour between any 2 successive 15 minute excursion periods.

Application of Excursion Limits for Extended Work Periods

Section 5.50 of the *Regulation* and the associated OHS Guideline G5.50 explain how and when the TWA must be reduced for exposures during an extended work period. When the provisions for reduction of the TWA apply, this reduced value is the value to be used for excursion limit calculations in section 5.49.

For example, if a worker is exposed to airborne elemental mercury (8-hour TWA limit of 0.025 mg/m^3, no STEL, no ceiling limit) routinely over a 12-hour work shift, then a reduction factor of 0.5 must be applied to the exposure limit, resulting in a reduced TWA limit of 0.0125 mg/m^3. This worker must not be exposed to an average of more than (3 X 0.0125 =) 0.0375 mg/m^3 for more than a total of 30 minutes during the 12-hour work period. The worker must not be exposed to more than (5 X 0.0125 =) 0.0625 mg/m^3 at any time during the 12-hour work period.

G5.50 Extended work periods

Issued August 1, 1999; Revised February 11, 2004

Regulatory Excerpt

Section 5.50(1) of the *OHS Regulation* ("*Regulation*") states:

> If the work period is more than 8 hours in a 24 hour day, the 8-hour TWA limit must be reduced by multiplying the TWA limit by the following factors:

Factor	Length of work period (in hours)
0.7	More than 8, but not more than 10
0.5	More than 10, but not more than 12
0.25	More than 12, but not more than 16
0.1	More than 16

Purpose of guideline
The purpose of this guideline is to explain the modifications required in the 8-hour TWA limit if the work period exceeds 8 hours in a 24-hour day.

Modified 8-hour TWA limit
Where the work period exceeds 8 hours in a 24-hour day, the 8-hour TWA limit listed in the Table of Exposure Limits for Chemical and Biological Substances must be modified to ensure that workers on extended shifts are as equally protected as if they were working on conventional 8-hour shifts. Section 5.50(1) of the *Regulation* provides the factors by which the 8-hour TWA limit must be reduced.

Refer to OHS Guideline G5.48-3 for clarification of "normal" 8-hour shift.

This section envisages several consecutive workdays with shifts longer than the normal 8-hour shift, not an occasional overtime shift. If exposure occurs as a single event lasting less than 8 hours during a work shift and there is a recovery period of at least 16 hours (at work or otherwise) before any further exposure, the reduction factor would not normally apply.

G5.51 Additive effects

Issued August 1, 1999; Revised October 29, 2003

Regulatory excerpt
Section 5.51 of the *OHS Regulation* ("*Regulation*") states:

> If there is exposure to a mixture of 2 or more substances with established exposure limits which exhibit similar toxicological effects, the effects of such exposure must be considered additive unless it is known otherwise, and the additive exposure must not exceed 100% when calculated as follows:
>
> $AE = \%EL_1 + \%EL_2 + \ldots \%EL_n$
>
> where
>
> (a) AE is the calculated additive exposure to the mixture,
>
> (b) $\%EL_1$ is the measured exposure to component 1 of the mixture expressed as a percentage of its exposure limit,
>
> (c) $\%EL_2$ is the measured exposure to component 2 of the mixture expressed as a percentage of its exposure limit, and
>
> (d) $\%EL_n$ is the measured exposure to any additional components of the mixture expressed as a percentage of their respective exposure limits.

Purpose of guideline
The purpose of this guideline is to explain the additive effects in section 5.51 of the *Regulation*. If the sum derived from the equation exceeds 100% then the exposure limit of the mixture is considered to be exceeded.

Background
This section applies to all exposure limits, with the exception of excursion limits (section 5.49 of the *Regulation*), as they are not considered to be "established exposure limits." When considering additive effects, similar exposure limits must be compared (for example 8-hour TWA limits must be compared with 8-hour TWA limits; do not compare an 8-hour TWA limit and a STEL).

For effects to be considered additive, the substances must act upon the same target organ (such as the kidneys) or target organ system (such as the respiratory system) and have similar toxicological effects. Thus, substances with primarily acute effects would not be considered additive with substances which cause chronic effects, even if same organ or organ system was involved. For example, although both silica and ammonia affect the lungs, they would not be considered additive because exposure to silica causes a chronic condition (silicosis), while exposure to ammonia causes acute effects (respiratory tract irritation).

Examples of additive effects
Some examples of processes where additive effects need to be considered are welding, painting, and plastics manufacturing. Additive effects should also be taken into account for exposure to diesel exhaust. If it is not clear whether additive effects apply an occupational hygienist should be

consulte.

G5.52 Skin notation

Issued August 1999; Revised February 11, 2004

Regulatory excerpt
Section 5.52 of the *OHS Regulation* ("*Regulation*") states:

> If skin absorption may contribute to the overall exposure, effective measures must be taken to limit exposure by this route.

Purpose of guideline
The purpose of this guideline is to explain how this section of the *Regulation* applies to those substances listed with a "Skin" notation in the Table of Exposure Limits for Chemical and Biological Substances..

Background information
The notation refers to the potential significant contribution to the overall exposure by skin absorption (called the cutaneous route) either by contact with vapours or, of probable greater significance, by direct skin contact with the substance. This includes contact with the mucous membranes of the eyes. Specific substances (vehicles) in solutions or mixtures can also significantly enhance potential skin absorption. Although some substances are capable of causing irritation, dermatitis, and sensitization in workers, these properties are not considered relevant by the ACGIH when assigning a "Skin" notation. However, a dermatological condition can significantly affect the potential for skin absorption.

The "Skin" notation is intended to alert the reader that air sampling alone is insufficient to quantify exposure accurately and that measures to prevent significant skin absorption should be considered. For guidance on measures to control exposure, refer to OHS Guideline G5.55 or consult with an occupational hygienist or occupational physician.

G5.53-1 Workplace monitoring

Issued August 1999; Editorial Revision April 6, 2020; Revised November 13, 2020

Regulatory excerpt
Section 5.53(1) of the *OHS Regulation* ("*Regulation*") states:

> (1) If a worker is or may be exposed to a hazardous substance, the employer must ensure that
>
> (a) a walkthrough survey is conducted to assess the potential for overexposure taking into account all routes of exposure, including inhalation, ingestion, and skin contact, and
>
> (b) reassessment is conducted when there is a change in work conditions which may increase the exposure, such as a change in production rate, process or equipment.
>
> (2) If the walkthrough survey required by subsection (1) reveals that a worker may be at risk of overexposure to an airborne contaminant, the employer must ensure that air sampling is conducted to assess the potential for overexposure.
>
> (3) Additional workplace monitoring to reliably determine worker exposure is required if
>
> (a) the assessment under subsection (2) reveals that a worker may be exposed to an air contaminant in excess of 50% of its exposure limit, or
>
> (b) measurement is not possible at 50% of the applicable exposure limit.
>
> (4) Workplace exposure monitoring and assessment must be conducted using occupational hygiene methods acceptable to the Board.
>
> (5) The results of workplace exposure monitoring and assessment, or a summary of the results, must be provided to workers at their request without undue delay.

Purpose of guideline
The purpose of this guideline is to outline that where a worker is or may be exposed to a hazardous substance, section 5.53 of the *Regulation* requires an assessment of the potential for harmful exposure and monitoring, or sampling, of exposure levels to airborne contaminants.

Assessment process
The process required under section 5.53 has 3 major elements:

- A walk-through survey
- Air sampling to assess the potential for overexposure
- Workplace monitoring to reliably characterize worker exposure, where workers may be exposed to an air contaminant at levels greater than 50% of the exposure limit. Section 5.53(4) provides that "Workplace exposure monitoring and assessment must be conducted using

> occupational hygiene methods acceptable to the Board." Refer to OHS Guideline G5.53-4 for examples of occupational hygiene methods that have been deemed acceptable to WorkSafeBC.

As provided for under section 36(i) of the *Workers Compensation Act* and section 3.8 of the *Regulation*, the joint committee should be involved in workplace monitoring, where feasible.

Workplace monitoring
WorkSafeBC prevention officers may conduct sampling to determine compliance with both sections 5.48 and 5.53 of the *Regulation.* Additional circumstances where a prevention officer may be required to conduct workplace monitoring include the following:

- Claims investigations
- Accident investigations
- Investigations conducted under section 3.12(5)
- Dispute resolution
- Asbestos abatement projects
- Penalty assessments

A prevention officer may encounter situations where the employer has neither conducted a walkthrough survey nor performed sampling of contaminants, as required. In these circumstances, the prevention officer may elect to either assist the employer in conducting the survey or performing the sampling (as part of an inspection) or require the employer to conduct the survey or perform the sampling. In deciding whether to assist the employer, the prevention officer may consider the following:

- The employer's resources and abilities to
  - conduct the survey or perform the sampling him- or herself, or
  - engage professional services,
- The educational benefit to the employer of accompanying the prevention officer on a walkthrough survey
- The employer's commitment to an occupational health and safety program under the OHS provisions.

Some questions to consider include the following:

- Does the firm have appropriate in-house expertise?
- Does the firm have access to technical support from either the parent corporation or a supplier of the harmful substance(s)?
- Are private occupational hygiene services for sampling and/or analytical work readily available in the community?

The manner in which compliance is assessed with each element of the progress is described in OHS Guidelines G5.53-2, G5.53-3, and G5.53-4.

G5.53-2 Assessing compliance - The walkthrough survey

Issued August 1999

Regulatory excerpt
Sections 5.53(1) and (2) of the OHS Regulation ("*Regulation*") state:

> (1) If a worker is or may be exposed to a hazardous substance, the employer must ensure that
>
> (a) a walkthrough survey is conducted to assess the potential for overexposure taking into account all routes of exposure, including inhalation, ingestion, and skin contact, and
>
> (b) reassessment is conducted when there is a change in work conditions which may increase the exposure, such as a change in production rate, process or equipment.
>
> (2) If the walkthrough survey required by subsection (1) reveals that a worker may be at risk of overexposure to an airborne contaminant, the employer must ensure that air sampling is conducted to assess the potential for overexposure.

Purpose of guideline
The purpose of this guideline is to outline situations when a walkthrough survey and, if applicable, air sampling are required if a worker is or may be exposed to a hazardous substance.

Walkthrough survey
Section 5.53(1) of the *Regulation* requires an employer to conduct a walkthrough survey if a worker is or may be exposed to a harmful substance. A WorkSafeBC prevention officer encountering an employer who has not conducted a walkthrough survey at a workplace where in the prevention officer's opinion workers may be exposed to a harmful substance, will require the employer to conduct the walkthrough survey in accordance with this section.

If the employer conducts the walk-through survey and concludes that no worker may be at risk of overexposure to an airborne contaminant, and the prevention officer accepts this conclusion as being reasonable, no further action will be necessary, unless there is a change in work conditions. If, on the other hand, the employer finds a worker potentially at risk of overexposure to an airborne contaminant, air sampling must be considered, as required by section 5.53(2). Depending on the outcome of the sampling, further action may be required under sections 5.53(3), 5.54, and 5.55

of the *Regulation*.

The prevention officer may determine that workers are at risk based on the following:

- Observations at the worksite (this may be in the course of assisting an employer with a walkthrough survey or during an inspection)
- Sampling results from the worksite or similar worksites or operations
- First aid reports
- Worker complaints

G5.53-3 Monitoring worker exposure

Issued August 1999; Revised February 11, 2004

Regulatory excerpt
Sections 5.53 of the OHS Regulation ("*Regulation*") states, in part:

> (1) If a worker is or may be exposed to a hazardous substance, the employer must ensure that
>
> (a) a walkthrough survey is conducted to assess the potential for overexposure taking into account all routes of exposure, including inhalation, ingestion, and skin contact, and
>
> (b) reassessment is conducted when there is a change in work conditions which may increase the exposure, such as a change in production rate, process or equipment.
>
> (2) If the walkthrough survey required by subsection (1) reveals that a worker may be at risk of overexposure to an airborne contaminant, the employer must ensure that air sampling is conducted to assess the potential for overexposure.
>
> (3) Additional workplace monitoring to reliably determine worker exposure is required if
>
> (a) the assessment under subsection (2) reveals that a worker may be exposed to an air contaminant in excess of 50% of its exposure limit, or
>
> (b) measurement is not possible at 50% of the applicable exposure limit.

Purpose of guideline
The purpose of this guideline is to outline that under section 5.53(2) of the *Regulation*, the employer must conduct air sampling when the walkthrough survey required under section 5.53(1) reveals that workers may be at risk of overexposure.

Air sampling
The requirements set out in OHS Guideline G5.48-9 are acceptable to WorkSafeBC for complying with section 5.53(2). Normally, the employer would select one or more workers for sampling, which should be those workers who are likely to be the most heavily exposed on a given day (worst case conditions). Sampling results are then compared with exposure limits in section 5.48 (Table of Exposure Limits for Chemical and Biological Substances) using the parameters in G5.48-9.

If the assessment conducted under section 5.53(2) reveals that a worker may be exposed to an air contaminant in excess of 50% of its exposure limit, or measurement is not possible at 50% of the applicable exposure limit, additional workplace monitoring to reliably determine worker exposure is required under section 5.53(3)(a).

Air sampling
"Additional monitoring" differs from "worst case" sampling discussed in OHS Guideline G5.48-9 in that a larger number of samples are collected to account for day-to-day, as well as worker-to-worker, variability. The WorkSafeBC prevention officer will not normally conduct the additional monitoring. The following is an acceptable process for carrying out the additional monitoring

- Collect samples over an appropriate period of time in order to obtain a reliable estimate of exposure,
- Group workers to be sampled on the basis of potential exposures (refer to the Note below),
- Take 6-10 samples from each group of workers
- Calculate the mean exposure for each group
    - If the mean exposure for some workers in the group is much higher than for other workers, the group is not similarly exposed and should be split into two or more groups.
- calculate the geometric standard deviation for each mean exposure
    - Formulae for calculating the standard deviation can be found in standard occupational hygiene references. Three references that are acceptable to WorkSafeBC are listed in OHS Guideline G5.53-4.
- Calculate the 95% upper and lower confidence limits for each mean exposure
    - Formulae for calculating the upper and lower confidence limits can be found in standard occupational hygiene references. Three references that are acceptable to WorkSafeBC are listed in OHS Guideline G5.53-4.
- Apply the protocols of compliance outlined in OHS Guideline G5.48-9

Note: Prevention officers should consider whether the employer has grouped workers with similar patterns of exposure together. Such grouping would normally be based on an examination of work processes, procedures, job descriptions, process schedules and weather conditions. Groups of workers with similar patterns of exposure are referred to as "similarly exposed groups" or "homogeneous exposed groups."

G5.53-4 Occupational hygiene methods acceptable to WorkSafeBC

Issued August 1999; Revised November 17, 2003; Revised May 6, 2009; Revised March 31, 2015; Revised September 25, 2019; Revised December 20, 2019; Revised November 13, 2020.

Regulatory excerpt

Section 5.53(4) of the *OHS Regulation* ("*Regulation*") states:

> Workplace exposure monitoring and assessment must be conducted using occupational hygiene methods acceptable to the Board.

Purpose of guideline

The purpose of this guideline is to provide information on the publications that detail occupational hygiene methods acceptable to WorkSafeBC. The guideline also explains how approval may be obtained to use methods that are not discussed in those publications.

Acceptable occupational hygiene methods

All elements of an assessment or monitoring program (e.g., hazardous materials survey, air sampling and bulk sampling) must be conducted using occupational hygiene methods acceptable to WorkSafeBC.

WorkSafeBC accepts methods detailed in standard occupational hygiene references published by the following:

(a) National Institute for Occupational Safety and Health (NIOSH), such as

Occupational Exposure Sampling Strategy Manual. Published by the National Institute of Occupational Safety and Health. Cincinnati, Ohio, 1977 (or later editions).

NIOSH Manual of Analytical Methods. Published online at https://www.cdc.gov/niosh/nmam/default.html

(b) American Industrial Hygiene Association (AIHA), such as

A Strategy for Assessing and Managing Occupational Exposures. Published by the American Industrial Hygiene Association, Fairfax, Virginia, 2006, 3rd edition (or later editions).

The Occupational Environment: Its Evaluation, Control, and Management. Published by the American Industrial Hygiene Association, Akron, Ohio, 2003, 2nd edition (or later editions).

Recognition, Evaluation, and Control of Indoor Mold. Published by the American Industrial Hygiene Association, Akron, Ohio, 2008 (or later editions).

(c) American Conference of Governmental Industrial Hygienists (ACGIH.org)

(d) U.S. Occupational Safety and Health Administration (OSHA), such as

OSHA Sampling and Analytical Methods. Published online at https://www.osha.gov/dts/sltc/methods/index.html.

(e) ASTM International, such as the methods published at https://www.astm.org/

(f) U.S. Environmental Protection Agency (https://www.epa.gov/)

(g) International Organization for Standardization (ISO), such as those listed: https://www.iso.org/standards.html

(h) Institut de recherche Robert-SauvÃ© en santÃ© et en sÃ©curitÃ© du travail (IRSST) methods, such as those listed: https://www.irsst.qc.ca/en/laboratories/analysis/methods

(i) U.K's Health & Safety Executive's Methods for the Determination of Hazardous Substances (MDHS) methods, such as those listed: https://www.hse.gov.uk/pubns/mdhs/

In order to conduct workplace exposure monitoring for some new or revised exposure limits, it is necessary to use sampling devices that may not be stated within the accepted analytical methods. Examples of these sampling devices include cyclones, Parallel Particle Impactors, inhalable samplers, inhalable fraction and vapour (IFV) sampling devices, and mixed phase denuder-filter samplers. These samplers are acceptable provided that they are used in accordance with the manufacturer's instructions, and have been validated in accordance with international consensus standards and practices for the intended purpose by the manufacturer and the laboratories who will conduct the analyses.

Acceptable analytical methods include the requirement for the collection of field blanks. The purpose of field blanks is to detect and identify any contamination from the sampling site or arising from the transportation of samples to the laboratory. The number of field blanks required is usually referenced in the analytical method. If the number of field blanks is not referenced, a minimum of two field blanks must be included with each set of samples that are collected from a site, or at least 10% of the sample number. If sampling is performed over several days, each day should be considered a separate set of samples. WorkSafeBC accepts that a certified industrial hygienist (CIH), a registered occupational hygienist (ROH), and a registered occupational hygiene technologist (ROHT) are trained and experienced to perform occupational hygiene sample collection and interpretation of results. A CIH, ROH, or ROHT may make a determination regarding the number of field blanks that vary from those stated in this guideline. The rationale for the determination must be documented and presented to a WorkSafeBC prevention officer if requested.

Where an exposure limit (e.g., 0.05 mg/m^3 for elemental lead) or a definition that prescribes a limit (e.g., asbestos-containing material means at least 0.5% asbestos) is published by WorkSafeBC, an occupational hygiene method will only be acceptable if the parameters of the method (e.g., accuracy and detection limit) allow comparison of the test results to the published limits. Where a section of the *Regulation* specifies use of specific test methodology, that section's specifications prevail. For example, section 6.1 of the *Regulation* specifies certain methods for asbestos analysis, and those methods are the acceptable methods.

Before using occupational hygiene methods that are not discussed in references published by the organizations listed above or do not meet the other criteria in this guideline, the employer must obtain approval from WorkSafeBC's Prevention Practice, Quality, and Engineering department. For more information about how to submit an acceptance request under the *Regulation*, refer to the Variance and Acceptances webpage.

G5.54-1 Exposure control plan

Issued August 1, 1999; Revised October 29, 2003; Editorial Revision February 2, 2006; Editorial Revision February 1, 2008; Editorial Revision consequential to May 1, 2017 Regulatory Amendment; Editorial Revision consequential to December 1, 2023 Regulatory Amendment

Regulatory excerpt
Section 5.54(1) of the *OHS Regulation* ("*Regulation*") states:

> (1) An exposure control plan must be implemented when
>
> (a) exposure monitoring under section 5.53(3) indicates that a worker is or may be exposed to an air contaminant in excess of 50% of its exposure limit,
>
> (b) measurement is not possible at 50% of the applicable exposure limit, or
>
> (c) otherwise required by this *Regulation*.

Purpose of guideline
The purpose of this guideline is to discuss when an exposure control plan is required. This includes providing specific sections under the *Regulation* where an exposure control plan is required.

When an exposure control plan is required
Section 5.54(1) of the *Regulation* requires the employer to implement an exposure control plan under certain specific circumstances. The elements that must be incorporated into the exposure control plan are listed in section 5.54(2).

An exposure control plan is required when any of the following conditions are present:

- The results of exposure monitoring indicate that a worker is or may be exposed to an air contaminant at levels greater than 50% of its exposure limit.
- Measurement is not possible at 50% of the applicable exposure limit.
- An exposure control plan is required by another section of the *Regulation*.

If the employer has failed to conduct workplace monitoring under section 5.53(3), a WorkSafeBC prevention officer may order the employer to implement an exposure control plan if the prevention officer determines exposure exceeds 50% of the exposure limit.

The determination of whether an exposure control plan is required will typically be made on the basis of the additional monitoring under section 5.53(3). Worst-case sampling (refer to OHS Guideline G5.53-3 Monitoring worker exposure) can also demonstrate exposure, although with less certainty. Where exposure greater than 50% of the exposure limit would occur only in an emergency, an emergency plan rather than an exposure control plan is required under sections 5.2 and 5.97 of the *Regulation*. For example, an accidental spill or leak of a substance may occur, which is otherwise contained or controlled below 50% of the exposure limit.

The word "may" in clause (a) in section 5.54(1) refers to situations where there is "possible exposure." The figure in OHS Guideline G5.48-9 Measuring compliance with the exposure limits shows that a guideline for determining possible exposure includes situations where the upper confidence limit is above the exposure limit and the lower confidence limit is below the exposure limit. For further clarification, refer to OHS Guidelines G5.48-9 and G5.53-3.

The levels of most common substances can be measured at the exposure limit. Even though exposure cannot be precisely measured or determined at 50% of the exposure limit, there may still be sufficient evidence for a knowledgeable person to reasonably conclude that there is no probability of exposure to levels greater than 50% of the exposure limit. In such cases no exposure control plan is required.

There are several other sections of the *Regulation* that require an exposure control plan. They are listed below.

Sections of the *Regulation* requiring an exposure control plan (ECP)

Section	Topic	Situations when an ECP is required
5.57	Controlling exposure	Where it is not practicable to replace a material referred to in section 5.57(1) (designated substances) with a material that reduces the risk
6.3	Asbestos	If a worker is or may be exposed to potentially harmful levels of asbestos
6.34	Biological agents	If a worker has or may have occupational exposure, as defined in section 6.33
6.46	Hazardous drugs	If a worker is or may be exposed to a hazardous drug
6.60	Lead	If a risk assessment indicates that a worker is or may be exposed to lead dust, fumes, or mist
6.112.1	Silica	If a risk assessment shows that a worker is or may be exposed to respirable crystalline silica dust
6.119	Toxic process Gases	If there is a risk of adverse health effects to workers from exposure to a toxic process gas
7.13	Vibration exposure control obligations	If a worker is or may be exposed to vibration in excess of the vibration exposure limits
7.20	Ionizing and non-ionizing radiation	If a worker exceeds, or may exceed, an applicable action level for ionizing or non-ionizing radiation
7.29	Heat stress	If: • A worker is or may be exposed to thermal conditions which could cause heat stress • The thermal conditions could result in a worker's core body temperature exceeding 38°C (100°F) • The thermal conditions are or may be in excess of the levels listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard for unacclimatized workers
7.34	Cold stress	If a worker is or may be exposed to: • Thermal conditions that could cause cold stress or injury • Thermal conditions that could cause a worker's core body temperature to fall below 36°C (96.8°F) • Thermal conditions that are below the levels classified as "little danger" to workers in the criteria for the cooling power of wind on exposed flesh in the cold stress section of the ACGIH Standard

G5.54-2 Elements of an exposure control plan

Issued August 1999

Regulatory excerpt
Section 5.54(2) of the OHS Regulation ("*Regulation*") states:

> (2) The exposure control plan must incorporate the following elements:
>
> (a) a statement of purpose and responsibilities;
>
> (b) risk identification, assessment and control;
>
> (c) education and training;
>
> (d) written work procedures, when required;
>
> (e) hygiene facilities and decontamination procedures, when required;
>
> (f) health monitoring, when required;
>
> (g) documentation, when required.

Purpose of guideline
The purposed of this guideline is to provide guidance on the seven major elements that an exposure control plan must incorporate as listed in section 5.54(2) of the *Regulation*.

Elements of an exposure control plan
The exposure control plan will normally be in writing so that all its elements can be recorded properly. If an exposure control plan is functioning effectively in a workplace, and the elements of the plan are not complex and require only limited record keeping, writing the plan may not be necessary. Similar considerations will determine the need for written work procedures under section 5.54(2)(d). Section 5.2 may require written

work procedures under certain conditions, even though a written exposure control plan is not necessary.

Additional details regarding some of the specific elements of an exposure control plan are described in OHS Guidelines G5.54-3 Risk identification, assessment, and control, G5.54-4 Hygiene facilities and decontamination procedures, G5.54-5 Health monitoring, and G5.54-6 Documentation.

G5.54-3 Risk identification, assessment and control

Issued August 1999

Regulatory excerpt
Section 5.54(2)(b) of the OHS Regulation ("*Regulation*") states:

> (2) The exposure control plan must incorporate the following elements:
>
> (b) risk identification, assessment and control;

Purpose of guideline
The purpose of this guideline is to explain how the exposure control plan must incorporate risk identification, assessment and control pursuant to section 5.54(2)(b) of the *Regulation*.

Risk assessment
When identifying and assessing risk, the requirements of sections 5.53(1) and 5.53(3) for a walkthrough survey and exposure monitoring apply. Continuous monitoring of the work area may also be required, when necessary, to ensure the continuing safety of workers. For example, section 6.128 requires continuous monitoring in some workplaces. For controlling risk, section 5.55 applies.

To evaluate compliance with this section, WorkSafeBC prevention officers will:

- Determine whether the hazards have been correctly identified
- Establish whether the risk assessment is acceptable
- Assess the practicability of any proposed control measures
- Evaluate whether those measures provide an acceptable level of protection to workers

The degree of risk will depend on the probability, the extent, and the possible consequences of exposure (an injury or disease). Some of the factors that an employer should consider when performing a risk assessment are outlined in the table below.

Factors to be considered when performing a risk assessment

General	Specific
What is the nature of the hazard?	• What are the body systems involved (e.g., lungs, skin)? • What are the possible effects of exposure (e.g., breathing difficulties, scarring of tissues)? • Are there short-term or long-term effects (e.g., mild irritation, irreversible tissue damage, cancer)?
What is the nature of the exposure?	• What are the specific substances to which workers may be exposed? • What are the way(s) in which workers may be exposed (e.g., spills, during routine tasks or preventative maintenance)? • What are the specific work methods or procedures which may result in exposure? • Who are the workers at risk for exposure (i.e. process workers, maintenance workers, outside contractors)? • How many workers are potentially exposed?
Are there control measures in place to reduce the risk of exposure?	• Are there any engineering controls? (e.g., is the process enclosed or isolated?) • Are there administrative controls (e.g., is work scheduled to minimize time spent in the hazardous area)? • Is personal protective equipment available? (i.e., what type is available and how is it used?)

G5.54-4 Hygiene facilities and decontamination procedures

Issued August 1999; Editorial Revision February 1, 2008

Regulatory excerpt
Section 5.54(2)(e) of the *OHS Regulation* ("*Regulation*") states:

> (2) The exposure control plan must incorporate the following elements:
>
> (e) hygiene facilities and decontamination procedures, when required;

Purpose of guideline
The purpose of this guideline is to clarify that the walk-through survey required under section 5.53(1), the risk assessment performed under section 5.88, along with specific requirements in Parts 6 and 7, will help determine whether or not hygiene facilities and decontamination procedures are required.

Hygiene facilities and decontamination procedures
Section 5.54(2)(e) requires that the exposure control plan incorporate "hygiene facilities and decontamination procedures, when required." The walk-through survey required under section 5.53(1), as well as the risk assessment required under section 5.88, will determine the need for specific hygiene facilities and decontamination procedures. Certain sections of Parts 6 and 7 may also require hygiene facilities and decontamination procedures, such as for asbestos, lead, and biological agents designated as hazardous substances in section 5.1.1. Refer to the relevant OHS Guidelines for further assistance.

G5.54-5 Health monitoring

Issued August 1999; Revised June 7, 2002; Editorial Revision October 2004

Regulatory excerpt
Section 5.54(2)(f) of the OHS Regulation ("*Regulation*") states:

> (2) The exposure control plan must incorporate the following elements:
>
> (f) health monitoring, when required;

Purpose of guideline
The purpose of this guideline is to explain how the exposure control plan must incorporate "health monitoring, when required" pursuant to section 5.54(2)(f) of the *Regulation*.

Health monitoring
Health monitoring may be required explicitly (such as under section 6.79 of the *Regulation*, WorkSafeBC may require health monitoring for workers exposed to pesticides in non-agricultural operations), or as an element of an exposure control plan. A list of the sections in which an exposure control plan is required is tabulated in OHS Guideline G5.54-1.

The purpose of health monitoring is to protect workers from developing occupational disease by detecting biological indicators or adverse health effects at an early stage. Action can then be taken to prevent, reverse, reduce the severity, or arrest the progression of the adverse health effect or disease. Biological Action Values (BAV) for biological indicators are established by WorkSafeBC, based on current information and are reviewed periodically. For further information, consult the occupational physicians of WorkSafeBC.

Health monitoring should be considered when:

- There is reasonable likelihood of a workplace exposure
- The exposure can potentially cause an occupational disease or adverse health effect
- There is a means of detecting or measuring the disease, adverse health effect or its precursor or biological indicator

Effectiveness of exposure control plan
The results of health monitoring are also useful in evaluating the effectiveness of the exposure control plan, particularly when it cannot be evaluated by exposure monitoring alone. This occurs in any of the following situations:

- The skin or the gut are significant routes of absorption
- The skin itself may be affected by contact exposure
- Exposure control is dependent on the use of personal protective equipment

The skin and gut could be significant routes of exposure if the skin is in direct contact with a contaminant or if the contaminant is ingested and absorbed into the gut.

Biological monitoring
Biological monitoring of a substance, its metabolite, or its biological effect can be a component of health monitoring. An appropriate biological indicator is one that can be detected before disease or an adverse health effect occurs. Preventive action can then be taken as required. Before undertaking biological monitoring, the following criteria regarding the biological test should be met. The test should:

- Specifically assess the exposure or the effect
- Be sufficiently sensitive to detect occupational exposure levels and effects

- Vary quantitatively with the intensity of exposure and the risk of development of adverse effects
- Provide more information on potential health risk than can be obtained from exposure monitoring alone
- Be as non-invasive as possible
- Be readily available and not be too time-consuming, complex or expensive
- Be measured by analytical techniques which are accurate, specific and sensitive
- Have minimal storage and transport limitations

Health monitoring testing
Substances for which WorkSafeBC considers health monitoring may be appropriate include, but are not limited to, any of the following:

- Lead
- Cadmium
- Mercury
- Respiratory sensitizers (such as cedar dust or isocyanates)
- 4,4'-methylene bis[2-chloroaniline] or MOCA
- Organophosphate compounds

Health monitoring does not necessarily entail sophisticated testing, requiring medical or nursing personnel. Setting up a health monitoring system should be done by an occupational health physician or nurse, although its day-to-day functioning can often be managed by a qualified person, such as an occupational hygienist or health and safety manager. For some substances, health monitoring may only require an early reporting system linked with periodic inquiries about signs and symptoms, self-checks (such as examination of the skin for signs of sensitivity) by a lay person such as a first aid attendant or supervisor. When biological or biological effect monitoring is necessary, the services of appropriate medical, nursing, or technical personnel may be required for ordering tests and taking samples. A physician or nurse needs to interpret the results.

Health, biological, and biological effect monitoring should only be carried out with the informed consent of the worker. The individual should be advised of the purpose of the tests and biological samples should be analyzed only for the substances or effects for which consent has been obtained. Informed consent should ensure that the worker is made aware of any consequences that might occur if the results of the monitoring indicate that exposure should be reduced.

Personal results of health monitoring, as well as their interpretation, should be given to individual workers. Unless the worker's written informed consent for release is obtained, only categorical results (such as a range of values rather than specific measurement values) should be released to any person other than the individual or the worker's family physician. Both the worker and the employer should be advised about the worker's fitness to work, along with any work restrictions or recommended health and safety precautions.

Records concerning health, biological and biological effect monitoring should be kept and maintained in a form, which is easily linked to job and exposure records, while still observing the rules of confidentiality.

Although this section of the *Regulation* does not stipulate the period of time that records must be retained, they should be kept as long as practicable. This is especially important for identifying and assessing work-related health changes associated with changes over time in work processes, practices or control measures, as well as for detecting occupational diseases with delayed onset. In terms of confidentiality, standard guidelines and current accepted practice of regulatory bodies and recognized occupational health organizations should be followed. These include, for example, the Royal College of Physicians and Surgeons of Canada, the Canadian Medical Association, Doctors of BC (formerly known as the British Columbia Medical Association), the Occupational and Environmental Medicine Association of Canada, and the American College of Occupational and Environmental Medicine. Employers, in conjunction with worker health and safety representatives and occupational health personnel, should develop written policy regarding confidentiality. This policy, as well as any monitoring records, should be reviewed periodically.

Health monitoring programs should be reviewed and re-evaluated on a regular basis, and when the following occurs:

- There is a change in work processes or substance usage
- There is a significant change in the results of air monitoring, where a significant change may indicate either that the exposure limit is being exceeded or that control measures are keeping exposure levels below 50% of the exposure limit
- Signs or symptoms of occupational ill health are reported and investigated, as required by section 5.59 of the *Regulation*
- Results of biological or biological effect monitoring exceed recommended limits

G5.54-6 Documentation

Issued August 1999; Editorial Revision February 1, 2008; Editorial Revision consequential to May 1, 2017 Regulatory Amendment

Regulatory excerpt
Section 5.54(2)(g) of the *OHS Regulation ("Regulation")* states:

> (2) The exposure control plan must incorporate the following elements:
>
> (g) documentation, when required.

Purpose of guideline
The purpose of this guideline is to specify when documentation is specifically required under certain sections.

Documentation
Section 5.54(2)(g) provides that the exposure control plan must incorporate "documentation, when required." Documentation is specifically required under certain sections. Some examples include the following:

- Section 6.4 of the *Regulation* – inventory of asbestos-containing materials and a record of any changes made to the inventory
- Section 6.32 – records of risk assessments, inspections, air monitoring results, instruction and training of workers, and incident investigation reports
- Section 6.34(1) – records of all workers who have occupational exposure, as defined in section 6.33

Documentation is also required under section 5.2 and whenever workplace monitoring is conducted under section 5.53.

G5.54-7 Drywall sanding requirements

Issued June 14, 2002; Revised February 11, 2004; Editorial Revision June 6, 2007

Regulatory excerpt
Section 5.54(1) of the *OHS Regulation* ("*Regulation*") states:

> An exposure control plan must be implemented when
>
> (a) exposure monitoring under section 5.53(3) indicates that a worker is or may be exposed to an air contaminant in excess of 50% of its exposure limit,
>
> (b) measurement is not possible at 50% of the applicable exposure limit, or
>
> (c) otherwise required by this Regulation.

Purpose of guideline
The purpose of this guideline is to clarify how Part 5 of the *Regulation* should be applied to control workers' exposure to the hazard of dust from drywall sanding operations. It includes a sample exposure control plan to assist the drywall installation industry in meeting the requirements of section 5.54(2) of the *Regulation*.

Background
Workers sanding drywall filler compounds are exposed to large amounts of fine dust. Depending on the supplier, drywall filler compounds contain calcite, gypsum, mica, kaolin, perlite, talc, and silica and may contain trace amounts of crystalline silica, a *designated substance* (see section 5.57 of the *Regulation*). WorkSafeBC has evaluated the dust exposures typically experienced by drywall sanders in a variety of workplaces, from wood frame residential construction to concrete high-rise construction, during both pole-sanding and hand-sanding activities. This evaluation found that drywall sanders are exposed to high dust levels, typically up to 8 times the exposure limit for "Particles (Insoluble or Poorly Soluble) not otherwise Classified (PNOC)" in the Table of Exposure Limits for Chemical and Biological Substances (see OHS Guideline G5.48-2). These results are consistent with research reports from other agencies.

Workers' exposure to crystalline silica from drywall sanding was found to be typically at or below the detection limit for crystalline silica (less than 0.02 mg/m^3). Bulk samples of the various drywall filler compounds analyzed by WorkSafeBC all contained less than 1% crystalline silica. PNOC applies to dusts that contain no asbestos, contain less than 1% crystalline silica, and are known not to produce significant organic disease or toxic effect when exposures are maintained under reasonable control.

Application of the *Regulation*
Section 5.54(1)(a) of the *Regulation* requires an exposure control plan for drywall sanding operations as WorkSafeBC has established that workers involved in such operations are routinely overexposed to PNOC. The 8-hour TWA limit for PNOC as total dust is 10 mg/m^3. The substance also has an 8-hour TWA limit of 3 mg/m^3 for the respirable fraction of the dust.

Section 5.55 of the *Regulation* requires control measures to minimize or eliminate workers' exposure to airborne contaminants. The following "hierarchy of controls" is listed with substitution as the most preferable option and personal protective equipment as the least preferable (see OHS Guideline G5.55 for additional information):

- Substitution
- Engineering controls
- Administrative controls
- Personal protective equipment (PPE)

Substitution means replacing the substance of concern with a less harmful substance. For drywall filler compounds, crystalline silica would be the one substance of concern for elimination by substitution. Substitution would mean finding a filler compound with no crystalline silica content. The presence of crystalline silica in filler compounds is the result of small amounts present in the raw materials used in the manufacture of the drywall filler. Although manufacturers can specify raw material with the lowest amount of contamination with crystalline silica, achieving a product that is totally free of crystalline silica content is not feasible. Substitution with a product that requires no sanding or produces less dust would be ideal from a business and health perspective; however, no such product has yet been developed.

WorkSafeBC has reviewed control options and recognizes the following:

1. Local exhaust ventilation, such as the use of a high velocity/low volume extraction system attached to a sander, is not considered a viable option at this time. This is based on the findings of a joint WorkSafeBC/industry committee that the desired quality of finish required for prepping walls to be painted cannot be achieved by the present technology.
2. Wet sanding is not considered a viable option at this time. It wets the drywall paper and the desired quality of finish for large, new wall assemblies cannot be achieved. However, wet sanding may be viable for small touch-up jobs in dust-sensitive areas such as finished offices, computer labs, and clean rooms.
3. Respiratory protection is a viable option to control worker exposure to drywall sanding dust at this time.

The minimum respiratory protective device acceptable to WorkSafeBC for PNOC is a half-facepiece respirator fitted with N95 particulate filters or an N95 filtering facepiece respirator, having a minimum assigned protection factor of 10 (NIOSH TC-84A-xxx approvals only, where xxx is the assigned approval number). See also OHS Guideline G8.33(2)-1 for a list of other acceptable filtering facepiece respirators Only those respirators capable of being seal checked and/or fit tested, as applicable, are to be selected.

WorkSafeBC recognizes respiratory protection as the only current viable option for controlling exposure with the following conditions:

1. The industry is expected to actively investigate and evaluate the suitability of new technologies and methods for drywall installation and finishing as they become available. If suitable equipment or methods are found to lower worker exposure to drywall sanding dust, it is expected the industry will adopt the new technology or method(s). This is as required by section 5.55 of the *Regulation*.
2. The use of respiratory protection is to be accompanied by the use of other available control measures as follows:
    - Restricting access to the drywall sanding area to the personnel required for the sanding operation.
    - Posting signs at the access routes to the drywall sanding area stating:
        - Entry to the area is restricted to authorized personnel
        - A warning to unprotected workers of the hazards
        - Precautions for entering the area
        - For example, a sign stating "Authorized Personnel Only, Drywall sanding operation in process, Respiratory protection required" would be acceptable.
    - Scheduling the entry of workers who do not have respiratory protection (such as workers delivering materials or inspecting the area) to times when the airborne dust levels will be at their lowest, for example at the start of a shift or after a break. Workers without respiratory protection will be limited to a brief exposure to the hazardous area, such as a few minutes a few times each shift.
    - Training workers in the hazards and control measures associated with drywall sanding.
    - Coordinating with other sub-trades and the prime contractor on-site to minimize the need for workers not directly involved in the drywall sanding operation to be near the dust hazard area.
    - Providing wash-up facilities for workers to wash dust off their hands and face before meal breaks and at the end of the shift.
    - Arranging for workers to change to clean clothing upon completion of their sanding task so they do not wear dust-contaminated clothing in other work areas.

Sample Exposure Control Plan for Drywall Sanding

Purpose and Responsibilities

This plan provides direction to the supervisors and workers of ____ on the company's policies and procedures for drywall sanding operations. It covers all standard work practices including the use of pole sanders, sanding sponges, and hand-held sanding blocks for sanding of joints, corners, and seams where drywall filler compounds have been applied.

The employer is responsible for the following:

- Providing a job-specific exposure control plan (ECP) for each project to deal with the hazards and risks associated with sanding operations
- Reviewing periodically the effectiveness of the ECP, which may require sampling of worker exposure levels to drywall filler dust when there are significant changes in exposure conditions during non-standard work practices
- Ensuring that personal protective equipment is readily available and used and mechanical ventilation equipment is provided and used where deemed necessary
- Ensuring supervisors and workers are educated and trained to an acceptable level of competency
- Maintaining records of training, fit-test results, crew talks, and inspections
- Coordinating the work with the prime contractor and other employers to ensure a safe work environment

The supervisor is responsible for the following:

- Providing adequate instruction to workers on the hazards associated with drywall sanding and on the precautions specified in the job-specific plan covering hazards at the location
- Selecting and implementing the appropriate control measures
- Ensuring that workers using respirators have been properly fit-tested and that the results are recorded
- Directing the work in a manner that ensures the risk to workers is minimized and adequately controlled
- Liaising with the prime contractor and other sub-contractors to ensure a safe work environment

The worker is responsible for the following:

- Using the assigned protective equipment in an effective and safe manner
- Setting up the operation in accordance with the site-specific plan
- Following established work procedures as directed by the supervisor
- Reporting any unsafe conditions or acts to the supervisor

Risk Identification and Assessment
Drywall taping compounds may contain calcite, gypsum mica, kaolin, perlite, talc, and silica. Most of these substances do not have individual component or specific exposure limits. Evaluations conducted by WorkSafeBC and the National Institute for Occupational Safety and Health (NIOSH) have found that the exposure of drywall sanders to crystalline silica is less than posted exposure limits and mostly at or below the detection limit. Dusts without established exposure criteria are called "Particles (Insoluble or Poorly Soluble) Not Otherwise Classified (PNOC)." The general criteria for these dusts is that they contain no asbestos, have less than 1% crystalline silica, and are known not to produce significant organic disease or toxic effect when exposures are maintained under reasonable control.

The exposure control requirements for drywall sanding are to address the hazard of PNOC concentration. An 8-hour TWA limit of 10 mg/m^3 for total dust and 3 mg/m^3 for respirable dust applies to drywall dust. WorkSafeBC evaluation of worker exposure to dust from drywall filler sanding operations has determined 80% of the exposures are above the 8-hour TWA limit of 10 mg/m^3 for PNOC. The PNOC exposure levels can be as much as 8 times the 8-hour TWA limit.

Control Options
Company policy is to use the following control options to eliminate or reduce the risk to workers from the hazard of drywall sanding dust exposure. Every effort will be made to ensure the need to sand is reduced or minimized in the taping and filling stages of drywall installation. Care in and use of proper and appropriate filling procedures, methods, and practices will reduce the need to sand out joint compounds. If sanding is required, the following hierarchy of control measures needs to be considered:

- Engineering control options: A combination of local and general ventilation systems
- Administrative control options: Pole sanding or wet sanding when practicable
  - NOTE: Wet sanding of large, new wall assemblies is not considered a viable option; however, it may be practicable for small touch-ups in dust-sensitive areas such as finished offices, computer labs, and clean rooms.
- Personal protective equipment (PPE):
  - The minimum respiratory protective device for use in drywall sanding is a half-facepiece respirator fitted with N95 particulate filters or a particulate facepiece N95 respirator (NIOSH TC-84A-xxx approvals only, where xxx is the assigned approval number). Only those respirators capable of being seal checked or fit tested will be selected.
- Coveralls

A combination of the above control options should be considered to ensure maximum protection for workers.

In addition, consideration must be given to the following:

- Restricting access to the sanding area.
- Posting all access routes to the designated sanding area with signs warning unprotected workers of the hazards, listing precautions for entering the area, and restricting the area to authorized personnel only. (Signs stating "Authorized Personnel Only, Drywall sanding operation in process, Respiratory protection required" are acceptable.)
- Coordinating with the prime contractor and other sub-trades to ensure other workers on-site are not placed to do work in the dust hazard area.
- Scheduling the entry of workers who do not have respiratory protection (such as workers delivering materials or inspecting the area) to times when the airborne dust levels will be at their lowest, for example at the start of a shift or after a break. Workers without respiratory protection will be limited to a brief exposure to the hazardous area, such as a few minutes a few times each shift.

Education and Training
Workers and supervisors involved in drywall filler sanding will be educated and instructed in the health hazards associated with the sanding operations and will be trained in the operation and use of the sanding equipment and control measures, including the safe use, limitations, and maintenance of the respiratory protection used.

Written Work Safety Procedures
The following written procedures will be made available on-site for the direction of workers:

- A site-specific exposure control plan (such as this document, modified accordingly with site-specific requirements)
- Specific instructions when any engineering control options are used to supplement the required personal protective equipment (such as use and maintenance of local exhaust ventilation systems; proper set-up of general ventilation such as pedestal fans)
- Respirator instructions provided by the supplier (manufacturer's booklet)
- Respiratory protection program (see *Regulation* Part 8 and WorkSafeBC's *Breathe Safer* manual)

Hygiene Practices and Cleanup Procedures
All workers sanding drywall filler compounds are to change into coveralls or work clothes in a "clean area."

Workers will have and use facilities for washing of their hands and face before meal breaks and at the end of each shift.

Health Monitoring
Workers will promptly report any symptoms of exposure to the job site first aid attendant and their supervisor for further investigation.

Documentation
The company will keep records of the instruction and training provided to workers, respirator fit-test records, any related crew talks, and any reported unsafe conditions or deficiencies noted in workplace inspections or reported to the supervisor on the site.

Annual Review
The employer will undertake, on an annual basis, the following:

- Evaluation of the control options and work procedures used
- Evaluation of any new technologies and methods that have come onto the market
- Review of first aid reports and any reported health-related symptoms
- Review of documentation for training and education
- Review of the respirator program

The annual review will be done in consultation with the joint health and safety committee, and/or worker health and safety representative, if applicable.

G5.55 Type of controls

Issued August 1, 1999; Revised February 11, 2004; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.55 of the *OHS Regulation* ("*Regulation*") states:

> (1) If there is a risk to a worker from exposure to a hazardous substance by any route of exposure, the employer must eliminate the exposure, or otherwise control it below harmful levels and below the applicable exposure limit established under section 5.48 by
>
> (a) substitution,
>
> (b) engineering control,
>
> (c) administrative control, or
>
> (d) personal protective equipment.
>
> (2) When selecting a suitable substitute, the employer must ensure that the hazards of the substitute are known, and that the risk to workers is reduced by its use.
>
> (3) The use of personal protective equipment as the primary means to control exposure is permitted only when
>
> (a) substitution, or engineering or administrative controls are not practicable, or
>
> (b) additional protection is required because engineering or administrative controls are insufficient to reduce exposure below the applicable exposure limits, or
>
> (c) the exposure results from temporary or emergency conditions only.

Purpose of guideline
The purpose of this guideline is to describe acceptable control options.

Exposure limits
Section 5.55 of the *Regulation* requires that control measures be implemented to eliminate the exposure or control it below harmful levels and below the applicable exposure limit established under section 5.48. Those limits are available in the Table of Exposure Limits for Chemical and Biological Substances (refer to OHS Guideline G5.48-2).

Other useful sources of information in making the determination of a potentially harmful level include the SDS, supplier's recommendations, and reference literature, such as the *Documentation of Threshold Limit Values and Biological Exposure Indices* published by the ACGIH.

Control measures
Acceptable control options include substitution, engineering control, administrative control, and personal protective equipment. Good occupational hygiene practice considers this to be the "hierarchy of controls." That is, substitution is the most preferable option and personal protective equipment is the least preferable.

Section 5.55(2) requires that, when selecting a substitute, the employer ensures that the hazards of a substitute are known and that the risk to workers is reduced by its use. Factors that should be considered in selecting a suitable substitute include the following:

- The exposure limit
- Route(s) of exposure
- Acute and chronic effects
- Warning properties
- Flammability or other hazards
- Work procedures
- Training and supervision required

The only circumstances under which WorkSafeBC would consider personal protective equipment to be a primary means of control are when the conditions of section 5.55(3) are met. Section 5.55(3)(b) permits the use of respirators when engineering or administrative controls are insufficient to reduce exposure below the exposure limit (e.g., while sandblasting in a booth). In section 5.55(c), the term "emergency conditions" includes leaks, rescue situations, or repair efforts when controls break down. The definition of "temporary" is provided in section 5.1 of the *Regulation*.

G5.56 Oxygen deficiency

Issued August 1, 1999

Regulatory excerpt
Section 5.56 of the OHS Regulation ("*Regulation*") states:

> The airborne concentration of any gas or vapour must be controlled so that a worker is not exposed to an oxygen deficient atmosphere, and there is no other hazard, such as fire or explosion.

Purpose of guideline
The purpose of this guideline is to explain the requirement that the airborne concentration of any gas or vapour be controlled to ensure that a worker is not exposed to an oxygen deficient atmosphere pursuant to section 5.56 of the *Regulation.*.

Oxygen deficient atmosphere
An oxygen deficient atmosphere is one in which the concentration of oxygen is below that required to sustain normal respiration. The process of respiration includes breathing, as well as the exchange of oxygen and carbon dioxide (between the lungs and the blood and also between the blood and tissues).

At standard pressure and temperature, atmospheric air at sea level contains 20.95% oxygen. This atmosphere is oxygen deficient at concentrations of oxygen of 19.5% or less. The IDLH (immediately dangerous to life or health) concentration of oxygen in atmospheric air at sea level is 14%. At 3660 metres (10,000 feet) above sea level, the IDLH concentration of oxygen is 20.9%. Further information on oxygen deficient atmospheres is found in the WorkSafeBC publications "Breathe Safer" and "Confined Space Entry — A Reference Manual." Refer to the definitions for "oxygen deficient" and "IDLH" in section 1.1 of the *Regulation*.

Some examples of gases that can cause an oxygen deficient atmosphere include the following:

- acetylene
- argon
- ethane
- ethylene
- helium
- hydrogen
- methane propane
- neon
- nitrogen
- propylene

Due to the flammability of some of these gases, the requirements of sections 5.27 and 5.31 also apply.

G5.57 Designated substances

Issued August 1, 1999; Revised February 11, 2004; Revised February 4, 2005; Revised January 1, 2009; Editorial Revision consequential to August 4, 2015 Regulatory Amendment; Editorial Revision June 1, 2017; Revised June 3, 2019

Regulatory excerpt
Section 5.57 of the *OHS Regulation* ("*Regulation*") states:

> (1) If a substance identified as any of the following is present in the workplace, the employer must replace it, if practicable, with a material which reduces the risk to workers:
>
> (a) ACGIH A1 or A2, or IARC 1, 2A or 2B carcinogen;
>
> (b) ACGIH reproductive toxin;

(c) ACGIH sensitizer;

(d) ACGIH L endnote.

(2) If it is not practicable to substitute a material which reduces the risk to workers, in accordance with subsection (1), the employer must implement an exposure control plan to maintain workers' exposure as low as reasonably achievable below the exposure limit established under section 5.48.

(3) The exposure control plan must meet the requirements of section 5.54.

Purpose of guideline

Section 5.57(1) of the *Regulation* requires that designated substances be replaced or substituted, whenever practicable, with a less hazardous material, and if that is not practicable, measures must be taken to keep a worker's exposure to a level as low as is reasonably achievable.

The purpose of this guideline is to provide background information on the designations for carcinogenicity, reproductive effects, sensitization, and L endnotes as referenced in section 5.57(1), and to describe factors to consider when determining the practicability of using substitute materials.

Background

Section 5.57 of the *Regulation* establishes requirements for substances with specific designations by two authorities - the ACGIH (American Conference of Governmental Industrial Hygienists) and IARC (International Agency for Research on Cancer).

Periodically, designations for specific chemical substances are subject to change by the ACGIH and IARC if new scientific evidence concludes a different health outcome. As a result, the ACGIH and/or IARC will revise the designations for specific substances accordingly.

There may be circumstances where the ACGIH and/or IARC designations may not be reflected on other commonly used information sources, such as updated safety data sheets (SDS). To address such matters, the *Regulation* under the provisions of Part 5, also requires employers to use such updated information sources in assessing adverse health effects and establishing safe work procedures.

Section 5.57(1)(a): Carcinogenic substances - ACGIH and IARC notations

A substance is an ACGIH A1 or A2 carcinogen if the ACGIH assigns the following designations for a substance in the most current edition of the ACGIH *Threshold Limit Values and Biological Exposure Indices* (commonly known as the *TLV Booklet*):

- A1 - a substance is a *confirmed human carcinogen* based on the weight of evidence from epidemiological studies
- A2 - a substance is a *suspected human carcinogen* based on limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals with relevance to humans

A substance is an IARC 1, 2A, or 2B carcinogen if IARC declares any of these categories for a substance in the publication *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, as amended from time to time:

- Group 1 - substances are deemed as *carcinogenic to humans* on the basis of sufficient evidence of carcinogenicity in humans
- Group 2A - substances are deemed *probably carcinogenic to humans* on the basis of limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals
- Group 2B - substances are deemed *possibly carcinogenic to humans* on the basis of limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals

For reference, the Table of Exposure Limits for Chemical and Biological Substances associated with the OHS Guideline G5.48-2 lists substances that are considered to be an ACGIH and IARC carcinogen by A1, A2, 1, 2A, or 2B in the Notations' column.

For additional information on the background and rationale for the different categories of carcinogens, refer to the most current edition of the ACGIH's *Threshold Limit Values and Biological Exposure Indices*, the most current edition of the ACGIH's *Documentation of TLVs and BEIs*, and the most current publications of IARC's *Overall Evaluations of Carcinogenicity to Humans.* Both agencies provide information on their websites:

- ACGIH can be found at acgih.org
- IARC can be found at iarc.fr

Section 5.57(1)(b): ACGIH reproductive toxins

ACGIH reproductive toxins are substances described by the ACGIH as having the potential for causing adverse reproductive effects on female and male reproductive organs, tissues or cells, on fertility, on the embryo or fetus, and may result in developmental abnormalities, tumours, and adverse effects on newborns.

ACGIH reproductive toxins are identified as such if reproductive effects are noted in the "TLV Basis" column in the ACGIH's annual publication *Threshold Limit Values and Biological Exposure Indices*, or the potential for adverse reproductive effects are stated in the ACGIH publication *Documentation of TLVs and BEIs*, as amended from time to time.

For reference, the Table of Exposure Limits for Chemical and Biological Substances associated with the OHS Guideline G5.48-2 lists substances that are considered to be an ACGIH reproductive toxin by a letter "R" in the Notations' column.

Section 5.57(1)(c): ACGIH sensitizers

ACGIH sensitizers are substances that have been designated by the ACGIH as having a sensitization effect. As defined in section 1.1 of the *Regulation*, a "sensitizer" is a substance that has been shown to elicit an allergenic type of response in humans after an initial exposure, resulting in development of symptoms upon subsequent exposure at much lower concentrations.

Depending on the substance, workers can become sensitized to the substance through the respiratory system, the skin, and/or the eyes. Sensitization often involves a response by the body's immune system. Initially, there may be little or no response to a sensitizing substance. However, after a worker is sensitized, subsequent exposure may cause severe reactions even at low exposure concentrations, including at levels below the exposure limit.

The ACGIH designates sensitizers in several ways. The designations "SEN," "RSEN," or "DSEN" in the Notations' column of ACGIH's annual publication *Threshold Limit Values and Biological Exposure Indices* refer to the potential for a substance to produce sensitization as confirmed by human or animal data. "DSEN" indicates a substance with specific evidence of sensitization by the dermal route and "RSEN" indicates a substance with specific evidence of sensitization by the respiratory route. Some ACGIH sensitizers are also identified as such if the sensitizing effect is mentioned in the TLV Basis column in the ACGIH's annual publication *Threshold Limit Values and Biological Exposure Indices*.

For reference, the Table of Exposure Limits for Chemical and Biological Substances associated with the OHS Guideline G5.48-2 lists substances considered to be an ACGIH sensitizer by the terms "S," "S(D)," or "S(R)" in the Notations' column.

For an ACGIH sensitizer, the exposure limit is primarily meant to protect workers from becoming sensitized to the substance. However, it is not intended to and likely will not protect those workers who have already become sensitized.

The absence of a sensitization notation by the ACGIH does not mean that a substance lacks the ability to produce sensitization, but may reflect the inconclusiveness of scientific evidence at the time of the publication. Employers still need to protect workers who may be exposed to potential sensitizers in the workplace by implementing appropriate control measures.

Section 5.57(1)(d): L endnote
A substance with an ACGIH "L" endnote is identified with an "L" notation in the "TWA" column of the ACGIH's annual publication *Threshold Limit Values and Biological Exposure Indices*.

The ACGIH defines the "L" endnote as "exposure by all routes should be carefully controlled to levels as low as possible." WorkSafeBC considers substances with this notation to be highly toxic, and which have not been assigned an exposure limit. Examples of substances in this category include benzo(α)pyrene, chrysene, and rosin core solder thermal decomposition products (colophony).

Substitution
Eliminating the potential for worker exposures to carcinogens, reproductive toxins, sensitizers, and other designated substances by substituting it with a less hazardous substance is the preferred approach. However, substitution as a control may not always be practicable in every situation.

To evaluate compliance with section 5.57 of the *Regulation*, the following questions should be considered:

- Is the designated substance essential or integral to the process?
- Are alternative materials available?
- Are the alternatives practicable?
- Are the hazards of the alternative known?
- Is the risk to the worker reduced by the alternative?

Section 5.57(2) of the *Regulation* prescribes that if substitution is not practicable for those substances listed in section 5.57(1) of the *Regulation*, the employer must implement an exposure control plan to ensure a worker's exposure is kept as low as reasonably achievable to levels below the exposure limit. As indicated by section 5.57(3), the exposure control plan must meet the requirements of section 5.54.

Refer to OHS Guidelines G5.54-1 to G5.54-3 for further information on expectations for exposure control plans.

G5.58 Protective policy

Issued August 1, 1999; Revised October 29, 2003; Editorial Revision October 2004; Editorial Revision January 1, 2009

Regulatory excerpt
Section 5.58 of the *OHS Regulation* ("*Regulation*") states:

> (1) At any worksite where a worker is exposed to a substance which is identified in section 5.57(1) as an ACGIH reproductive toxin or an ACGIH sensitizer, the employer must develop policy and procedures appropriate to the risk, which may include protective reassignment.
>
> (2) The policy and procedures required by subsection (1) must
>
> (a) inform workers about the reproductive toxin and identify ways to minimize exposure to the toxin for a worker who has advised the employer of pregnancy or intent to conceive a child, and
>
> (b) identify ways to eliminate or minimize exposure to a sensitizer for a worker who is or may be sensitized to that substance.

Purpose of guideline
The purpose of this guideline is to provide additional information about protective reassignment and exposure control plans.

Protective policy
The policy and procedures may include protective reassignment, meaning that a worker may be relocated from a high-risk to a low-risk work area, based on the risk assessment carried out for the exposure potential.

"Exposure" or routes of exposure in this section include inhalation, ingestion, and skin absorption. The policy and procedures must be appropriate to the level of risk. Since exposure levels to substances exhibiting reproductive and sensitization toxic effects must be kept as low as reasonably achievable, section 5.57(2) of the *Regulation* requires that an exposure control plan be implemented. For example, at a given level of exposure in the workplace, the risk may be minimal. In this case, a policy that informs workers about the material and its reproductive toxicity or sensitizing capability may be all that is required. For further guidance, contact WorkSafeBC.

G5.59 Investigating symptoms

Issued August 1999; Editorial Revision June 26, 2014; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.59 of the *OHS Regulation* ("*Regulation*") states:

> (1) If a worker exhibits signs or reports symptoms of overexposure to a hazardous substance present in the workplace, the employer must investigate and assess the potential for exposure.
>
> (2) If the assessment demonstrates that the signs or symptoms can be caused by exposure to a hazardous substance that is present in the workplace, further investigation must be conducted, in consultation with the joint committee or the worker health and safety representative, as applicable, to address and resolve the worker's concern.
>
> (3) Records of the investigation required under subsection (2) must be made available to workers, and maintained by the employer for a minimum of 10 years.

Purpose of guideline
The purpose of this revised guideline is to provide guidance around investigating possible exposure to a hazardous substance.

Conducting an investigation into possible exposure
Under section 5.59(1) of the *Regulation* the potential for exposure must be investigated and assessed when a worker exhibits signs or reports symptoms of overexposure to a harmful substance present in the workplace. Where signs or symptoms are shown to be associated with workplace exposure, section 5.59(2) requires further investigation to address and resolve the worker's concern. The employer must consult with the joint committee or worker health and safety representative as applicable. These requirements are consistent with sections 3.9 and 3.10 of the *Regulation*, which provide that unsafe or harmful conditions must be investigated and remedied without delay.

The investigation of symptoms should include an initial review of hazardous substances present in the workplace with an emphasis on those materials to which the worker(s) exhibiting signs or symptoms of overexposure may have been exposed. For hazardous products controlled under the *Hazardous Products Act* and the *Hazardous Products Regulations*, this would mean a review of the safety data sheets (SDS) to identify the hazardous ingredients and toxicological properties. For complaints associated with indoor air quality (sections 4.71 to 4.80 of the *Regulation*), fugitive emissions, intermediate reaction products, or environmental contaminants, exploratory air sampling may have to be conducted to identify the contaminant. Once the hazardous substance has been identified, the employer should consider the symptoms workers are experiencing to determine if there is a relationship between the symptoms and the exposure. Not only should the substance be considered, but also the circumstances that give rise to the exposure. If a relationship is found, then a further investigation should be conducted to identify a means of controlling the hazard. When identifying a means of controlling the hazards, the requirements of section 5.55 of the *Regulation* apply.

Section 5.59(3) requires that the investigation be documented, that records are made available to workers, and that records are maintained for a minimum of 10 years. The records should include the following information:

- The signs or symptoms of reported overexposure
- The harmful substance(s) considered in the investigation
- The relationship (if any) between the reported symptoms and exposure to the harmful substance(s) investigated
- Workplace conditions considered, such as locations, tasks, and process conditions
- Any action(s) taken to control the hazard(s)

Explanation of table entries
Table of exposure limits (Updated August 20, 2025)
Download PDF version (532 kb) of the table
Use E-Limit to search the Table of Exposure Limits

Occupational Health and Safety Regulation section 5.48 provides established exposure limits for a worker's exposure to hazardous chemical substances. Generally, these exposure limits are established according to the Threshold Limit Values ("TLVs") adopted by the American Conference of Governmental Industrial Hygienists ("ACGIH"). WorkSafeBC (the Workers' Compensation Board) has the authority to make exceptions and adopt exposure limits for specific chemical substances that are not consistent with the TLVs established by the ACGIH. Policy R5.48-1 sets out those exceptions. The below Table of Exposure Limits for Chemical and Biological Substances shows all exposure limits for British Columbia workplaces, i.e., adopted TLVs and exposure limits developed by exception.

WorkSafeBC publishes this exposure limit table in accordance with its mandate under the *Workers Compensation Act* to provide information and promote public awareness. This table does not represent the official exposure limits and designations. WorkSafeBC does not warrant the accuracy or the completeness of the information in this table, and none of its board of directors, employees or agents shall be liable to any person for any loss or damage of any nature arising from this version.

Where WorkSafeBC has adopted a TLV or ACGIH designation, the official exposure limit is in the ACGIH TLV documentation. Where an exposure limit is adopted by exception, the official exposure limit is found in Policy R5.48-1. The official source of the International Agency for Research on Cancer (IARC) carcinogenicity designations is the IARC set of monographs.

Explanation of table entries

General notes regarding the Table entries:

- Chemicals and other substances are listed in alphabetical order. Numerals and prefixes, for example, 1,3-, tert-, o-, sec-, cis-, are disregarded in determining alphabetical order.
- In square brackets is the Chemical Abstracts Services (CAS) registry number. This is a unique identification number assigned specifically to that substance, and can be a convenient way to identify substances.
- WorkSafeBC reviews and updates this Table as necessary. If the exposure limit for a substance has been revised or newly adopted since January 1, 2003 this Table reports the change with the words "Revised (year)." Each year, new and amended substances, including notation changes, are highlighted for a period of time in the Table. Recent deletions of substances from the Table are shown as strike through (e.g., ~~Emery~~).
- Endnotes: Letters in parentheses indicate endnotes, which are explained at the end of the table. Substances which have an "L" endnote are subject to section 5.57 (Designated substances) of the *OHS Regulation*. For more information see OHS Guideline G5.57.
- For solid and liquid particulate matter, except where the terms inhalable, thoracic, or respirable particulate mass are stated, the exposure limits listed in the table are expressed in terms of "total particulate matter".
- Additional explanation about this table is available at G5.48-2 Annual revisions to exposure limits.

TWA column

This is the 8-hour time weighted average (TWA) limit, as defined in section 5.1 of the *OHS Regulation*.

- Units: Exposure limits are reported in ppm, mg/m^3, or f/cc. In general, substances present in air as a vapour or gas are reported in parts per million (ppm). Substances present in air as an aerosol (dust, fume, mist) and mixtures such as diesel fuel are typically reported in milligrams per cubic metre (mg/m^3). See OHS Guideline G5.48-4 for a procedure to convert from one type of unit to the other. Fibrous substances, such as synthetic vitreous fibres (e.g., glass wool fibres) are reported in fibres per cubic centimetre (f/cc). This is equivalent to fibres per millilitre, or f/ml, which is another common term.

STEL/Ceiling column

This is the short-term exposure limit or STEL, which is defined in section 5.1 of the *OHS Regulation*. Note that:

- "**C**" indicates a ceiling limit, which is defined in section 5.1 of the *OHS Regulation*.
- The units ppm and mg/m^3 are used as in the TWA column.
- In some cases, the term "**simple asphyxiant**" is used. This is a gas or vapour that can displace oxygen in the air, resulting in possible suffocation from lack of oxygen. Because simple asphyxiants do not have other significant toxic effects, an exposure limit is not applicable. The limiting factor is the available oxygen. See section 5.56 of the *OHS Regulation* (Oxygen deficiency).

Notations column

The notations identify substances considered to be carcinogens, sensitizers and those with adverse reproductive effect under section 5.57 of the *OHS Regulation*. Section 5.57 deals with requirements for substitution and keeping exposure as low as reasonably achievable below the exposure limit. The notations column also indicates substances that contribute significantly to overall exposure by the skin route, in which case section 5.52 of the *OHS Regulation* applies. Note that:

- ACGIH notations **A1** and **A2** and IARC notations **1**, **2A** and **2B** indicate substances designated as carcinogens under section 5.57(1) of the *OHS Regulation*. The different categories used by the two organizations indicate different levels of certainty of carcinogenic effect, eg. from confirmed carcinogen to probable or possible. For more information see OHS Guideline G5.57.
- Three terms, "S", "S(D)", and "S(R)", indicate a substance is an ACGIH sensitizer under section 5.57(1) of the OHS Regulation. The ACGIH indicates that a substance is a sensitizer with a "SEN" notation or it states a substance as having a sensitizing effect in the *TLV Basis* column in the ACGIH booklet. "S" indicates that a substance has the potential to produce sensitization, as confirmed by human or animal data. "S(D)" indicates a substance with specific evidence of sensitization by dermal route and "S(R)" indicates a substance with specific evidence of sensitization by respiratory route. The absence of a sensitization notation does not mean that a substance lacks the ability to produce sensitization, but may reflect the inconclusiveness of scientific evidence. For more information, see OHS Guideline G5.57.

- The letter "**R**" means that the substance has an adverse reproductive effect under section 5.57(1) of the *OHS Regulation*. For more information see OHS Guideline G5.57.
- The term **"EX"** means that the substance is a flammable asphyxiant or excursions above the exposure limit could approach 10% of the lower explosive limit.
- The term "**Skin**" identifies substances that contribute significantly to the overall exposure by the skin route. For more information see OHS Guideline G5.52.

Table of exposure limits for chemical and biological substances

Use **E-Limit** to search the Table of Exposure Limits
Updated August 20, 2025

Substance [CAS No.]	TWA	STEL/Ceiling	Notations
Abate (See Temephos)			
Acetaldehyde [75-07-0] Revised 2014		C 25 ppm	A2, 2B
Acetamide [60-35-5]			2B; (I)
Acetamiprid, Inhalable fraction and vapour [135410-20-7]			R; (I)
Acetic acid [64-19-7]	10 ppm	15 ppm	
Acetic anhydride [108-24-7] Revised 2011	1 ppm	3 ppm	
Acetone [67-64-1]	250 ppm	500 ppm	
Acetone cyanohydrin, as CN [75-86-5]		C 1ppm	Skin
Acetonitrile [75-05-8]	20 ppm		Skin
Acetophenone [98-86-2]	10 ppm		R
Acetylene [74-86-2]		Simple asphyxiant	EX
Acetylene tetrabromide (See 1,1,2,2 Tetrabromoethane)			
Acetylsalicylic acid (Aspirin) [50-78-2]	5 mg/m^3		S(R); Skin
Acetylsalicylic acid (Aspirin) [50-78-2]	5 mg/m^3		
Acrolein [107-02-8]		C 0.1 ppm	Skin; 2A
Acrylamide, Inhalable [79-06-1] Revised 2005	0.03 mg/m^3 (V)		S(D); Skin; A2; 2A
Acrylic acid [79-10-7]	2 ppm		Skin; R
Acrylonitrile [107-13-1]	2 ppm		Skin; 2B
Adipic acid [124-04-9]	5 mg/m^3		
Adiponitrile [111-69-3]	2 ppm		Skin
Alachlor, Inhalable [15972-60-8] Revised 2007	1.0 mg/m^3 (V)		S(D)
Aldicarb [116-06-3]			Skin; (I)
Aldrin, Inhalable [309-00-2] Revised 2007	0.05mg/m^3 (V)		2A; Skin
Allyl alcohol [107-18-6]	0.5 ppm		Skin
Allyl amine [107-11-9]	2 ppm		
Allyl bromide [106-95-6]			Skin; (I)
Allyl chloride [107-05-1] Revised 2011	1 ppm	2 ppm	Skin
Allyl glycidyl ether [106-92-3]	1 ppm		
Allyl methacrylate [96-05-9]			Skin; (I)
Allyl propyl disulfide [2179-59-1] Revised 2006	0.5 ppm		S(D)
Aluminum metal and insoluble compounds [7429-90-5] , Respirable, Revised 2008	1.0 mg/m^3		
o-Aminoazotoluene [97-56-3]			2B
4-Aminobiphenyl [92-67-1]	(L)		Skin; A1, 1
1-Amino-2,4-dibromoanthraquinone [81-49-2]			2B
2-Aminopyridine [504-29-0]	0.5 ppm		
Amitrole [61-82-5] Revised 2006	0.2 mg/m^3		R
Ammonia [7664-41-7]	25 ppm	35 ppm	

Ammonium chloride - Fume [12125-02-9]	10 mg/m^3	20 mg/m^3	
Ammonium perfluorooctanoate [3825-26-1]	0.01 mg/m^3		Skin
Ammonium sulfamate [7773-06-0]	10 mg/m^3 (N)		
tert-Amyl methyl ether (TAME) [994-05-8]	20 ppm		R
Aniline [62-53-3]	2 ppm		Skin; 2A
o-Anisidine [90-04-0]	0.5 mg/m^3		Skin; 2A
p-Anisidine [104-94-9]	0.5 mg/m^3		Skin
Anthraquinone [84-65-1]			2B
Antimony and compounds, as Sb [7440-36-0]	0.5 mg/m^3		
Antimony hydride (Stibine) [7803-52-3]	0.1 ppm		
Antimony trioxide, Inhalable [1309-64-4] Adopted 2025	0.02 mg/m^3		A2, 2A
ANTU [86-88-4]	0.3 mg/m^3		Skin
Argon [7440-37-1]		Simple asphyxiant	
Arsenic and inorganic compounds, as As [7440-38-2]	0.01 mg/m^3		A1, 1
Arsine [7784-42-1] Revised 2007	0.005 ppm		
Asbestos - All forms [1332-21-4]	0.1 f/cc (F)		A1, 1
Asphalt (Bitumen) fume, as benzene-soluble aerosol, Inhalable [8052-42-4]	0.5 mg/m^3		2B; (I)
Atrazine [1912-24-9]	5 mg/m^3		R
Azinphos-methyl, Inhalable [86-50-0]	0.2 mg/m^3 (V)		Skin; S(D)
Barium and soluble compounds, as Ba [7440-39-3]	0.5 mg/m^3		
Barium sulfate [7727-43-7], Inhalable, Revised 2018	5 mg/m^3 (E)		
Bendiocarb [22781-23-3]			Skin; (I)
Benomyl, Inhalable [17804-35-2] Revised 2008	1 mg/m^3		R, S(D)
Bensulide, Inhalable fraction and vapour [741-58-2]			(I)
Benz[a]anthracene [56-55-3] Revised 2006	(L)		A2, 2B
Benzene [71-43-2]	0.5 ppm	2.5 ppm	Skin; A1, 1
Benzidine [92-87-5]	(L)		Skin; A1, 1
Benzidine based dyes			2A
Benzo[b]fluoranthene [205-99-2]	(L)		A2, 2B
Benzoic acid and alkali benzoates:			
Benzoic acid [65-85-0], Inhalable fraction and vapour			Skin; (I)
Sodium benzoate, as benzoate [532-32-1], Inhalable			Skin; (I)
Potassium benzoate, as benzoate [582-25-2], Inhalable			Skin; (I)
Benzophenone [119-61-9]			2B
Benzo[a]pyrene [50-32-8] Revised 2006	(L)		A2, 1
1,4-Benzoquinone [106-51-4]	0.1 ppm		S(D)
Benzotrichloride [98-07-7]		C 0.1 ppm	Skin; A2, 2A
Benzoyl chloride [98-88-4]		C 0.5 ppm	2A
Benzoyl peroxide [94-36-0]	5 mg/m^3		
Benzyl acetate [140-11-4]	10 ppm		
Benzyl chloride [100-44-7]		C 1 ppm	2A
Beryllium and compounds, Inhalable, as Be [7440-41-7] Revised 2009; 2010; 2015	0.00005 mg/m^3		A1, 1; Skin; S(D); S(R); (I)
Biphenyl [92-52-4]	0.2 ppm		

Bis(2-dimethylaminoethyl) ether (DMAEE) [3033-62-3]	0.05 ppm	0.15 ppm	Skin
Bismuth telluride - Se-doped [1304-82-1]	5 mg/m^3		
Bismuth telluride - Undoped [1304-82-1]	10 mg/m^3 (N)		
Borate compounds, Inorganic, Inhalable [1303-96-4; 1330-43-4; 10043-35-3; 12179-04-3] Revised 2005	2 mg/m^3	6 mg/m^3	
Boron oxide [1303-86-2]	10 mg/m^3		
Boron tribromide [10294-33-4]		C 1 ppm	
Boron trichloride [10294-34-5]			(I)
Boron trifluoride [7637-07-2] Revised 2020	0.1 ppm	C 1 ppm	
Boron trifluoride ethers, as BF_3 [109-63-7; 353-42-4]	0.1 ppm		
Bromacil [314-40-9]	10 mg/m^3		
Bromine [7726-95-6]	0.1 ppm	0.2 ppm	
Bromine pentafluoride [7789-30-2]	0.1 ppm		
Bromochloroacetic acid [5589-96-8]			2B
Bromochloromethane [74-97-5]	200 ppm	250 ppm	
Bromodichloromethane [75-27-5]			2B
Bromoform [75-25-2] Revised 2009	0.5 ppm		
1-Bromopropane [106-94-5] Revised 2018	0.1 ppm		R; 2B
Buprofezin, Inhalable fraction and vapour [69327-76-0]			S(D); (I)
1,3-Butadiene [106-99-0]	2 ppm		A2, 1
Butane, all isomers: n-butane [106-97-8] and isobutane [75-28-5] Revised 2018		1000 ppm	EX
n-Butanol [71-36-3]	15 ppm	C 30 ppm	
sec-Butanol [78-92-2]	100 ppm		
tert-Butanol [75-65-0]	100 ppm		
Butenes, all isomers, including Isobutene [106-98-9; 107-01-7; 590-18-1; 624-64-6; 25167-67-3; 115-11-7]			(I)
2-Butoxyethanol (EGBE) [111-76-2] Revised 2003	20 ppm		
2-Butoxyethyl acetate [112-07-2] Revised 2003	20 ppm		
1-tert-Butoxypropan-2-ol [57018-52-7]			2B
Butyl acetate, all isomers [105-46-4; 110-19-0; 123-86-4; 540-88-5]	50 ppm	150 ppm	
n-Butyl acrylate [141-32-2]	2 ppm		S(D)
n-Butylamine [109-73-9]		C 5 ppm	Skin
Butylated hydroxytoluene (BHT), Inhalable, (2,6-Di-tert-butyl-p-cresol) [128-37-0]	2 mg/m^3 (V)		
tert-Butyl chromate, as CrO3 [1189-85-1]		C 0.1 mg/m^3	Skin
n-Butyl glycidyl ether (BGE) [2426-08-6] Revised 2005	3 ppm		2B; Skin; S(D); R
tert-Butyl hydroperoxide [75-91-2]			A2; (I)
n-Butyl lactate [138-22-7]	5 ppm		
n-Butyl mercaptan [109-79-5]	0.5 ppm		
n-Butyl methacrylate [97-88-1]	50 ppm		2B
4-tert-Butylbenzoic acid [98-73-7]			(I); Skin; R
o-sec-Butylphenol [89-72-5]	5 ppm		Skin
p-tert-Butyltoluene [98-51-1]	1 ppm		
Cadmium and compounds, as Cd [7440-43-9]	0.01 mg/m^3		A2, 1
Cadmium and compounds, Respirable, as Cd [7440-43-9]	0.002 mg/m^3		A2, 1
Cadusafos [95465-99-9]			Skin; (I)
Calcium carbonate (incl. Limestone, Marble) [1317-65-3]	10 mg/m^3 (N)	20 mg/m^3	

Calcium chromate, as Cr, Total [13765-19-0]	0.001 mg/m^3		A1, 1; Skin; S(D); S(R)
Calcium cyanamide [156-62-7]	0.5 mg/m^3		
Calcium hydroxide [1305-62-0]	5 mg/m^3		
Calcium oxide [1305-78-8]	2 mg/m^3		
Calcium silicate, naturally occurring as Wollastonite, inhalable [13983-17-0] Revised 2020	1 mg/m^3 (E)		
Calcium sulfate, Inhalable [7778-18-9; 10034-76-1; 10101-41-4; 13397-24-5]	10 mg/m^3		
Camphor - Synthetic [76-22-2]	2 ppm	3 ppm	
Caprolactam, Dust [105-60-2]	1 mg/m^3	3 mg/m^3	
Captafol [2425-06-1]	0.1 mg/m^3		2A; S(D); S(R)
Captafol, Inhalable fraction and vapour [2425-06-1]			2A; S(D); S(R); (I)
Captan, Inhalable [133-06-2]	5 mg/m^3		S(D)
Carbaryl [63-25-2] Revised 2008; 2010	5 mg/m^3		Skin; R
Carbazole [86-74-8]			2B
Carbofuran, Inhalable [1563-66-2] Revised 2004	0.1 mg/m^3 (V)		
Carbon black, Inhalable [1333-86-4] Revised 2011	3 mg/m^3		2B
Carbon dioxide [124-38-9]	5000 ppm	15,000 ppm	
Carbon disulfide [75-15-0]	4 ppm	12 ppm	Skin
Carbon monoxide [630-08-0]	25 ppm	100 ppm	R
Carbon tetrabromide [558-13-4]	0.1 ppm	0.3 ppm	
Carbon tetrachloride [56-23-5]	2 ppm		Skin; A2, 2B
Carbonyl fluoride [353-50-4]	2 ppm	5 ppm	
Carbonyl sulfide [463-58-1] Revised 2015	5 ppm		
Carfentrazone-ethyl [128639-02-1]			(I)
Catechol [120-80-9]	5 ppm		Skin; 2B
Cellulose [9004-34-6]	10 mg/m^3 (N)		
Cesium hydroxide [21351-79-1]	2 mg/m^3		
Chlordane [57-74-9]	0.5 mg/m^3		Skin; 2B
Chlordane, Inhalable fraction and vapour [57-74-9]			Skin; 2B; (I)
Chlorinated camphene [8001-35-2]	0.5 mg/m^3	1 mg/m^3	Skin; 2B
o-Chlorinated diphenyl oxide [31242-93-0]	0.5 mg/m^3		
Chlorine [7782-50-5]	0.1 ppm	1 ppm	
Chlorine dioxide [10049-04-4]	0.1ppm	0.3 ppm	
Chlorine trifluoride [7790-91-2]		C 0.1 ppm	
Chloroacetaldehyde [107-20-0]		C 1 ppm	
Chloroacetic acid (monochloroacetic acid) [79-11-8]	0.3 ppm		Skin
Chloroacetone [78-95-5]		C 1 ppm	Skin
2-Chloroacetophenone [532-27-4]	0.05 ppm		
Chloroacetyl chloride [79-04-9]	0.05 ppm	0.15 ppm	Skin
p-Chloroaniline [106-47-8]			2B
Chlorobenzene [108-90-7]	10 ppm		
o-Chlorobenzylidene malononitrile [2698-41-1]		C 0.05 ppm	Skin
Chlorobromomethane (see Bromochloromethane)			
Chlordecone (Kepone) [143-50-0]			2B
1-Chloro-1,1-difluoroethane [75-68-3]	1000 ppm		
Chlorodifluoromethane [75-45-6]	500 ppm	1250 ppm	
Chlorodiphenyl (42% chloride) [53469-21-9]	1 mg/m^3		Skin; 1

Chlorodiphenyl (54% chloride) [11097-69-1]	0.5 mg/m^3		Skin; 1
Chloroform [67-66-3]	2 ppm		2B; R
bis(Chloromethyl) ether [542-88-1]	0.001 ppm		A1, 1
Chloromethyl methyl ether [107-30-2]	(L)		A2, 1
1-Chloro-2-methylpropene [513-37-1]			2B
3-Chloro-2-methylpropene [563-47-3]			2B
1-Chloro-1-nitropropane [600-25-9]	2 ppm		
Chloropentafluoroethane [76-15-3]	1000 ppm		
4-Chloro-ortho-phenylenediamine [95-83-0]			2B
Chloropicrin [76-06-2]	0.1 ppm		
beta-Chloroprene [126-99-8]	10 ppm		A2; 2B; Skin
1-Chloro-2-propanol [127-00-4] Revised 2008	1 ppm		Skin
2-Chloro-1-propanol [78-89-7] Revised 2008	1 ppm		Skin
2-Chloropropionic acid [598-78-7]	0.1 ppm		Skin; R
o-Chlorostyrene [2039-87-4]	50 ppm	75 ppm	
Chlorothalonil [1897-45-6]			2B
o-Chlorotoluene [95-49-8]	50 ppm		
4-Chloro-o-Toluidine [95-69-2]			2A
Chlorotrifluoromethane [75-72-9]	1000 ppm		
Chlorpyrifos, Inhalable [2921-88-2] Revised 2003	0.1 mg/m^3 (V)		Skin
Chromium and inorganic compounds:			
Metallic chromium, as Cr(0), Inhalable [7440-47-3] Adopted 2024	0.5 mg/m^3		
Trivalent chromium compounds, as Cr(III), Total [7440-47-3]	0.5 mg/m^3		S(D); S(R) for water-soluble only
Trivalent chromium compounds, as Cr(III), Inhalable [7440-47-3]			S(D); S(R) for water-soluble only; (I)
Hexavalent chromium compounds, as CR(VI), Total, Insoluble [7440-47-3]	0.01 mg/m^3		A1, 1; S(D); S(R)
Hexavalent chromium compounds, as CR(VI), Total, Water-soluble [7440-47-3]	0.025 mg/m^3	C 0.1 mg/m^3	A1, 1; Skin; S(D); S(R)
Hexavalent chromium compounds, as CR(VI), Inhalable [7440-47-3]			A1, 1; S(D); S(R); Skin for water-soluble only; (I)
Chromyl chloride, as Cr(VI), Total [14977-61-8]	0.025 ppm		A1, 1; Skin; S(D); S(R)
Chromite ore processing (See Trivalent chromium compounds, as Cr(III), Total; and Hexavalent chromium compounds, as Cr(VI), Total)			A1, 1; Skin; S(D); S(R)
Chrysene [218-01-9] Revised 2006	(L)		2B
Citral, inhalable [5392-40-5]			Skin; S(D); (I)
Clopidol [2971-90-6] Revised 2018	10 mg/m^3		
Clothianidin [210880-92-5], Inhalable			(I); R
Coal dust - Anthracite, Respirable [8029-10-5]	0.4 mg/m^3		
Coal dust - Bituminous or Lignite, Respirable [308062-82-0]	0.9 mg/m^3		
Coal tar pitch volatiles, as benzene-soluble aerosol [65996-93-2]	0.2 mg/m^3		A1, 1
Cobalt and inorganic compounds, as Co, Inhalable [7440-48-4] Adopted 2024	0.02 mg/m^3		2A; S(D); S(R); (I)
Cobalt carbonyl, as Co [10210-68-1]	0.1 mg/m^3		2B
Cobalt hydrocarbonyl, as Co [16842-03-8]	0.1 mg/m^3		2B
Copper - Dusts and mists, as Cu [7440-50-8]	1 mg/m^3		
Copper - Fume, as Cu [7440-50-8]	0.2 mg/m^3		
Copper naphthenate, Inhalable fraction and vapour [1338-02-9]			S(D); (I)
Cotton dust - Raw, Untreated, Thoracic, Revised 2011	0.1 mg/m^3		

Coumaphos, Inhalable [56-72-4] Revised 2006	0.05 mg/m^3 (V)		Skin
p-Cresidine [120-71-8]			2B
Cresol, all isomers [95-48-7; 106-44-5; 108-39-4; 1319-77-3]	10 mg/m^3		Skin
Crotonaldehyde [4170-30-3]		C 0.3 ppm	Skin; 2B
Crufomate [299-86-5]	5 mg/m^3		
Cumene [98-82-8] Revised 2025	5 ppm		2B
Cyanamide [420-04-2]	2 mg/m^3		
Cyanazine [21725-46-2]			(I); R
Cyanoacrylates, Ethyl [7085-85-0] and Methyl [137-05-3]	0.2 ppm		S(D); S(R)
Cyanogen [460-19-5]	10 ppm		
Cyanogen bromide [506-68-3]			(I)
Cyanogen chloride [506-77-4]		C 0.3 ppm	
Cyclohexane [110-82-7]	100 ppm		
Cyclohexanol [108-93-0]	50 ppm		Skin
Cyclohexanone [108-94-1] Revised 2003	20 ppm	50 ppm	Skin
Cyclohexene [110-83-8] Revised 2023	20 ppm		
Cyclohexylamine [108-91-8]	10 ppm		
Cyclonite [121-82-4]	0.5 mg/m^3		Skin
Cyclopentane [287-92-3]	600 ppm		EX
Cyhexatin [13121-70-5]	5 mg/m^3		
Cyromazine [66215-27-8], Inhalable			(I)
2,4-D (2,4-Dichlorophenoxy-acetic acid) [94-75-7] (see 2,4-Dichlorophenoxyacetic acid and its esters)			
DDT (Dichloro-diphenyltrichloroethane) [50-29-3]	1 mg/m^3		2A
Decaborane [17702-41-9]	0.05 ppm	0.15 ppm	Skin
Demeton, Inhalable [8065-48-3]	0.05 mg/m^3 (V)		Skin
Demeton-S-methyl, Inhalable [919-86-8]	0.05 mg/m^3 (V)		Skin; S(D)
Desflurane [57041-67-5]			(I)
Diacetone alcohol [123-42-2]	50 ppm		
Diacetyl [431-03-8] Revised 2015	0.01 ppm	0.02 ppm	S(D)
N,N'-Diacetylbenzidine [613-35-4]			2B
2,4-Diaminoanisole [615-05-4]			2B
4,4'-Diaminodiphenyl ether [101-80-4]			2B
2,4-Diaminotoluene [95-80-7]			2B
o-Dianisidine [119-93-7]			2B
Diazinon, Inhalable [333-41-5] Revised 2003	0.01 mg/m^3 (V)		2A; Skin
Diazomethane [334-88-3]	0.2 ppm		A2
Diborane [19287-45-7]	0.1 ppm		
Dibromoacetic acid [631-64-1]			2B
Dibromoacetonitrile [3252-43-5]			2B
1,2-Dibromo-3-chloropropane [96-12-8]			2B
2,3-Dibromopropan-1-ol [96-13-9]			2B
2-N-Dibutylaminoethanol [102-81-8]	0.5 ppm		Skin
Dibutyl phenyl phosphate [2528-36-1]	0.3 ppm		Skin
Dibutyl phosphate [107-66-4] Revised 2009; 2010	1 ppm	2 ppm	Skin
Dibutyl phthalate [84-74-2]	5 mg/m^3		R

Dichloroacetic acid [79-43-6] Revised 2005	0.5 ppm		Skin; 2B; R
Dichloroacetylene [7572-29-4]		C 0.1 ppm	
o-Dichlorobenzene [95-50-1]	25 ppm	50 ppm	
p-Dichlorobenzene [106-46-7]	10 ppm		2B
3,3'-Dichlorobenzidine [91-94-1]	(L)		Skin; 2B
1,4-Dichloro-2-butene [764-41-0]	0.005 ppm		Skin; A2
2,2-Dichlorodiethyl sulfide (Mustard Gas) [505-60-2]			1
Dichlorodifluoromethane [75-71-8]	1000 ppm		
1,3-Dichloro-5,5-dimethylhydantoin [118-52-5]	0.2 mg/m^3	0.4 mg/m^3	
1,1-Dichloroethane [75-34-3]	100 ppm		
1,2-Dichloroethane (see ethylene dichloride)			
1,2-Dichloroethylene, all isomers [540-59-0; 156-59-2; 156-60-5]	200 ppm		
Dichloroethyl ether [111-44-4]	5 ppm	10 ppm	Skin
Dichlorofluoromethane [75-43-4]	10 ppm		
Dichloromethane [75-09-2]	25 ppm		2A
2,2'-Dichloro-n-methyldiethylamine (Nitrogen mustard) [51-75-2]			2A
1,1-Dichloro-1-nitroethane [594-72-9]	2 ppm		
1,3-Dichloro-2-propanol [96-23-1]			2B
1,3-Dichloropropene [542-75-6]	1 ppm		Skin; 2B
2,4-Dichlorophenoxyacetic acid and its esters (2,4-D) [94-75-7] Revised 2006	10 mg/m^3	20 mg/m^3	2B; (I)
2,2-Dichloropropionic acid, Inhalable [75-99-0]	5 mg/m^3		
Dichlorotetrafluoroethane (Cryofluorane) [76-14-2]	1000 ppm		
Dichlorvos (DDVP), Inhalable [62-73-7]	0.1 mg/m^3 (V)		Skin; 2B; S(D)
Dicrotophos, Inhalable [141-66-2]	0.05 mg/m^3 (V)		Skin
Dicyclohexylmethane-4,4'-diisocyanate [5124-30-1] (see Methylene bis (4-cyclohexylisocyanate))			
Dicyclopentadiene [77-73-6] including Cyclopentadiene [542-92-7] Adopted 2024	0.5 ppm		
Dicyclopentadienyl iron, as Fe [102-54-5]	10 mg/m^3 (N)		
Dieldrin [60-57-1]	0.25 mg/m^3		2A; Skin; R
Diesel fuel, as total hydrocarbons, Inhalable [68334-30-5; 68476-30-2; 68476-31-3; 68476-34-6; 77650-28-3]	100 mg/m^3 (V)		Skin; 2B; (I)
Diethanolamine [111-42-2] Revised 2009; 2010	2 mg/m^3		Skin; 2B
Diethylamine [109-89-7]	5 ppm	15 ppm	Skin
2-Diethylaminoethanol [100-37-8]	2 ppm		Skin
Diethylene glycol monobutyl ether [112-34-5]			(I)
Diethylenetriamine [111-40-0]	1 ppm		Skin
Di(2-ethylhexyl)phthalate (DEHP) [117-81-7]	5 mg/m^3		2B; Skin; R
N,N-Diethylhydroxylamine [3710-84-7]			(I)
Diethyl ketone [96-22-0]	200 ppm	300 ppm	
Diethyl phthalate [84-66-2]	5 mg/m^3		
Diethyl sulfate [64-67-5]			2A
Difluorodibromomethane [75-61-6]	100 ppm		
Diglycidyl ether (DGE) [2238-07-5] Revised 2007	0.01 ppm		R
Diglycidyl resorcinol ether [101-90-6]			2B
Dihydrosafrole [94-58-6]			2B
Diisobutyl ketone [108-83-8]	25 ppm		
Diisocyanates, not elsewhere specified, NOS	0.005 ppm	C 0.01ppm	

Diisopropylamine [108-18-9]	5 ppm		Skin
Diisopropyl sulfate [2973-10-6]			2B
Dimethenamid-P, Inhalable fraction and vapour [163515-14-8]			SD; (I)
3,3'-Dimethoxybenzidine [119-90-4]			2B
Dimethoxymethane [109-87-5]	1000 ppm	1250 ppm	
Dimethylacetamide or N,N-Dimethylacetamide [127-19-5]	10 ppm		2B; Skin; R
Dimethylamine [124-40-3]	5 ppm	15 ppm	S(D)
bis(2-Dimethylaminoethyl) ether (DMAEE) [3033-62-3]	0.05 ppm	0.15 ppm	Skin
2,6-Dimethylaniline (2,6-Xylidine) [87-62-7]			2B
Dimethylaniline [121-69-7]	5 ppm	10 ppm	Skin
3,3'-Dimethylbenzidine [119-93-7]			2B
Dimethyl carbamoyl chloride [79-44-7] Revised 2007	0.005 ppm		Skin; A2, 2A
Dimethyl disulfide [624-92-0] Revised 2007	0.5 ppm		Skin
Dimethyl ether [115-10-6]	1000 ppm		
Dimethylethoxysilane [14857-34-2]	0.5 ppm	1.5 ppm	
Dimethylformamide [68-12-2]	5 ppm		Skin; 2A
1,1-Dimethylhydrazine [57-14-7]	0.01 ppm		Skin; 2B
1,2-Dimethylhydrazine [540-73-8]			2A
Dimethylphenol, all isomers [95-65-8; 95-87-4; 105-67-9; 108-68-9; 526-75-0; 576-26-1; 1300-71-6]			S(D); (I)
Dimethyl phthalate [131-11-3]	5 mg/m^3		
Dimethyl sulfate [77-78-1]		C 0.1 ppm	Skin; 2A
Dimethyl sulfide [75-18-3] Revised 2004	10 ppm		
N,N-Dimethyl-p-toluidine [99-97-8]			2B
Dinitolmide [148-01-6] (See 3,5-Dinitro-o-toluamide)			
Dinitrobenzene, all isomers [99-65-0; 100-25-4; 528-29-0; 25154-54-5]	0.15 ppm		Skin
Dinitro-o-cresol [534-52-1]	0.2 mg/m^3		Skin
3,5-Dinitro-o-toluamide [148-01-6] Revised 2007	1 mg/m^3		
Dinitrotoluene [25321-14-6]	0.2 mg/m^3		Skin; 2B; (I); R
n-Dioctyl phthalate [117-84-0]	5 mg/m^3		
1,4-Dioxane [123-91-1]	20 ppm		Skin; 2B
Dioxathion, Inhalable [78-34-2]	0.1 mg/m^3 (V)		Skin
1,3-Dioxolane [646-06-0]	20 ppm		
Diphenylamine [122-39-4]	10 mg/m^3		2B; S(D)
Dipropyl ketone [123-19-3]	50 ppm		
Dipropylene glycol methyl ether (DPGME) [13429-07-7; 13588-28-8; 20324-32-7; 34590-94-8; 55956-21-3] Revised 2025	50 ppm		
Diquat, Inhalable, as the cation [85-00-7; 2764-72-9; 6385-62-2]	0.5 mg/m^3		Skin
Diquat, Respirable, as the cation [85-00-7; 2764-72-9; 6385-62-2]	0.1 mg/m^3		Skin
Disulfiram [97-77-8]	2 mg/m^3		
Disulfoton, Inhalable [298-04-4]	0.05 mg/m^3 (V)		Skin
Diuron [330-54-1]	10 mg/m^3		
Divinylbenzene [1321-74-0]	10 ppm		
Divinylbenzene-ethyl styrene mixtures, as total divinylbenzene isomers [69011-19-4; 7525-62-4; 108-57-6; 105-06-6]			S(D); (I)
Dodecyl mercaptan [112-55-0] Revised 2004	0.1 ppm		S(D)
Dyfonate, Inhalable (Fonofos) [944-22-9] Revised 2006	0.1 mg/m^3 (V)		Skin
Endosulfan [115-29-7] Revised 2009; 2010	0.1 mg/m^3		Skin

Endotoxins, Inhalable [67924-63-4]			(I)
Endrin [72-20-8]	0.1 mg/m^3		Skin
Enflurane [13838-16-9]	2 ppm		R
Epichlorohydrin [106-89-8]	0.1 ppm		2A; A2; S(D); Skin
EPN, Inhalable [2104-64-5] Revised 2003	0.1 mg/m^3		Skin
EPN, Inhalable fraction and vapour [2104-64-5]			Skin; (I)
1,2-Epoxybutane [106-88-7]			2B
Ethane [74-84-0] Revised 2018		simple asphyxiant	EX
Ethanol [64-17-5] Revised 2009		1000 ppm	
Ethanolamine [141-43-5]	3 ppm	6 ppm	
Ethion, Inhalable [563-12-2] Revised 2003	0.05 mg/m^3 (V)		Skin
2-Ethoxyethanol (EGEE) [110-80-5]	5 ppm		Skin; R
2-Ethoxyethyl acetate (EGEEA) [111-15-9]	5 ppm		Skin; R
Ethyl acetate [141-78-6]	150 ppm		
Ethyl acrylate [140-88-5]	5 ppm	15 ppm	2B; S(D)
Ethylamine [75-04-7]	5 ppm	15 ppm	Skin
Ethyl amyl ketone [541-85-5] Revised 2007	10 ppm		
Ethylbenzene [100-41-4] Revised 2011	20 ppm		2B
Ethyl bromide [74-96-4]	5 ppm		Skin
Ethyl tert-butyl ether (ETBE) [637-92-3] Revised 2018	25 ppm		
Ethyl butyl ketone [106-35-4]	50 ppm	75 ppm	
Ethyl chloride [75-00-3]	100 ppm		Skin
Ethyl methacrylate [97-63-2]	50 ppm		
Ethylene [74-85-1] Revised 2005	200 ppm		
Ethylene chlorohydrin [107-07-3]		C 1 ppm	Skin
Ethylenediamine [107-15-3]	10 ppm		Skin
Ethylene dibromide [106-93-4]	0.5 ppm		Skin; 2A
Ethylene dichloride (1,2-dichloroethane) [107-06-2]	1 ppm	2 ppm	2B
Ethylene glycol, Inhalable, aerosol only [107-21-1]			(I)
Ethylene glycol, Total, aerosol only [107-21-1]	10 mg/m^3	20 mg/m^3; C 100 mg/m^3	
Ethylene glycol, Vapour [107-21-1]		C 50 ppm	
Ethylene glycol dimethyl ether [110-71-4]			Skin; R; (I)
Ethylene glycol dinitrate (EGDN) [628-96-6]	0.05 ppm		Skin
Ethylene oxide [75-21-8]	0.1 ppm	1 ppm	A2, 1
Ethyleneimine [151-56-4] Revised 2009; 2010	0.5 ppm		Skin; 2B
Ethyl ether [60-29-7]	400 ppm	500 ppm	
Ethyl formate [109-94-4] Revised 2015		100 ppm	
2-Ethylhexanoic acid, Inhalable [149-57-5]	5 mg/m^3 (V)		R
2-Ethyl-1-hexanol [104-76-7]			(I)
Ethylidene norbornene [16219-75-3]		C 5 ppm	
Ethyl isocyanate [109-90-0]	0.02 ppm	0.06 ppm	Skin; S(D); (I)
Ethyl mercaptan [75-08-1]	0.5 ppm		
N-Ethylmorpholine [100-74-3]	5 ppm		Skin
Ethyl silicate [78-10-4]	10 ppm		
Fenamiphos, Inhalable [22224-92-6] Revised 2006	0.05 mg/m^3 (V)		Skin
Fenoxycarb, Inhalable [72490-01-8]			(I)

Fensulfothion, Inhalable [115-90-2] Revised 2005	0.01 mg/m^3 (V)		Skin
Fentanyl [437-38-7] and Fentanyl Citrate [990-73-8], as Fentanyl, Inhalable [990-73-8] Revised 2025	0.0001 mg/m^3		Skin
Fenthion, Inhalable [55-38-9] Revised 2006	0.05 mg/m^3 (V)		Skin
Ferbam, Inhalable [14484-64-1] Revised 2009	5 mg/m^3		
Ferrovanadium dust [12604-58-9]	1 mg/m^3	3 mg/m^3	
Flour dust, Inhalable	0.5 mg/m^3		S(R)
Fludioxonil [131341-86-1]			(I)
Fluorides, as F	2.5 mg/m^3		
Fluorine [7782-41-4]	0.1 ppm		
Fluorine, as F [7782-41-4]			(I)
Fluroxene [406-90-6]	2 ppm		
Folpet [133-07-3]			S(D); (I)
Fonofos (see Dyfonate) [944-22-9]			
Formaldehyde [50-00-0] Revised 2020	0.1 ppm	0.3 ppm	A1, 1; S(D); S(R)
Formamide [75-12-7]	10 ppm		R; Skin
Formic acid [64-18-6]	5 ppm	10 ppm	
Furan [110-00-9]			2B
Furfural [98-01-1] Revised 2020	0.2 ppm		Skin
Furfuryl alcohol [98-00-0]	5 ppm	10 ppm	2B; Skin
Gallium arsenide, Respirable [1303-00-0] Revised 2005	0.0003 mg/m^3		1
Gasoline [86290-81-5]	300 ppm	500 ppm	2B
Germanium tetrahydride [7782-65-2]	0.2 ppm		
Glutaraldehyde, Activated & unactivated [111-30-8]		C 0.05 ppm	S(D); S(R)
Glycerin - mist, Total [56-81-5]	10 mg/m^3		
Glycerin - mist, Respirable [56-81-5]	3 mg/m^3		
Glycidol [556-52-5]	2 ppm		2A
Glycidyl methacrylate [106-91-2]			A2; 2A; S(D); Skin; (I)
Glyoxal, Inhalable [107-22-2]	0.1 mg/m^3 (V)		S(D)
Glyphosate [1071-83-6]			2A; (I)
Grain dust (oat, wheat, barley)	4 mg/m^3		
Graphite - All forms except graphite fibres, Respirable [7782-42-5]	2 mg/m^3		
Gypsum [13397-24-5]	10 mg/m^3 (N)	20 mg/m^3	
Hafnium and compounds, as Hf [7440-58-6]	0.5 mg/m^3		
Halothane [151-67-7]	2 ppm		R
Hard metals, containing Cobalt and Tungsten Carbide, as Co, Thoracic [7440-48-4; 12070-12-1]	0.005 mg.m^3		A2; 2A; S(R); (I)
Helium [7440-59-7]		Simple asphyxiant	
Heptachlor [76-44-8]	0.05 mg/m^3		Skin; 2B
Heptachlor epoxide [1024-57-3]	0.05 mg/m^3		Skin
Heptane, Isomers [108-08-7; 142-82-5; 565-59-3; 589-34-4; 590-35-2; 591-76-4]	400 ppm	500 ppm	
Heptane, straight and branched isomers [562-49-2; 31394-54-4; 617-78-7; 464-06-2]			(I)
Hexachlorobenzene (HCB) [118-74-1]	0.002 mg/m^3		Skin; 2B

Hexachlorobutadiene [87-68-3]	0.02 ppm		Skin
Hexachlorocyclopentadiene [77-47-4]	0.01 ppm		
Hexachloroethane [67-72-1]	1 ppm		Skin; 2B
Hexachloronaphthalene [1335-87-1]	0.2 mg/m^3		Skin
2,4-Hexadienal [142-83-6]			2B
Hexafluoroacetone [684-16-2]	0.1 ppm		Skin; R
Hexafluoropropylene [116-15-4] Revised 2007	0.1 ppm		
Hexahydrophthalic anhydride, all isomers, Inhalable [85-42-7; 13149-00-3; 14166-21-3] Revised 2004		C 0.005 mg/m^3 (V)	S(R)
Hexamethylene diisocyanate (HDI) [822-06-0]	0.005 ppm	C 0.01 ppm	S(R)
Hexamethylenetetramine, Inhalable fraction and vapour [100-97-0]			S(D); (I)
Hexamethyl phosphoramide [680-31-9]			Skin; 2B
n-Hexane [110-54-3]	20 ppm		Skin
Hexane (Commercial, <54% n-Hexane) and the branched hexane isomers Adopted 2025:			
Hexane (Commercial, <54% n-Hexane) [various, including 64742-49-0; 64742-89-8]	100 ppm		Skin
Branched Hexane isomers [75-83-2; 79-29-8; 96-14-0; 107-83-5]	200 ppm		
1,6-Hexanediamine [124-09-4]	0.5 ppm		
Hexazinone [51235-04-2]			(I)
1-Hexene [592-41-6]	50 ppm		
sec-Hexyl acetate [108-84-9] Revised 2025	20 ppm	50 ppm	
Hexylene glycol, Inhalable, aerosol only [107-41-5]			(I)
Hexylene glycol, vapour [107-41-5]			(I)
Hydrazine [302-01-2]	0.01 ppm		Skin; 2A
Hydrogen [1333-74-0]		Simple asphyxiant	EX
Hydrogenated terphenyls - Nonirradiated [61788-32-7]	0.5 ppm		
Hydrogen bromide [10035-10-6] Revised 2004		C 2 ppm	
Hydrogen chloride [7647-01-0] Revised 2006		C 2 ppm	
Hydrogen cyanide, as CN [74-90-8]		C 4.7 ppm	Skin
Cyanide salts, as CN [143-33-9; 151-50-8; 592-01-8]		C 5 mg/m^3	Skin
Hydrogen fluoride, as F [7664-39-3]		C 2 ppm	Skin
Hydrogen peroxide [7722-84-1]	1 ppm		
Hydrogen selenide [7783-07-5]	0.05 ppm		
Hydrogen sulfide [7783-06-4]		C 10 ppm	
Hydroquinone [123-31-9] Revised 2008	1 mg/m^3		S(D)
2-Hydroxypropyl acrylate [999-61-1]	0.5 ppm		Skin; S(D)
Imidacloprid, Inhalable [138261-41-3]			R; (I)
Imazosulfuron [122548-33-8], Inhalable			(I)
Indene [95-13-6] Revised 2008; 2010	10 ppm		
Indium and compounds, as In [7440-74-6]	0.1 mg/m^3		2A; 2B; (I)
Indium tin oxide, as In [50926-11-9], Respirable			2B; S(D); (I)
Iodine and iodides:			
Iodides			R; Skin; (I)
Iodides, as I [various], Inhalable			R; Skin; (I)
Iodine [7553-56-2] Revised 2008; 2010		C 0.1 ppm	R; Skin
Iodine, as I [7553-56-2], Inhalable fraction and vapour			R; Skin; (I)
Iodoform, as elemental Iodine [75-47-8]	0.6 ppm		R; Skin
Iodoform, as elemental Iodine [75-47-8], Inhalable fraction and vapour			Skin; R; (I)
Iron oxide dust, as Fe [1309-37-1]	5 mg/m^3		

Iron oxide fume , as Fe [1309-37-1]	5 mg/m^3	10 mg/m^3	
Iron pentacarbonyl [13463-40-6]	0.01 ppm		
Iron salts - soluble, as Fe	1 mg/m^3	2 mg/m^3	
Isoamyl alcohol [123-51-3]	100 ppm	125 ppm	
Isobutanol [78-83-1]	50 ppm		
Isobutyl nitrite, Inhalable [542-56-3]		C 1 ppm (V)	2B
Isobutyl nitrite, Total [542-56-3]			2B; (I)
Isoflurane [26675-46-7]			R; (I)
Isooctyl alcohol [26952-21-6]	50 ppm		Skin
Isophorone [78-59-1]		C 5 ppm	2B
Isophorone diisocyanate [4098-71-9]	0.005 ppm	C 0.01 ppm	S(R)
Isoprene [78-79-5]			2B
Isopropanol (Isopropyl alcohol, 2-Propanol) [67-63-0] Revised 2003	200 ppm	400 ppm	
2-Isopropoxyethanol [109-59-1]	25 ppm		Skin
Isopropylamine [75-31-0] Revised 2025	2 ppm	5 ppm	Skin
N-Isopropylaniline [768-52-5]	2 ppm		Skin
Isopropyl ether [108-20-3] Revised 2025	20 ppm		R
Isopropyl glycidyl ether (IGE) [4016-14-2]		C 50 ppm	
Kaolin, Respirable [1332-58-7]	2 mg/m^3 (E)		
Kerosene [8008-20-6; 64742-81-0]/Jet fuels, as total hydrocarbon vapour, Revised 2003	200 mg/m^3 (P)		Skin
Ketene [463-51-4]	0.5 ppm	1.5 ppm	
Lead - elemental and inorganic compounds, as Pb [7439-92-1]	0.05 mg/m^3		Elemental 2B; R Other inorganic 2A; R
Lead chromate, as Cr(VI), Total (See Hexavalent chromium compounds, as Cr(VI), Total) [7758-97-6]			A1, 1; S(D); S(R); R; (I)
Lead chromate, as Cr(VI), Inhalable [7758-97-6]			A1, 1; S(D); S(R); R; (I)
Lindane [58-89-9]	0.5 mg/m^3		1; Skin
Liquified petroleum gas (L.P.G.) [68476-85-7] Revised 2020		Simple asphyxiant	EX
Lithium hydroxide [1310-65-2]		C 1 mg/m^3	
Lithium hydride [7580-67-8]	0.025 mg/m^3		
Magnesite [546-93-0] Revised 2006 (See Particles Not Otherwise Classified (PNOC))			
Magnesium oxide (fume), Inhalable [1309-48-4] Revised 2003	10 mg/m^3		
Magnesium oxide, Respirable dust and fume, as Mg [1309-48-4]	3 mg/m^3	10 mg/m^3	
Malathion, Inhalable [121-75-5] Revised 2003	1 mg/m^3 (V)		2A; Skin
Maleic anhydride [108-31-6]	0.1 ppm		S(D); S(R)
Manganese - Elemental & inorganic compounds, as Mn, Respirable [7439-96-5] Revised 2018	0.02 mg/m^3		R
Manganese - Elemental & inorganic compounds, as Mn, Inhalable [7439-96-5] Adopted 2024	0.1 mg/m^3		R
Manganese cyclopentadienyl tricarbonyl, as Mn [12079-65-1]	0.1 mg/m^3		Skin
Melamine [108-78-1]			2B
Mercury - Alkyl compounds, as Hg [7439-97-6]	0.01 mg/m^3	0.03 mg/m^3	Skin; R
Mercury - Aryl compounds, as Hg [7439-97-6]	0.05 mg/m^3	C 0.1 mg/m^3	Skin; R
Mercury - Elemental, as Hg [7439-97-6]	0.025 mg/m^3		Skin; R

Mercury - Inorganic compounds, as Hg [7439-97-6]	0.025 mg/m^3		Skin; R
Mercury - Methyl, as Hg [7439-97-6]	0.01 mg/m^3	0.03 mg/m^3	Skin; 2B; R
Mesityl oxide [141-79-7]	10 ppm	25 ppm	
Methacrylic acid [79-41-4]	20 ppm		
Methane [74-82-8] Revised 2018		Simple asphyxiant	EX
Methanol [67-56-1]	200 ppm	250 ppm	Skin
Methomyl [16752-77-5]	2.5 mg/m^3		Skin; R
Methoxychlor [72-43-5]	10 mg/m^3		
2-Methoxyethanol (EGME) [109-86-4] Revised 2006	0.1 ppm		Skin; R
2-Methoxyethyl acetate (EGMEA) [110-49-6] Revised 2006	0.1 ppm		Skin; R
Methoxyflurane [76-38-0]	2 ppm		
4-Methoxyphenol [150-76-5]	5 mg/m^3		
1-Methoxy-2-propanol (PGME) [107-98-2] Revised 2018	50 ppm	100 ppm	
2-Methoxy-1-propanol [1589-47-5]	20 ppm	40 ppm	
1-Methoxypropyl-2-acetate [108-65-6]	50 ppm	75 ppm	
2-Methoxypropyl-1-acetate [70657-70-4]	20 ppm	40 ppm	
bis-(2-Methoxypropyl) ether (DPGME) (see Dipropylene glycol methyl ether) [34590-94-8]			
Methyl acetate [79-20-9]	200 ppm	250 ppm	
Methyl acetylene [74-99-7]	1000 ppm		EX
Methyl acetylene-propadiene mixture (MAPP) [59355-75-8]	1000 ppm	1250 ppm	EX
Methyl acrylate [96-33-3]	2 ppm		2B; Skin; S(D)
Methylacrylonitrile [126-98-7]	1 ppm		Skin
Methylal (see Dimethoxymethane) [109-87-5]			
Methylamine [74-89-5]	5 ppm	15 ppm	
Methyl n-amyl ketone [110-43-0]	50 ppm		
N-Methylaniline [100-61-8]	0.5 ppm		Skin
Methylarsonic acid [124-58-3]			2B
Methyl bromide [74-83-9]	1 ppm		Skin
2-Methyl-2-butene [513-35-9]			(I)
Methyl tert-butyl ether (MTBE) [1634-04-4]	50 ppm		
Methyl n-butyl ketone [591-78-6] Revised 2008	5 ppm	10 ppm	Skin; R
Methyl chloride [74-87-3]	50 ppm	100 ppm	Skin; R
Methyl chloroform [71-55-6]	350 ppm	450 ppm	2A
Methylcyclohexane [108-87-2] Revised 2025	100 ppm		
Methylcyclohexanol [25639-42-3]	50 ppm		
o-Methylcyclohexanone [583-60-8]	50 ppm	75 ppm	
Methylcyclohexanone, all isomers [591-24-2; 589-92-4; 1331-22-2]			(I)
2-Methylcyclopentadienyl manganese tricarbonyl, as Mn [12108-13-3]	0.2 mg/m^3		Skin
Methyl demeton, Inhalable [8022-00-2] Revised 2007	0.05 mg/m^3 (V)		Skin
Methylene bisphenyl isocyanate (MDI) [101-68-8]	0.005 ppm	C 0.01 ppm	S(R)
4,4'-Methylene bis(2-chloroaniline) (MBOCA; MOCA) [101-14-4] Revised 2009	0.01 ppm		Skin; A2, 1
Methylene bis (4-cyclohexylisocyanate), [5124-30-1]	0.005 ppm	C 0.01 ppm	S(R)
Methylene chloride (See Dichloromethane)			
4,4'-Methylene dianiline [101-77-9]	0.01 ppm		Skin; 2B
Methyl ethyl ketone (MEK) [78-93-3]	50 ppm	100 ppm	R; Skin
Methyl ethyl ketone peroxide (MEKP) [1338-23-4]		C 0.2 ppm	
Methyleugenol [93-15-2]			2A

Methyl formate [107-31-3] Revised 2018	50 ppm	100 ppm	Skin
Methyl hydrazine [60-34-4]	0.01 ppm		Skin
4-Methylimidazole [693-98-1]			2B
Methyl iodide [74-88-4]	2 ppm		Skin
Methyl isoamyl ketone [110-12-3] Revised 2018	20 ppm	50 ppm	
Methyl isobutyl carbinol [108-11-2] Revised 2023	20 ppm	40 ppm	
Methyl isobutyl ketone [108-10-1] Revised 2011	20 ppm	75 ppm	2B
Methyl isocyanate [624-83-9] Revised 2018	0.02 ppm	0.06 ppm	Skin; S(D)
Methyl isopropyl ketone [563-80-4] Revised 2011	20 ppm		R
Methyl mercaptan [74-93-1]	0.5 ppm		
Methyl methacrylate [80-62-6]	50 ppm	100 ppm	S(D)
1-Methyl naphthalene [90-12-0] Revised 2007	0.5 ppm		Skin
2-Methyl naphthalene [91-57-6] Revised 2007	0.5 ppm		Skin
Methylnapthalene, all isomers [90-12-0, 91-57-6, 1321-94-4]			Skin; (I)
Methyl parathion [298-00-0] Revised 2009; 2010	0.2 mg/m^3		Skin
Methyl propyl ketone (2-pentanone) [107-87-9]	150 ppm	250 ppm	
Methyl silicate [681-84-5]	1 ppm		
alpha-Methylstyrene [98-83-9] Revised 2015	10 ppm		R; 2B
Methyltetrahydrophthalic anhydride isomers [3425-89-6; 5333-84-6; 11070-44-3; 19438-64-3; 26590-20-5; 42498-58-8]			Skin; S(D); S(R); (I)
Methyl vinyl ketone [78-94-4]		C 0.2 ppm	
Metribuzin [21087-64-9]	5 mg/m^3		
Metribuzin, Inhalable [21087-64-9]			(I)
Mevinphos, Inhalable [7786-34-7] Revised 2003	0.01 mg/m^3 (V)		Skin
Mica, <1% silica, Respirable [12001-26-2] Revised 2025	0.1 mg/m^3		(I)
Molybdenum - Metal and insoluble compounds, as Mo, Respirable [7439-98-7]	3 mg/m^3		
Molybdenum - Metal and insoluble compounds, as Mo, Inhalable [7439-98-7]	10 mg/m^3		
Molybdenum - Soluble compounds, as Mo, Respirable [7439-98-7]	0.5 mg/m^3		
Molybdenum trioxide [1313-27-5]			2B
Monochloroacetic acid [79-11-8] See Chloroacetic acid			
3-Monochloro-1,2-propanediol [96-24-2]			2B
Monocrotophos, Inhalable [6923-22-4]	0.05 mg/m^3 (V)		Skin
Monomethylformamide [123-39-7]			R; Skin; (I)
Morpholine [110-91-8]	20 ppm		Skin
beta-Myrcene [123-35-3]			2B
Naled, Inhalable [300-76-5]	0.1 mg/m^3 (V)		Skin; S(D)
Naphthalene [91-20-3] Revised 2018	10 ppm		Skin; 2B
1,5-Naphthalene diisocyanate [3173-72-6]	0.005 ppm	C 0.01 ppm	
beta-Naphthylamine (2-Naphthylamine) [91-59-8]	(L)		A1, 1
Natural gas [8006-14-2] Revised 2018		Simple asphyxiant	EX
Natural rubber latex, as total proteins, Inhalable [9006-04-6] Revised 2004; 2008; 2010	0.001 mg/m^3		Skin; S(D); S(R)
Neon [7440-01-9]		Simple asphyxiant	
Nickel - Insoluble inorganic compounds, as Ni [7440-02-0]	0.05 mg/m^3		A1, 1; (I)

Nickel - Elemental, Soluble inorganic compounds, as Ni [7440-02-0]	0.05 mg/m^3		1, 2B; (I)
Nickel carbonyl, as Ni [13463-39-3] Revised 2018	0.001 ppm	C 0.05 ppm	1; (I)
Nickel subsulfide, as Ni, Inhalable [12035-72-2]	0.1 mg/m^3		A1, 1
Nicotine [54-11-5]	0.5 mg/m^3		Skin
Nicotine, Inhalable fraction and vapour [54-11-5]			Skin; (I)
Nitrapyrin [1929-82-4]	10 mg/m^3 (N)	20 mg/m^3	
Nitrapyrin, Inhalable fraction and vapour [1929-82-4]			(I)
Nitric acid [7697-37-2]	2 ppm	4 ppm	
Nitric oxide [10102-43-9]	25 ppm		
p-Nitroaniline [100-01-6]	3 mg/m^3		Skin
2-Nitroanisole [91-23-6]			2A
3-Nitrobenzanthrone [17117-34-9]			2B
Nitrobenzene [98-95-3]	1 ppm		Skin; 2B
p-Nitrochlorobenzene [100-00-5]	0.1 ppm		2B; Skin
4-Nitrodiphenyl [92-93-3]	(L)		Skin; A2
Nitroethane [79-24-3]	100 ppm		
2-Nitrofluorene [607-57-8]			2B
Nitrogen [7727-37-9]		Simple asphyxiant	
Nitrogen dioxide [10102-44-0]		C 1 ppm	
Nitrogen trifluoride [7783-54-2]	10 ppm		
Nitroglycerin (NG) [55-63-0]	0.05 ppm		Skin
Nitromethane [75-52-5]	20 ppm		2B
1-Nitropropane [108-03-2]	25 ppm		
2-Nitropropane [79-46-9]	5 ppm		2B
Nitropyrene, mono, di, tri, tetra, isomers [42397-64-8; 42397-65-9; 5522-43-0; 57835-92-4; 75321-20-9]			2A; 2B; (I)
n-Nitrosodiethanolamine [1116-54-7]			2B
n-Nitrosodiethylamine [55-18-5]			2A
n-Nitrosodimethylamine [62-75-9]	(L)		Skin; 2A
n-Nitrosomethylethylamine [10595-95-6]			2B
n-Nitrosomethylvinylamine [4549-40-0]			2B
n-Nitrosomorpholine [59-89-2]			2B
n-Nitrosopiperidine [100-75-4]			2B
n-Nitrosopyrrolidine [930-55-2]			2B
Nitrotoluene, all isomers [88-72-2; 99-08-1; 99-99-0]	2 ppm		Skin; 2A; (I)
5-Nitro-o-toluidine, Inhalable [99-55-8] Revised 2007	1 mg/m^3		
5-Nitro-o-toluidine, Inhalable fraction and vapour [99-55-8]			(I)
Nitrous oxide [10024-97-2]	25 ppm		R
Nonane [111-84-2] Revised 2015	200 ppm		
Octachloronaphthalene [2234-13-1]	0.1 mg/m^3	0.3 mg/m^3	Skin
Octane, all isomers [111-65-9]	300 ppm		
Oil mist - mineral, mildly refined	0.2 mg/m^3		1
Oil mist - mineral, severely refined	1 mg/m^3		
Osmium tetroxide, as Os [20816-12-0]	0.0002 ppm	0.0006 ppm	
Oxalic acid, anhydrous [144-62-7] and dihydrate [6153-56-6] Revised 2018	1 mg/m^3	2 mg/m^3	
p,p'-Oxybis(benzenesulfonyl hydrazide), Inhalable [80-51-3] Revised 2008	0.1 mg/m^3		R
Oxygen difluoride [7783-41-7]		C 0.05 ppm	

Ozone - Heavy work [10028-15-6]	0.05 ppm		
Ozone - Moderate work [10028-15-6]	0.08 ppm		
Ozone - Light work [10028-15-6]	0.1 ppm		
Ozone - Light, mod., or heavy workload =/< 2 hrs [10028-15-6]	0.2 ppm		
Paraffin wax fume [8002-74-2]	2 mg/m^3		
Paraquat, as the cation, Respirable [4685-14-7]	0.1 mg/m^3		Skin
Paraquat, as the cation, Total [4685-14-7]	0.5 mg/m^3		Skin
Paraquat, as the cation, Inhalable [4685-14-7]	0.1 mg/m^3		Skin; (I)
Parathion, Inhalable [56-38-2] Revised 2003	0.05 mg/m^3 (V)		2B; Skin
Particles (Insoluble or Poorly Soluble) Not Otherwise Classified (PNOC)	10 mg/m^3 (N)		
Pentaborane [19624-22-7]	0.005 ppm	0.015 ppm	Skin
Pentachloronaphthalene [1321-64-8]	0.5 mg/m^3		Skin
Pentachloronaphthalene, Inhalable fraction and vapour [1321-64-8]			Skin; (I)
Pentachloronitrobenzene [82-68-8]	0.5 mg/m^3		
Pentachlorophenol [87-86-5]	0.5 mg/m^3		1; Skin
Pentaerythritol [115-77-5]	10 mg/m^3 (N)		
Pentane, all isomers [78-78-4; 109-66-0; 463-82-1] Revised 2018	1000 ppm		
2,4-Pentanedione [123-54-6]			Skin; (I)
Pentyl acetate, all isomers [123-92-2; 620-11-1; 624-41-9; 625-16-1; 626-38-0; 628-63-7]	50 ppm	100 ppm	
Peracetic acid [79-21-0]			(I)
Perchloroethylene (See Tetrachloroethylene)			
Perchloromethyl mercaptan [594-42-3]	0.1 ppm		
Perchloryl fluoride [7616-94-6]	3 ppm	6 ppm	
Perfluorobutyl ethylene [19430-93-4] Revised 2004	100 ppm		
Perfluoroisobutylene [382-21-8]		C 0.01 ppm	
Perlite [93763-70-3] Revised 2006 (See Particles Not Otherwise Classified (PNOC))			
Persulfates, as persulfate [7727-21-1; 7727-54-0; 7775-27-1]	0.1 mg/m^3		
Phenol [108-95-2]	5 ppm		Skin
Phenolpththalein [77-09-8]			2B
Phenothiazine [92-84-2]	5 mg/m^3		Skin; S(D)
Phenothiazine [92-84-2], Inhalable			Skin; (I)
N-Phenyl-beta-naphthylamine [135-88-6]	(L)		
m-Phenylenediamine [108-45-2]	0.1 mg/m3		
o-Phenylenediamine [95-54-5]	0.1 mg/m^3		2B
m-Phenylenediamine [108-45-2]	0.1 mg/m^3		
p-Phenylenediamine [106-50-3]	0.1 mg/m^3		S(D)
Phenyl ether - Vapour (Diphenyl ether) [101-84-8]	1 ppm	2 ppm	
Phenylethyl alcohol [60-12-8]			R; Skin; (I)
Phenyl glycidyl ether (PGE) [122-60-1] Revised 2008	0.1 ppm		2B; Skin; S(D); R
Phenylhydrazine [100-63-0]	0.1 ppm		Skin
Phenyl isocyanate [103-71-9]	0.005 ppm	0.015 ppm	Skin; S(D); S(R)
Phenyl mercaptan [108-98-5]		C 0.1 ppm	Skin
Phenylphosphine [638-21-1]		C 0.05 ppm	R
Phorate, Inhalable [298-02-2] Revised 2005	0.05 mg/m^3 (V)		Skin
Phosgene [75-44-5]	0.1 ppm		
Phosphine [7803-51-2]	0.3 ppm	1 ppm	

Phosphoric acid [7664-38-2]	1 mg/m^3	3 mg/m^3	
Phosphorus (yellow) [12185-10-3]	0.1 mg/m^3		
Phosphorus oxychloride [10025-87-3]	0.1 ppm		
Phosphorus pentachloride [10026-13-8]	0.1 ppm		
Phosphorus pentasulfide [1314-80-3]	1 mg/m^3	3 mg/m^3	
Phosphorus trichloride [7719-12-2]	0.2 ppm	0.5 ppm	
o-Phthalaldehyde [643-79-8]			Skin; S(D); S(R); (I)
Phthalic anhydride [85-44-9]	1 ppm		S(D); S(R); Skin
Phthalic anhydride, Inhalable fraction and vapour [85-44-9]			S(D); S(R); Skin (I)
m-Phthalodinitrile, Inhalable [626-17-5] Revised 2009	5 mg/m^3 (V)		
o-Phthalodinitrile [91-15-6]			(I)
Picloram [1918-02-1]	10 mg/m^3 (N)		
Picric acid [88-89-1]	0.1 mg/m^3		S(D)
Pindone [83-26-1]	0.1 mg/m^3		
Piperazine and its Salts, as Piperazine [110-85-0]	0.3 mg/m^3	1 mg/m^3	S(D); S(R)
Piperidine [110-89-4]	1 ppm		
Plaster of Paris [26499-65-0]	10 mg/m^3 (N)	20 mg/m^3	
Platinum - Metal [7440-06-4]	1 mg/m^3		
Platinum - Soluble salts (as Pt) [7440-06-4]	0.002 mg/m^3		
Polyvinyl chloride (PVC), Respirable [9002-86-2] Revised 2008	1 mg/m^3		
Portland cement, Respirable [65997-15-1] Revised 2015	1 mg/m^3 (E)		
Potassium bromate [7758-01-2]			2B
Potassium hydroxide [1310-58-3]		C 2 mg/m^3	
Prometon [1610-18-0], Inhalable			(I)
Prometryn [7287-19-6], Inhalable			R; (I)
Propane [74-98-6] Revised 2018		Simple asphyxiant	EX
Propane sultone [1120-71-4]	(L)		2A
n-Propanol (n-Propyl alcohol) [71-23-8] Revised 2007	100 ppm		
2-Propanol [67-63-0] (see Isopropanol)			
Propargyl alcohol [107-19-7]	1 ppm		Skin
beta-Propiolactone [57-57-8]	0.5 ppm		2B
Propionaldehyde [123-38-6]	20 ppm		
Propionic acid [79-09-4]	10 ppm		
Propionitrile [107-12-0]			R; Skin; (I)
Propoxur [114-26-1]	0.5 mg/m^3		
Propyl acetate isomers [108-21-4; 109-60-4]	100 ppm	150 ppm	
Propylene [115-07-1] Revised 2006	500 ppm		
Propylene dichloride (1,2-Dichloropropane) [78-87-5] Revised 2006	75 ppm	110 ppm	1; S(D)
Propylene glycol dinitrate [6423-43-4]	0.05 ppm		Skin
Propylene glycol ethyl ether [1569-02-4]			Skin; (I)
Propylene oxide [75-56-9]	2 ppm		2B; S(D)
Propyleneimine (2-Methylaziridine) [75-55-8] Revised 2009; 2010	2 ppm		2B; Skin
n-Propyl nitrate [627-13-4]	25 ppm	40 ppm	
Pyrethrum [8003-34-7]	5 mg/m^3		

Pyridine [110-86-1] Revised 2004	1 ppm		2B
Resin acids, as total resin acids [8050-09-7], Inhalable Adopted 2024	0.001 mg/m^3		S(D); S(R)
Resorcinol [108-46-3]	10 ppm	20 ppm	
Rhodium, Metal and insoluble compounds as Rh [7440-16-6]	0.1 mg/m^3	0.3 mg/m^3	
Rhodium - Soluble compounds, as Rh [7440-16-6]	0.001 mg/m^3	0.003 mg/m^3	
Ronnel, Inhalable [299-84-3] Revised 2006	5 mg/m^3 (V)		
Rotenone (commercial) [83-79-4]	5 mg/m^3		
Rouge [1309-37-1]	10 mg/m^3 (E,N)		
Rubber solvent (Naphtha) [8030-30-6] Revised 2009	(H)		
Safrole [94-59-7]			2B
Selenium and compounds, as Se [7782-49-2]	0.1 mg/m^3		
Selenium hexafluoride, as Se [7783-79-1]	0.05 ppm		
Sesone [136-78-7]	10 mg/m^3 (N)		
Sevoflurane [28523-86-6]			(I)
Silica, Amorphous - Diatomaceous earth (uncalcined), Total [61790-53-2]	4 mg/m^3		
Silica, Amorphous - Diatomaceous earth (uncalcined), Respirable [61790-53-2]	1.5 mg/m^3		
Silica, Amorphous - Fume, Total [69012-64-2]	4 mg/m^3		
Silica, Amorphous - Fume, Respirable [69012-64-2]	1.5 mg/m^3		
Silica, Amorphous - Precipitated and gel, Total [112926-00-8]	4 mg/m^3		
Silica, Amorphous - Precipitated and gel, Respirable [112926-00-8]	1.5 mg/m^3		
Silica, Crystalline - alpha quartz [14808-60-7; 1317-95-9] and Cristobalite, Respirable [14464-46-1] Revised 2006	0.025 mg/m^3		A2, 1
Silicon [7440-21-3] Revised 2006 (See Particles Not Otherwise Classified (PNOC))			
Silicon carbide Nonfibrous, Inhalable, [409-21-2] Revised 2003	10 mg/m^3 (E)		
Silicon carbide, Nonfibrous, Respirable, [409-21-2] Revised 2003	3 mg/m^3 (E)		
Silicon carbide, Fibrous (including whiskers) [409-21-2] Revised 2003	0.1 f/cc (F)		A2; 2A
Silicon carbide, Nonfibrous particles (containing <0.1% crystalline silica), Inhalable [409-21-2]			(I)
Silicon carbide, Nonfibrous particles (containing <0.1% crystalline silica), Respirable [409-21-2]			(I)
Silicon tetrahydride (Silane) [7803-62-5]	0.5 ppm	1 ppm	
Silver and Compounds, as Ag [7440-22-4]	0.01 mg/m^3	0.03 mg/m^3	
Simazine [122-34-9]			(I)
Soapstone (see Talc) Revised 2011			
Sodium azide (as Sodium azide) [26628-22-8]		C 0.29 mg/m^3	
Sodium azide (as Hydrazoic acid vapour) [26628-22-8]		C 0.11 ppm	
Sodium bisulfite [7631-90-5]	5 mg/m^3		
Sodium fluoroacetate [62-74-8]	0.05 mg/m^3		Skin
Sodium hydroxide [1310-73-2]		C 2 mg/m^3	
Sodium metabisulfite [7681-57-4]	5 mg/m^3		

Starch [9005-25-8]	10 mg/m^3 (N)		
Stearates, Inhalable [57-11-4; 557-04-0; 557-05-1; 822-16-2]	10 mg/m^3 (J)		
Stearates, Respirable [57-11-4; 557-04-0; 557-05-1; 822-16-2]	3 mg/m^3 (J)		
Stoddard solvent (mineral spirits) [8052-41-3]	290 mg/m^3	580 mg/m^3	
Strontium chromate, as Cr, Total [7789-06-2]	0.0005 mg/m^3		A1; S(D); S(R); (I)
Strychnine [57-24-9]	0.15 mg/m^3		
Styrene - monomer [100-42-5] Revised 2025	10 ppm	20 ppm	2A
Styrene oxide [96-09-3]			2A; S(D); Skin; (I)
Subtilisins, as crystalline active pure enzyme [1395-21-7; 9014-01-1]		C 0.00006 mg/m^3	S(R)
Sucrose [57-50-1]	10 mg/m^3 (N)		
Sulfometuron methyl [74222-97-2]	5 mg/m^3		
Sulfometuron methyl, Inhalable fraction and vapour [74222-97-2]			(I)
Sulfotepp (TEDP), Inhalable [3689-24-5] Revised 2005	0.1 mg/m^3 (V)		Skin
Sulfoxaflor [946578-00-3]			R; (I)
Sulfur dioxide [7446-09-5]	2 ppm	5 ppm	
Sulfur hexafluoride [2551-62-4]	1000 ppm		
Sulfuric acid, Thoracic [7664-93-9] Revised 2004	0.2 mg/m^3 (M)		A2, 1
Sulfur monochloride [10025-67-9]		C 1ppm	
Sulfur pentafluoride [5714-22-7]		C 0.01 ppm	
Sulfur tetrafluoride [7783-60-0]		C 0.1 ppm	
Sulfuryl fluoride [2699-79-8]	5 ppm	10 ppm	
Sulprofos [35400-43-2] Revised 2009; 2010	1 mg/m^3		Skin
Synthetic Vitreous Fibres - Continuous filament glass fibres	1 f/cc (F)		
Synthetic Vitreous Fibres - Continuous filament glass fibres, Inhalable	5 mg/m^3		
Synthetic Vitreous Fibres - Glass wool fibres	1 f/cc (F)		
Synthetic Vitreous Fibres - Rock wool fibres	1 f/cc (F)		
Synthetic Vitreous Fibres -Slag wool fibres	1 f/cc (F)		
Synthetic Vitreous Fibres - Special purpose glass fibres	1 f/cc (F)		2B
Synthetic Vitreous Fibres - Refractory ceramic fibres	0.2 f/cc (F)		A2, 2B
2,4,5-T (2,4,5-Trichlorophenoxyacetic acid) [93-76-5]	10 mg/m^3		
Talc - Containing no asbestos fibres, Respirable [14807-96-6]	2 mg/m^3 (E)		
Talc - Containing asbestos fibres [14807-96-6]	0.1 f/cc (K)		A1, 1
Tantalum - Metal [7440-25-7]	5 mg/m^3		
Tantalum oxide dusts, as Ta [1314-61-0]	5 mg/m^3		
Tellurium and compounds (NOS), as Te, excluding hydrogen telluride [13494-80-9]	0.1 mg/m^3		
Tellurium hexafluoride [7783-80-4]	0.02 ppm		
Temephos, Total [3383-96-8]	10 mg/m^3	20 mg/m^3	Skin
Terbufos, Inhalable [13071-79-9]	0.01 mg/m^3 (V)		Skin

Terepthalic acid [100-21-0]	10 mg/m^3 (N)		
Terphenyls (o-, m-, p-isomers) [26140-60-3]		C 5 mg/m^3	
1,1,2,2-Tetrabromoethane [79-27-6] Adopted 2024	0.1 ppm		
1,1,1,2-Tetrachloro-2,2-difluoroethane [76-11-9] Revised 2008; 2010	500 ppm		
1,1,2,2-Tetrachloro-1,2-difluoroethane [76-12-0] Revised 2008; 2010	200 ppm		
1,1,1,2-Tetrachloroethane [630-20-6]			2B
1,1,2,2-Tetrachloroethane [79-34-5]	1 ppm		Skin; 2B
Tetrachloroethylene (Perchloroethylene) [127-18-4]	25 ppm	100 ppm	2A
Tetrachloronaphthalene [1335-88-2]	2 mg/m^3		
Tetrachlorovinphos, Inhalable [22248-79-9; 22350-76-1; 961-11-5]			2B; S(D); Skin; (I)
Tetraethyl lead, as Pb [78-00-2]	0.075 mg/m^3		Skin
Tetraethyl pyrophosphate (TEPP), Inhalable [107-49-3] Revised 2007	0.01 mg/m (V)		Skin
Tetrafluoroethylene [116-14-3]	2 ppm		2A
Tetrahydrofuran [109-99-9] Revised 2005	50 ppm	100 ppm	2B; Skin
Tetramethyl lead, as Pb [75-74-1]	0.075 mg/m^3		Skin
Tetramethyl succinonitrile [3333-52-6]	0.5 ppm		Skin
Tetranitromethane [509-14-8]	0.005 ppm		2B
Tetrakis (hydroxymethyl) phosphonium chloride [124-64-1] Revised 2005	2 mg/m^3		S(D)
Tetrakis (hydroxymethyl) phosphonium sulfate [55566-30-8] Revised 2005	2 mg/m^3		S(D)
Tetryl [479-45-8]	1.5 mg/m^3		
Thallium and soluble compounds, as Tl, Inhalable [7440-28-0] Revised 2011	0.02 mg/m^3		Skin
Thiacloprid [111988-49-9]			Skin; (I)
4,4'-Thiobis(6-tert-butyl-m-cresol), Inhalable [96-69-5] Revised 2011	1 mg/m^3		
Thiodicarb [59669-26-0]			S(D); (I)
Thioglycolic acid [68-11-1]	1 ppm		Skin; S(D)
Thioglycolic acid and salts [68-11-1]			Skin; S(D); (I)
Thionyl chloride [7719-09-7]		C 1ppm	
Thiram [137-26-8] Revised 2008; 2010	1 mg/m^3		S(D)
Tin [7440-31-5] and inorganic compounds, Inhalable [18282-10-5; 21651-19-4] excluding Tin hydride and Indium tin oxide, as Sn Revised 2024	2 mg/m^3		
Tin - Organic compounds, as Sn [7440-31-5]	0.1 mg/m^3	0.2 mg/m^3	Skin
Titanium dioxide [13463-67-7] Revised 2006	10 mg/m^3 (N)		2B
Titanium dioxide [13463-67-7]:			
Nanoscale particles, Respirable			(I)
Finescale particles, Respirable			(I)
Titanium tetrachloride, as HCl [7550-45-0]			(I)
o-Tolidine [119-93-7]			Skin; 2B
Toluene [108-88-3] Revised 2007; 2008	20 ppm		R
Toluene-2,4-diisocyanate (2,4-TDI) [584-84-9]	0.005 ppm	C 0.01 ppm	2B; S(D); S(R); Skin
Toluene-2,6-diisocyanate (2,6-TDI) [91-08-7]	0.005 ppm	C 0.01 ppm	2B; S(D); S(R); Skin
2,4- and 2,6-Toluene diisocyanate as a mixture [584-84-9; 91-08-7]			2B; S(D); S(R); Skin; (I)
m-Toluidine [108-44-1]	2 ppm		Skin
o-Toluidine [95-53-4] Revised 2009	2 ppm		Skin; 1
p-Toluidine [106-49-0]	2 ppm		Skin
Tributyl phosphate [126-73-8]	0.2 ppm		
Trichloroacetic acid [76-03-9] Revised 2018	0.5 ppm		2B

Trichlorfon, Inhalable fraction and vapour [52-68-6] (see also trichlorphon)			S(D); (I)
1,2,4-Trichlorobenzene [120-82-1]		C 5 ppm	
1,1,2-Trichloroethane [79-00-5]	10 ppm		Skin
Trichloroethylene [79-01-6] Revised 2007	10 ppm	25 ppm	A2, 1
Trichlorofluoromethane [75-69-4]		C 1000 ppm	
Trichloronaphthalene [1321-65-9]	5 mg/m^3		Skin
2,4,6-Trichlorophenol [88-06-2]			2B
1,2,3-Trichloropropane [96-18-4]	10 ppm		A2, 2A
1,1,2-Trichloro-1,2,2-trifluoroethane [76-13-1]	500 ppm	1250 ppm	
Trichlorphon, Inhalable [52-68-6] Revised 2003	1 mg/m^3		S(D)
Triclosan [3380-34-5]			Skin; (I)
Triethanolamine [102-71-6]	5 mg/m^3		
Triethylamine [121-44-8] Revised 2018	0.5 ppm	1 ppm	Skin
Triethylene glycol, Inhalable fraction and vapour [112-27-6]			(I)
Triflumizole, Inhalable [68694-11-1]			S(D); (I)
Trifluorobromomethane [75-63-8]	1000 ppm		
1,3,5-Triglycidyl-s-triazinetrione [2451-62-9]	0.05 mg/m^3		R
Trimellitic anhydride [552-30-7] Revised 2008; 2010		C 0.04 mg/m^3	Skin; S(D); S(R)
Trimetacresyl phosphate, Inhalable fraction and vapour [563-04-2]			R; (I)
Trimethylamine [75-50-3]	5 ppm	15 ppm	
Trimethyl benzene, isomers [25551-13-7; 526-73-8; 95-63-6; 108-67-8] Revised 2025	10 ppm		
Trimethyl hexamethylene diisocyanate [28679-16-5]	0.005 ppm	C 0.01 ppm	
Trimethylolpropane, Inhalable fraction and vapour [77-99-6]			R; (I)
Trimethyl phosphite [121-45-9]	2 ppm		
Tri-n-Butyltin compounds [688-73-3]	0.05 mg/m^3		
2,4,6-Trinitrotoluene (TNT), Total [118-96-7]	0.1 mg/m^3		Skin
2,4,6-Trinitrotoluene (TNT), Inhalable fraction and vapour [118-96-7]			Skin; (I);
Triorthocresyl phosphate [78-30-8]	0.1 mg/m^3		Skin
Triparacresyl phosphate, Inhalable fraction and vapour [78-32-0]			R; (I)
Triphenyl phosphate [115-86-6]	3 mg/m^3		
Tris(2,3-dibromopropyl) phosphate [126-72-7]			2A
Tungsten and compounds in the absence of Cobalt, as W [7440-33-7]	3 mg/m^3		
Turpentine [8006-64-2] and selected monoterpenes [80-56-8; 127-91-3; 13466-78-9] Revised 2003	20 ppm		S(D)
Uranium (Natural) - Insoluble compounds, as U [7440-61-1]	0.2 mg/m^3	0.6 mg/m^3	A1, 1; (I)
Uranium (Natural) - Soluble compounds, as U [7440-61-1]	0.05 mg/m^3		A1, 1; (I)
n-Valeraldehyde [110-62-3]	50 ppm		
Vanadium pentoxide, as V, Inhalable [1314-62-1] Revised 2015	0.05 mg/m^3		2B
Vegetable oil, Mist, Respirable, except castor, cashew nut, or similar irritating oil [8008-89-7]	3 mg/m^3		
Vinyl acetate [108-05-4]	10 ppm	15 ppm	2B
Vinyl bromide [593-60-2]	0.5 ppm		A2, 2A
Vinyl chloride [75-01-4]	1 ppm		A1, 1
4-Vinyl cyclohexene [100-40-3]	0.1 ppm		2B; R
Vinyl cyclohexene dioxide [106-87-6]	0.1 ppm		Skin; 2B; R
Vinyl fluoride [75-02-5]	1 ppm		A2, 2A
N-Vinyl-2-pyrrolidone [88-12-0] Revised 2003	0.05 ppm		

Vinylidene chloride [75-35-4]	1 ppm		2B
Vinylidene fluoride [75-38-7]	500 ppm		
Vinyl toluene, all isomers [25013-15-4]	25 ppm	75 ppm	
Vinyltoluene, all isomers [25013-15-4; 611-15-4;100-80-1; 622-97-9]			(I)
VM & P Naphtha [8032-32-4] Revised 2009	(H)		
Warfarin [81-81-2]	0.1 mg/m^3		R; Skin
Wood dust - Allergenic species	1 mg/m^3		S(R); S(D); A1, A2, 1; (I)
Wood dust - Non-Allergenic Hardwood	1 mg/m^3		A1, A2, 1; (I)
Wood dust - Non-Allergenic Softwood	2.5 mg/m^3		1; (I)
Xylene, all isomers [1330-20-7; 95-47-6; 108-38-3; 106-42-3] Revised 2025	20 ppm		
m-Xylene alpha,alpha'-diamine [1477-55-0]		C 0.1 mg/m^3	Skin
Xylidine - Mixed isomers, Inhalable [1300-73-8]	0.5 ppm (V)		Skin
Yttrium - Metal [7440-65-5]	1 mg/m^3		
Yttrium and compounds, as Y [7440-65-5]	1 mg/m^3		
Zinc chloride - Fume [7646-85-7]	1 mg/m^3	2 mg/m^3	
Zinc chromates, as Cr, Total [13530-65-9; 11103-86-9; 37300-23-5]	0.01 mg/m^3		A1, 1; S(D); S(R); (I)
Zinc oxide, Respirable [1314-13-2] Revised 2003	2 mg/m^3	10 mg/m^3	
Zirconium and compounds, as Zr [7440-67-7]	5 mg/m^3	10 mg/m^3	

Endnotes

(E) - the value is for particulate matter containing no asbestos and less than 1% crystalline silica.
(F) - the value for fibres longer than 5 microns, with an aspect ratio of equal than/greater than 3:1, as determined by the membrane filter method at 400-450 times magnification (4 mm objective), using phase-contrast illumination.
(G) - as measured by the vertical elutriator, cotton-dust sampler, see *TLV Documentation*.
(H) - reciprocal calculation method, see OHS Guideline G5.48-12.
(I) - see Special Notes in Table 1 below
(J) - does not include stearates of toxic metals.
(K) - should not exceed 2 mg/m^3 respirable particulate.
(L) - No exposure limit. Exposure by all routes should be carefully controlled to levels as low as possible.
(M) - refers to sulfuric acid contained in strong inorganic acid mists.
(N) - the 8-hour TWA listed in the Table is for the total dust. The substance also has an 8-hour TWA of 3 mg/m^3 for the respirable fraction.
(O) - sampled by method that does not collect vapour.
(P) - application restricted to conditions in which there are negligible aerosol exposures.
(V) - vapour and inhalable aerosol.

Table 1: Special Notes

Substance [CAS No.]	Note
Asphalt (Bitumen) fume, as benzene-soluble aerosol, Inhalable [8052-42-4]	IARC group 2A carcinogen - Bitumens, occupational exposure to oxidized bitumens and their emissions during roofing IARC group 2B carcinogen - Bitumens, occupational exposure to straight-run bitumens and their emissions during road paving IARC group 2B carcinogen - Bitumens, occupational exposure to hard bitumens and their emissions during mastic asphalt work
Beryllium and compounds, as Be [7440-41-7]	Soluble compounds - dermal sensitization Soluble and insoluble compounds - respiratory sensitization
Cobalt and inorganic compounds, as Co, Inhalable [7440-48-4]	IARC group 2A carcinogen - Cobalt metal (without tungsten carbide or other metal alloys) [7440-48-4]
2,4-Dichlorophenoxyacetic acid and its esters [94-75-7]	IARC group 2B carcinogens - chlorophenoxy herbicides as a group
Diesel fuel, as total hydrocarbons, Inhalable [68334-30-5; 68476-30-2; 68476-31-3; 68476-34-6; 77650-28-3]	Diesel fuel, marine, is an IARC group 2B carcinogen

Dinitrotoluene [25321-14-6]	2,4-Dinitrotoluene, 2,6-Dinitrotoluene, and 3,6-Dinitrotoluene are IARC group 2B carcinogens
Heptane, straight and branched isomers [562-49-2; 31394-54-4; 617-78-7; 464-06-2]	ACGIH description of "Heptane, straight and branched isomers" also includes isomers with CAS numbers [108-08-7; 142-82-5; 565-59-3; 589-34-4; 590-35-2; 591-76-4], these specific isomers are referenced under "Heptane, isomers"
Hexane (Commercial, <54% n-Hexane) and the branched hexane isomers [various, including 64742-49-0; 64742-89-8; 75-83-2; 79-29-8; 96-14-0; 107-83-5]	Skin notation only applies to Hexane (Commercial, <54% n-Hexane). Skin notation does not apply to branched hexane isomers.
Indium and compounds, as In [7440-74-6]	Indium phosphide is an IARC group 2A carcinogen
Lead chromate, as Cr [7758-97-6]	IARC group 1 carcinogen - Chromium (VI) compounds as a whole
Mica, >1% silica (Respirable) [12001-26-2]	When occupational exposures are to mica containing >1% crystalline silica, the B.C. exposure limit for crystalline silica should be applied (in addition to the B.C. exposure limit for mica).
Nickel - Elemental, Soluble inorganic compounds, as Ni [7440-02-0]	Elemental nickel and alloys containing nickel are IARC group 2B carcinogens. Nickel compounds are IARC group 1 carcinogens.
Nickel - Insoluble inorganic compounds, as Ni [7440-02-0]	Nickel compounds are IARC group 1 carcinogens
Nickel carbonyl, as Ni [13463-39-3]	
Nitropyrene, mono, di, tri, tetra, isomers [42397-64-8; 42397-65-9; 5522-43-0; 57835-92-4; 75321-20-9]	1-Nitropyrene is an IARC group 2A carcinogen 4-Nitropyrene is an IARC group 2B carcinogen 1,6-Dinitropyrene is an IARC 2B carcinogen 1,8-Dinitropyrene is an IARC 2B carcinogen 1,3-Dinitropyrene is an IARC 2B carcinogen
Nitrotoluene, all isomers [88-72-2; 99-08-1; 99-99-0]	2-Nitrotoluene [88-72-2] is an IARC group 2A carcinogen
Strontium chromate, as Cr, Total [7789-06-2]	Strontium chromate is hexavalent chromium compound
Uranium (Natural) [7440-61-1]	Ionizing radiation (all types) and Radionuclides are IARC group 1 carcinogens
Wood dust	ACGIH sensitizer – western red cedar ACGIH A1 - oak and beech ACGIH A2 - birch, mahogany, teak, walnut Wood dust is an IARC group 1 carcinogen
Zinc chromates, as Cr [13530-65-9; 11103 -86-9; 37300-23-5]	Zinc chromate is a hexavalent chromium compound

Table 1: Special Notes – No British Columbia exposure limit at this time

Substance [CAS No.]	Note
Acetamide [60-35-5]	No British Columbia exposure limit at this time.
Acetamiprid, Inhalable fraction and vapour [135410-20-7]	
Aldicarb [116-06-3]	
Allyl bromide [106-95-6]	
Allyl methacrylate [96-06-9	
Bendiocarb [22781-23-3	
Bensulide, Inhalable fraction and vapour [741-58-2]	
Benzoic acid and alkali benzoates: Benzoic acid [65-85-0], Inhalable fraction and vapour Sodium benzoate, as benzoate [532-32-1], Inhalable Potassium benzoate, as benzoate [582-25-2], Inhalable	
Boron trichloride [10294-34-5]	
Buprofezin, Inhalable fraction and vapour [69327-76-0]	
Butenes, all isomers, including Isobutene [106-98-9; 107-01-7; 590-18-1; 624-64-6; 25167-67-3; 115-11-7]	
4-tert-Butylbenzoic acid [98-73-7]	
tert-Butyl hydroperoxide [75-91-2]	
Cadusafos [95464-99-9]	
Captafol, Inhalable fraction and vapour [2425-06-1]	
Carfentrazone-ethyl [128639-02-1]	

Chlordane, Inhalable fraction and vapour [57-74-9]
Chromium - trivalent chromium compounds, as Cr(III), Inhalable [7440-47-3]
Chromium - hexavalent chromium compounds, as Cr(VI), Inhalable [7440-47-3]
Citral, inhalable [5292-40-5]
Clothianidin [210880-92-5], Inhalable
Copper Naphthenate, Inhalable fraction and vapour [1338-02-9]
Cyanazine [21725-46-2]
Cyanogen bromide [506-68-3]
Cyromazine [66215-27-8], Inhalable
Desflurane [57041-67-5]
Diethylene glycol monobutyl ether [112-34-5]
N,N-Diethylhydroxylamine [3710-84-7]
Dimethylphenol, all isomers [95-65-8; 95-87-4; 105-67-9; 108-68-9; 526-75-0; 576-26-1; 1300-71-6]
Dimethenamid-P, Inhalable fraction and vapour [163515-14-8]
Divinylbenzene-ethyl styrene mixtures, as total divinylbenzene isomers [69011-19-4; 7525-62-4; 108-57-6; 105-06-6]
Endotoxins, Inhalable [67924-63-4]
EPN, Inhalable fraction and vapour [2104-64-5]
Ethylene glycol, Inhalable, aerosol only [107-21-1]
Ethylene glycol dimethyl ether [110-71-4]
2-Ethyl-1-hexanol [104-76-7]
Fenoxycarb, Inhalable [72490-01-8]
Fludioxonil [131341-86-1]
Fluorine, as F [7782-41-4]
Folpet [133-07-3]
Glycidyl methacrylate [106-91-2]
Glyphosate, Inhalable [1071-83-6]
Heptane, straight and branched isomers [562-49-2; 31394-54-4; 617-78-7; 464-06-2]
Hexamethylenetetramine, Inhalable fraction and vapour [100-97-0]
Hexazinone [51235-04-2]
Hexylene glycol, Inhalable, aerosol only [107-41-5]
Hexylene glycol, vapour [107-41-5]
Imazosulfuron [122548-33-8], Inhalable
Imidacloprid, Inhalable [138261-41-3]
Indium tin oxide, as In [50926-11-9]
Iodides
Iodides, as I, Inhalable
Iodine, as I, Inhalable fraction and vapour [7553-56-2]
Iodoform, as elemental Iodine [75-47-8], Inhalable fraction and vapour
Isobutyl nitrite, Total [542-56-3]
Isoflurane [26675-46-7]
Lead chromate, as Cr(VI), Inhalable [7758-97-6]
2-Methyl-2-butene [513-35-9
Methylcyclohexanone, all isomers [591-24-2; 589-92-4; 1331-22-2]
Methylnaphthalene, all isomers [90-12-0; 91-57-6; 1321-94-4]
Methyltetrahydrophthalic anhydride isomers [3425-89-6; 5333-84-6; 11070-44-3; 19438-64-3; 26590-20-5; 42498-58-8]
Monomethylformamide [123-39-7]]
Nicotine, Inhalable fraction and vapour [54-11-5]
Nitrapyrin, Inhalable fraction and vapour [1929-82-4]
5-Nitro-o-toluidine, Inhalable fraction and vapour [99-55-8]

Paraquat, as the cation, Inhalable [4685-14-7]
2,4-Pentanedione [123-54-6]
Pentachloronaphthalene, Inhalable fraction and vapour [1321-64-8]
Peracetic acid [79-21-0]
Phenothiazine, Inhalable [92-84-2]
Phenylethyl alcohol [60-12-8]
o-Phthalaldehyde [643-79-8]
Phthalic anhydride, Inhalable fraction and vapour [85-44-9]
o-Phthalodinitrile [91-15-6]
Prometon [1610-18-0], Inhalable
Prometryn [7287-19-6], Inhalable
Propionitrile [107-12-0]
Propyl acetate isomers, as a mixture [108-21-4; 109-60-4]
Propylene glycol ethyl ether [1569-02-4]
Sevoflurane [28523-86-6]
Silicon carbide, Nonfibrous particles (containing <0.1% crystalline silica), Inhalable [409-21-2]
Silicon carbide, Nonfibrous particles (containing <0.1% crystalline silica), Respirable [409-21-2]
Simazine [122-34-9]
Styrene oxide [96-09-3]
Sulfometuron methyl, Inhalable fraction and vapour [74222-97-2]
Sulfoxaflor [946578-00-3]
Tetrachlorvinphos, Inhalable [22248-79-9; 22350-76-1; 961-11-5]
Thiacloprid [111988-49-9]
Thiodicarb [59669-26-0]
Thioglycolic acid and salts [68-11-1]
Titanium dioxide [13463-67-7], Nanoscale particles and finescale particles, Respirable
Titanium tetrachloride, as HCl [7550-45-0]
2,4- and 2,6- Toluene diisocyanate as as mixture [584-84-9; 91-08-7] (see OHS Regulation s. 5.51)
Triethylene glycol, Inhalable fraction and vapour [112-27-6]
Trichlorfon, Inhalable fraction and vapour [52-68-6]
Triclosan [3380-34-5]
Triflumizole, Inhalable [68694-11-1]
Trimetacresyl phosphate, Inhalable fraction and vapour [563-04-2]
Trimethylolpropane, Inhalable fraction and vapour [77-99-6]
2,4,6-Trinitrotoluene (TNT), Inhalable fraction and vapour [118-96-7]
Triparacresyl phosphate, Inhalable fraction and vapour [78-32-0]
Vinyltoluene, all isomers [611-15-4; 100-80-1; 622-97-9; 25013-15-4]

* Download PDF version (532 kb) of the table.

G5.62 Ventilation – Submitting plans

Issued August 1, 1999; Revised October 29, 2003

Regulatory excerpt
Section 5.62 of the *OHS Regulation* ("*Regulation*") states:

> The employer or the employer's agent must submit to the Board drawings and specifications for an existing or proposed ventilation system if requested by the Board.

Purpose of guideline
The purpose of this guideline is to explain when WorkSafeBC might request plans for industrial ventilation systems pursuant to section 5.62 of the

Regulation. It does not apply to heating, ventilation, or air conditioning (HVAC) systems, which are covered under section 4.71 of the Regulation.

Submitting plans
WorkSafeBC prevention officers may request plans to evaluate compliance with a previously written order or with the general requirements for industrial ventilation. It may be appropriate to request plans in any of the following situations:

- The installation of a new process requires addition(s) to the existing industrial ventilation system.
- The process being built or modified is uncommon and a generic industrial ventilation plan or guideline is not available in the ACGIH *Industrial Ventilation Manual*.
- The process being built or modified involves the control of a highly toxic material.
- The employer or employer's agent is unable to answer basic questions about the proposed system change, including basic areas of knowledge, as it applies to the workplace or process in question, for:
  - air flow requirements
  - fan static pressure
  - method of filtration
  - capture velocity
  - air flow patterns

Examples of highly toxic materials include methylene bisphenyl isocyanate (MDI), hexamethylene diisocyanate (HDI), and other substances identified in section 5.57(1).

If WorkSafeBC requests a plan, WorkSafeBC's role is to review the plan with respect to the regulatory requirements as noted above.

G5.63 Building modification

Issued August 1999

Regulatory excerpt
Section 5.63 of the *OHS Regulation* ("*Regulation*") states:

> The owner of a building must permit an employer to install an exhaust ventilation and makeup air system to meet the requirements of this Part for controlling harmful air contaminants in the workplace, provided that all such work is subject to the approval of the owner acting reasonably.

Purpose of guideline
The purpose of this guideline is to explain when the owner of a building to permit an employer to install a ventilation system if required by sections 4.73 and 5.63 of the *Regulation*.

Background
The requirement under section 4.73 of the *Regulation* applies to ventilation systems for maintaining indoor air quality, not to industrial ventilation systems. For example, installation of a ventilation system may be required in situations where the building has no existing HVAC system or the HVAC system is inadequate for the occupancy. All such work, however, is subject to the approval of the owner, acting reasonably. In the context of this section, "the owner, acting reasonably" is taken to mean that the owner cannot be unreasonable when rejecting the project.

Generally, the operation and maintenance of the heating, ventilation, and air conditioning (HVAC) system is the responsibility of the building owner or owner's agent, although this responsibility may be varied by commercial agreement. A statute or regulation overrides a private contract; therefore, the requirements of this section take precedence over any term of a lease agreement that might be contrary to the responsibility cast by the *Regulation*. However, the responsibility for the cost of the installation or upgrade will likely be determined by the lease agreement.

Section 5.63 applies to industrial ventilation systems, not to systems for maintaining indoor air quality or thermal comfort. The latter is covered under section 4.73 of the *Regulation*.

G5.70 Discharged air

Issued August 1, 1999; Revised October 29, 2003; Editorial Revision February 3, 2022

Regulatory excerpt
Section 5.70 of the *OHS Regulation* ("*Regulation*") states:

> (1) The use of a ventilation system designed to recirculate contaminants into the work area is restricted by the provisions of Table 5-1.
>
> (2) A ventilation system that discharges air from the work area must be designed to minimize the likelihood of exposing any worker at a workplace, including an adjacent workplace,
>
> (a) to an air contaminant in a concentration which exceeds either 10% of its applicable exposure limit in this Part or an acceptable ambient air quality standard established by an authority having jurisdiction over environment and air standards, whichever is greater, and

(b) if practicable, to an objectionable odour.

Table 5-1: Recirculation of discharged air

Recirculation permitted without written approval	A nuisance particulate with an 8-hour TWA limit of at least 10 mg/m^3, provided that its concentration in the discharged air is less than 10% of the TWA limit. Asbestos fibre or other particulate, except a biological contaminant, provided that it is exhausted from a portable vacuum cleaner or bench-top containment unit, fitted with an effective HEPA filter. A welding fume (including its components identified under section 5.57(1)) exhausted from a portable welding fume extractor fitted with an air cleaner, provided that its concentration in the discharged air is less than 10% of the applicable exposure limit. A biological contaminant discharged from a biological safety cabinet that is installed and operated in accordance with the requirements in Part 30 (Laboratories). Non-allergenic softwood dust, provided that its concentration in the discharged air is less than 10% of the 8-hour TWA limit.
Recirculation only with written approval by the Board	Allergenic wood dust. Non-allergenic hardwood dust. Any contaminant not otherwise listed in this Table.
No recirculation permitted	A substance identified under section 5.57(1), unless otherwise identified in this Table.

Purpose of guideline
The purpose of this guideline is to clarify that section 5.70 of the *Regulation* applies to industrial ventilation systems. It does not apply to heating, ventilation, or air conditioning (HVAC) systems. HVAC systems are covered under section 4.77 of the *Regulation*, which contains similar wording to section 5.70(2).

Recirculation provisions of Table 5-1
Table 5-1 sets out situations when recirculation is not permitted, when it is permitted with written approval from WorkSafeBC, and when it is permitted without such approval. The table states that WorkSafeBC may grant approval for recirculation for "any contaminant not otherwise listed in the table."

Recirculation of substances identified by section 5.57(1) are not permitted, unless otherwise permitted in Table 5-1.

Background
Authorities having jurisdiction over environmental air standards are the B.C. Ministry of Environment and Climate Change Strategy and Environment and Climate Change Canada for all regional districts in B.C. except the Greater Vancouver Regional District (GVRD). The GVRD sets and enforces its own standards for air quality within the GVRD.

Section 5.70 applies to minimizing exposure of all workers, including those at adjacent workplaces, even if those workers are employed by other employers. The term "likelihood" in section 5.70(2) refers to the probability that a worker may be exposed to discharge air from a ventilation system. If conditions, such as the direction of the prevailing wind, the discharge velocity of the exhaust air, or thermal effects in the air stream, routinely direct contaminants towards areas where workers are located, then this section applies.

Contaminated air
Contaminated air that is allowed to escape through a wall or ceiling opening could re-enter the work area or an adjacent location. If this situation is thought to exist, the problem needs to be investigated to identify the nature of the contaminants, as well as the employer responsible for generating them. Typically, in determining if a worker's overexposure to the limits set by section 5.70 exists, it is necessary to sample the air in the worker's breathing zone and not the air discharged from a ventilation system. The quantity of air contaminant discharged from a ventilation system falls under the jurisdiction of Environment and Climate Change Canada or the B.C. Ministry of Environment and Climate Change Strategy. WorkSafeBC's jurisdiction is the exposure of the worker, who may be located some distance away from the discharge point, and due to mixing and dilution, the concentration at that location may be significantly lower than at the discharge point. However, it may be helpful for determining the nature and/or the source of a particular contaminant by area sampling adjacent to the discharge.

Odor control
In determining the practicability of taking action to control an objectionable odour arising from discharged air, first determine if the contaminants

can be identified:

- If identification is possible, initially evaluate whether the concentration exceeds 10% of its applicable exposure limit or an acceptable air quality standard.
- If identification of the constituents is not possible or if the odour continues to be a concern at levels less than 10% of the exposure limit, the practicability of controlling the emission should then be discussed with the employer responsible for generating the odour.

A decision to issue orders to control the odour will be determined on the basis of the duration of exposure, the availability of control technology and the offensiveness of the emission. If workers are experiencing other health effects, such as sensitivity or acute reactions, WorkSafeBC's occupational health physicians should be consulted.

Some options for controlling an objectionable odour include the following:

- Decreasing the concentration of the contaminant in the exhaust
- Repositioning the stack
- Increasing the stack height

However, before recommending that the position or the height of the stack be altered, the WorkSafeBC prevention officer should consider whether this change will constitute a further hazard that is not practicable to control (for example, whether the required stack height will be unstable or whether the new position will affect the structural integrity of the building). If there is a further hazard, alternative control technologies for objectionable odours should be considered.

G5.71(3) Location and construction of dust collectors

Issued April 27, 2010; Revised July 20, 2012

Regulatory excerpt
Section 5.71(3) of the *OHS Regulation* ("*Regulation*") states:

> A dust collector having an internal volume greater than 0.6 m^3 (20 ft^3) and being used to control combustible dusts must be located and constructed so that no worker will be endangered in the event of an explosion inside the collector.

Purpose of guideline
This guideline explains terms used in *Regulation* section 5.71(3) and provides guidance for locating and constructing dust collectors used to control combustible dusts so that workers will not be endangered in the event of an explosion inside the collector.

Background
WorkSafeBC considers the relevant National Fire Protection Association (NFPA) standards to provide acceptable guidance with respect to combustible dust collectors. There are a series of NFPA standards that are relevant to the control of fire and explosion hazards from combustible dusts and an employer should review the standard(s) relevant to the application in question. Information in this guideline references mainly the following NFPA standards, which are available for review online at http://www.nfpa.org/.

> *NFPA 61 Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities (2008)*
>
> *NFPA 484 Standard for Combustible Metals (2009)*
>
> *NFPA 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids (2006)*
>
> *NFPA 655 Standard for Prevention of Sulfur Fires and Explosions (2007)*
>
> *NFPA 664 Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities (2007)*

In addition, there are specifications in the *BC Building Code* (e.g., edition 2006, articles 3.3.1.20 and 6.2.2), *BC Electrical Code Regulation (2009)* - Chapter 18, and the *BC Fire Code*, (e.g., edition 2006 article 5.3) with respect to protection from fires and explosions of combustible dust.

Employers should not rely solely on the generic information in this guideline to minimize hazards that could lead to a dust explosion. The entire relevant standard(s) or code(s) should be consulted for complete information.

What is a "dust collector having an internal volume greater than 0.6 m^3 (20 cu. feet)?"
A dust collector is one component of a dust collection system. The collection system is a pneumatic conveying system that is specifically designed to capture dust at the point of generation, sometimes from multiple pieces of equipment, and convey the particulate to a point of collection. The system includes the collection hood, conveyance ducting, and flexible hoses, exhaust fan, motor, and dust collector. The dust collector, also called an air-material separator, is a device used to separate the particulate material from the air stream, and includes but is not limited to cyclones, baghouse and media-type filter collectors, wet-type collectors, electrostatic precipitators, and enclosureless units.

A *cyclone* is defined in *NFPA 664* as a cylindrical type of dust collector used to separate particulate from the air stream by centrifugal force, having an enclosure of circular cross-section, a tangential air and material inlet, an air exhaust outlet, and a material discharge. In order to determine whether section 5.71(3) is applicable, the internal volume of the dust collector needs to be determined. The internal volume of a cyclone is considered to be the volume of the collector from the tangential inlet through the cylindrical and conical area, and includes the chute and dust container that holds the captured dust.

A *baghouse* dust collector is an air-material separator designed and used to remove dust from the transport air through a filter medium of suspended bags that are contained within an enclosure. The internal volume is considered to be the total volume inside the enclosure from the entrance point of the air-particle mixture, and includes the volume of the container designed to hold the captured dust.

NFPA 664 defines an *enclosureless dust collector* as an air-material separator where filtration is accomplished by passing dust-laden air through filter media, collecting the dust on the inside of the filter media and allowing cleaned air to exit to the surrounding area (Note: See also *Regulation* section 5.70 and guideline G5.70 for information about requirements for discharged air). The filter medium is not enclosed, is hand shaken and is under positive pressure during use. Removal of the collected dust is not continuous or mechanical. The internal volume of an enclosureless dust collector is considered to be the air volume inside all the bags plus the air volume of the container designed to hold the captured dust.

If the manufacturer's specifications for a dust collector do not include the internal volume of the dust collector, this volume can be calculated from measurements of height and area.

What is a combustible dust?
NFPA 654 defines combustible dust as a combustible particulate solid that presents a fire or deflagration* hazard when suspended in air or some other oxidizing medium over a range of concentrations, regardless of particle size or shape. This definition replaces a previous definition that required the particles to be, on average, less than 420 micron (0.017 inch) diameter (capable of passing through a U.S. No. 40 Standard Sieve). The newer definition applies more broadly to include elongated particles such as paper dust and some agglomerates, for which particle diameter is not a useful concept.

*NFPA Standards and this guideline use the term "deflagration." Deflagration is the propagation of a pressure wave (at a speed less than the speed of sound) from the ignition of a combustible dust, and includes both fires and explosions. An explosion can occur if the deflagration occurs in an enclosed space such as a dust collector, duct, or building.

Not all dusts are combustible. For example, substances that are stable inorganic oxides (e.g., silicates, sulphates, phosphates, and carbonates) are not combustible. Therefore dust clouds of Portland cement, sand, limestone, etc. are not combustible.

Materials that are combustible and that can give rise to dust explosions include, but are not limited to

- Food products (e.g., grain, cellulose, powdered milk, sugar, flour, starch, etc.)
- Natural organic materials (e.g., wood dust, wood flour, textiles such as cotton dust and nylon dust, biosolids, etc.)
- Synthetic organic materials (plastics such as phenolics and polypropylene, resins such as lacquer and phenol-formaldehyde, organic pigments, pharmaceuticals, pesticides, etc.)
- Coal and peat
- Metals (e.g., aluminum, magnesium, zinc, iron, etc.)

Combustible dusts have varying limits of flammability. These are usually expressed in terms of grams per cubic metre. For example, aluminum dust may be listed as requiring an airborne concentration of 30 grams per cubic metre for a combustible atmosphere to exist whereas coal dust may require 60 grams per cubic metre. A layer of dust as thin as a dime dispersed throughout a room can create an explosion hazard.

NFPA 499 Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas (2008) includes a table of selected combustible materials. This is not a comprehensive list and a dust should be considered to be combustible unless it is known otherwise. For certain, substances that are combustible as particulates should be considered as combustible dusts. OSHA also publishes a list of substances for which there is a risk of combustible dust explosion, at https://www.osha.gov/Publications/combustibledustposter.pdf.

What is a dust explosion?
A dust explosion/deflagration is essentially the very rapid combustion of a dust cloud or suspension of dust in air, during which heat and pressure is generated at a very high rate. The conditions necessary for an explosion are a sufficiently dense dust cloud of combustible dust in an enclosed area, adequate oxygen/air to support combustion, and an ignition source.

Dust explosions can be very destructive. Often there is a series of explosions in which the primary explosion/deflagration is relatively small. The pressure from the primary explosion can be intense enough to dislodge dust off walls, beams, ledges, machines, and other surfaces. This dislodged dust then mixes with air, creating a much larger dust cloud which can then be ignited and react explosively creating a secondary catastrophic explosion. This secondary explosion/deflagration can be much larger than the primary explosion.

Location and construction of dust collectors
The guidance in this guideline is taken mainly from the five NFPA standards listed above in the Background section. Information provided here represents some of the control measures from the NFPA standards. In addition, *NFPA 69 Standard on Explosion Prevention Systems (2008)* provides information on preventing and controlling deflagrations.

The NFPA standards also contain specifications not directly related to location or construction of the dust collector (e.g., electrical protection, ventilation, control of ignition sources, spark detection and arrest, isolation devices, ductwork, partitioning, preventing dust accumulations on horizontal surfaces, sprinkler and other fire suppression systems, relief venting, etc.). These specifications are not directly related to *Regulation* subsection 5.71(3) but many are related to other regulatory requirements. Employers should not rely solely on the generic information in this guideline to minimize hazards leading to dust explosions. The entire relevant standard(s) should be consulted for complete information.

Location of a dust collector

Regulation section 5.71(3) specifies that a dust collector used to control combustible dust be located so that no worker will be endangered in the event of an explosion inside the collector. Dust collectors used for collection of combustible dust are appropriately located outdoors - this is usually the preferred location with respect to compliance with this section of the *Regulation*. Under certain circumstances and conditions, it is acceptable to locate a dust collector indoors. The relevant B.C. Codes and NFPA standard(s) should be consulted for complete information on these circumstances and conditions, but some general guidance is provided here.

The *BC Fire Code* (2006) specifies in Division B Section 5.3 that a dust collector having a flow capacity greater than 0.5 m^3/s be located outside of a building and be equipped with explosion venting to the outdoors of not less than 0.1 m^2 of vent area for each cubic metre of dust collector enclosure volume.

The *BC Fire Code* allows a dust collector to be located inside a building if it is

a) Provided with explosion venting to the outdoors

b) Equipped with an automatic explosion prevention system, or

c) Located in a room with fire separations having a fire-resistance rating of not less than 1 hr and provided with explosion venting to the outdoors

The *BC Fire Code* also requires, when exhausted air is returned to the building, that the dust-collection system be designed so that the exhaust fan and ancillary equipment are automatically shut down in the event of a fire or an explosion inside the dust collector. Construction of a dust collector should also include isolation devices where ductwork returning to a building from the dust collector can provide a path for a fireball and a pressure wave to enter the building.

A number of NFPA standards also provide guidance for the location of a dust collector, and this guidance is acceptable as long as it does not contradict British Columbia code requirements such as the *BC Fire Code*. For example, *NFPA 61* Chapter 10 specifies location criteria for dust collectors used in ***agriculture and food processing facilities***, including operations involving dry agricultural bulk materials and their by-products, and dusts that include grains, oilseeds, agricultural seeds, legumes, sugar, flour, spices, feeds, and other related materials. An outside location of the dust collector is required, with several exceptions listed in the standard.

NFPA 484 describes specific dust collector location criteria for a number of ***combustible metals*** and has specific chapters for control of combustible dust hazards from alkali metals, aluminum, magnesium, niobium, tantalum, titanium, zirconium, and other combustible metals.

NFPA 654 provides specifications for control of dust explosions from ***materials not specifically addressed by another more specific NFPA standard***. This standard specifies that, where an explosion hazard exists, air-material separators be located outside of buildings. The standard provides some exceptions to this specification in Chapter 7.

NFPA 655 provides general specifications for control of fires and explosions from processes involving ***sulfur*** dust, and includes specific location criteria for the dust collector.

NFPA 664 provides specifications for selecting the location for a dust collector in ***wood processing and woodworking facilities***. Outdoor locations are recommended. The standard recommends that dust collectors not be located on the roof of a building. Indoor locations are permitted by the standard under special circumstances, which are listed in the standard for enclosed and enclosureless dust collectors.

Construction of a dust collector

Dust collectors used for combustible dust need to be designed and constructed entirely of non-combustible material suitable for the use intended (Note: the use of aluminum paint on the inside of a metal dust collector increases the fire hazard and should be avoided. If the aluminum flakes off or is struck by a foreign object, the heat of impact could be sufficient to cause ignition of the aluminum particle, thereby initiating a fire). However, filter bags and explosion vent panels fabricated from combustible material are acceptable. Dust collectors need to be constructed to prevent leakage of dust into the rest of the workplace and to minimize internal ledges or other points of dust accumulation (e.g., hopper bottoms should be sloped; surfaces and seams should be smooth). This is important since an accumulation of as little as 0.8 mm (1/32 inch) thick of combustible dust on horizontal surfaces (both inside and outside the dust collector) may lead to a secondary and more damaging explosion following any primary explosion. Dust collectors need to have independent supporting structures capable of supporting the weight of the collector, the material being collected, and any water from extinguishing systems that will not readily drain from the system.

NFPA 61 Chapter 10 specifies criteria for construction of a dust collector used for ***agricultural and food processing*** operations.

NFPA 484 describes construction criteria for dust collection in ***metal operations***.

NFPA 655 provides general specifications for control of fires and explosions from processes involving ***sulfur*** dust, and includes specific construction criteria.

NFPA 664 describes location and construction criteria for ***wood processing and woodworking*** facilities (see especially section 8.2).

Explosion relief venting and suppression

Explosion relief vents are panels or doors that are deliberate points of weakness. If they are of the correct size and construction, and properly positioned, they can help to safely vent an explosion in a dust collector so that workers are not endangered. These relief vents should be designed and constructed by experts. *NFPA 68 Standard on Explosion Protection by Deflagration Venting (2007)* addresses the design, location, installation, maintenance, and use of devices and systems that vent the combustion gases and pressures resulting from a deflagration within an enclosure. The standard specifies that deflagration venting be arranged to avoid injury from the vent discharge and that the material discharged from an enclosure during the venting of a deflagration be directed outside to a safe location.

NFPA 654 includes information on deflagration venting, suppression systems, mechanical and chemical isolation systems, flame front diverters, and abort gates to lower the risk to workers in the event of an explosion inside a dust collector.

G5.73 Engine servicing and work area assessment for mobile equipment operated indoors

Issued June 6, 2006; Editorial Revision October 28, 2019; Editorial Revision consequential to September 1, 2021 Regulatory Amendment

Regulatory excerpt

Section 5.73 of the *OHS Regulation* ("*Regulation*") states:

> If mobile equipment powered by an internal combustion engine is operated indoors or in an enclosed work area
>
> (a) the engine must be adequately serviced and maintained to minimize the concentration of air contaminants in the exhaust, and
>
> (b) the work area must be assessed to determine the potential for exposure of workers to harmful levels of exhaust components.

Section 5.74 of the *Regulation* states:

> If a worker is or may be exposed to an exhaust gas component in concentrations exceeding the applicable exposure limits, exhaust gas scrubbers, catalytic converters, or other engineering controls must be installed.

Purpose of guideline

This guideline provides information on

- The scope of application of section 5.73 to equipment with internal combustion engines
- Harmful emissions associated with the operation of internal combustion engines of the major fuel types - gasoline, natural gas, diesel, and propane (also termed liquefied petroleum gas or LPG)
- The importance of adequate servicing and maintenance of internal combustion engines and specific requirements for servicing and maintaining these engines
- The importance of adequately assessing the work area to determine the potential for exposure of workers to harmful levels of exhaust components, along with information on how to do that assessment

Scope of section 5.73

Mobile equipment

"Mobile equipment" is defined in Part 16 (Mobile equipment) of the *Regulation*, as "a prime mover, or a prime mover with a towed component, which towed component moves relative to the ground, or has a rider, for its work function, but does not include (a) a prime mover, or a towed component, that is carried as a load, (b) a commercial passenger vehicle under the *Passenger Transportation Act*, including a bus or a taxi, or (c) a motor assisted cycle, scooter, minibike, skateboard or other miniature vehicle." Based on this definition, section 5.73 applies to ground machines such as ice resurfacers, forklift trucks, excavators, and skidsteer loaders, if powered by an internal combustion engine.

Indoor and enclosed work areas

Section 5.73 applies to mobile equipment used indoors or in an enclosed work area. Refer to OHS Guideline G5.75 for a discussion of the meaning "indoors." For the purposes of this guideline, the term "enclosed" refers to any other work area where the operation of an internal combustion engine may result in the buildup of harmful exhaust gases. Such areas may include, but are not limited to, vehicle parking garages, tractor trailers, ferries with enclosed or partly enclosed car decks, or a building under construction, at a stage when natural air flows may become restricted.

It should be noted that section 5.73 is one of a series of requirements on the use of internal combustion engines, found in sections 5.72 to 5.75 of the *Regulation*. Other requirements such as section 5.55 on types of controls also apply.

Air contaminants in exhaust emissions

Section 5.73 refers both to "air contaminants" and "exhaust components." For the purposes of this guideline these terms will be considered to be interchangeable.

Although section 5.73 technically applies to a wide range of air contaminants that may be emitted during internal combustion engine operation, for practical purposes the number of exhaust components that need to be considered is usually limited to relatively few components, as discussed below.

Propane/gasoline/natural gas
For engines powered by gasoline, propane, and natural gas, the major harmful emissions are carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO_x).

Studies have shown that the HC components of the exhaust are generally not significant until the level of CO produced results in worker exposures well in excess of the applicable exposure limits. As a result, generally only CO or oxides of nitrogen (principally nitrogen dioxide or NO_2), need to be considered when these fuel types are being used.

Diesel
Determining primary air contaminants of concern from diesel powered equipment is more problematic, as the number of contaminants of significance can be considerable. The major components of diesel exhaust include carbon monoxide, hydrocarbons, aldehydes, nitrogen oxides, sulfur dioxide (SO_2), diesel particulate matter and polynuclear aromatic hydrocarbons (PAH). Diesel particulate matter is a complex aggregate of solid and liquid material. Diesel particulate is very fine and as such is totally respirable.

Engine servicing and maintenance - section 5.73(a)
Section 5.73(a) requires that the engine of the mobile equipment be adequately serviced and maintained to minimize the concentrations of air contaminants in the exhaust. Some general considerations related to this requirement are provided below along with recommendations for specific fuel types.

General considerations
This requirement of section 5.73(a) can only be met by implementing an effective program of regular servicing and maintenance of the engine. The levels of exhaust contaminants from engines of all fuel types can be reduced by an effective program of regular servicing and maintenance. The program should consider both the specifics of how the servicing and maintenance is to be performed, as well as the frequency.

Maintenance and servicing should be performed in accordance with the instructions of the manufacturer or those of a qualified mechanic for the type of equipment being used. The frequency of servicing should be determined by the information from the manufacturer or mechanic, together with the results of workplace assessment and ongoing monitoring.

Minimizing the concentration of one contaminant in an engine's exhaust may result in the increase of another, in addition to potentially adversely compromising engine performance. Hence, "minimizing the concentrations," in the context of this guideline, refers to striking the optimum balance between contaminant emission levels and engine performance.

Experience has shown that specific obligations need to be met, depending on the fuel type, in order to ensure that contaminant levels are minimized in the exhaust.

Propane/gasoline/natural gas
Maintenance involves typical adjustments and parts replacement required to maintain engine performance. However, to ensure that the concentrations of air contaminants in the exhaust are effectively minimized for these fuel types, exhaust emission levels should be directly measured. Exhaust gas measurement completes the preventive maintenance program and gives the employer a good quality control tool for determining an adequate schedule for adjustments and parts replacement.

As a general rule, exhaust emissions should be analyzed before performing any servicing or maintenance, as well as afterwards. The exhaust gas analyzer used for measuring should be at least a four gas model (CO, CO_2, HC, and oxygen) and preferably include NO_2 as well. At a minimum, it should meet BAR-90 specifications of the California Bureau of Automotive Repair. The need to analyze for NO_2 can usually be determined from workplace air monitoring results. Emission levels should be measured both at idle and also under load.

The optimum balance between good power efficiency and emissions will vary depending on the engine and fuel type. This balance will usually be achieved when the ratio of air to fuel is the exact amount required for complete combustion (e.g., about 14 to 1 for propane).

In general, for engines not equipped with specific emission controls such as catalytic converters, the level of carbon monoxide in the exhaust should not exceed about 1% for propane (with the optimum between about 0.5% - 0.8%) and about 2% for gasoline. It should be noted that if CO levels are much below 0.5%, then NO_2 will need to be evaluated as well.

For engines equipped with catalytic converters, a thermocouple installed either downstream of the catalyst or both upstream and downstream, can be used as an indicator of whether the catalyst has reached operating temperature (emissions will be considerably higher until this temperature is reached). Indoor emissions can be reduced by keeping equipment outside until the catalyst has reached operating temperature. Thermocouples can also help determine if the catalytic converter needs replacement, that is, when the operating temperature cannot be reached.

A gasoline powered engine may produce a visible smoke in the exhaust and a significant odour if it is running significantly out of tune or is otherwise in need of servicing or repair. Engines powered by propane or natural gas may not, so the absence of significant odour or smoke haze in the workplace is not a reliable indicator of acceptable air quality.

Diesel
It is essential that diesel engines be serviced and maintained in accordance with the schedule recommended by the manufacturer. Particular attention should be paid to the regular replacement of the fuel filter and to fuel injector servicing. In addition, diesel fuel designed for on-road use (i.e. diesel fuel with the lowest available sulfur level) should be used in order to minimize sulfur related emissions.

Visible smoke from the exhaust of a diesel engine may be an indicator of the need for tuning or servicing as follows:

- Blue smoke (mainly oil and unburnt fuel) - may indicate a badly worn engine in need of servicing.
- Black smoke (soot, oil and unburnt fuel) - indicates mechanical fault with the engine, such as defect in the fuel delivery system or the engine is working near its maximum speed.
- White smoke (water droplets and unburnt fuel) - produced when the engine is started from cold. Where appropriate the engine should be warmed up outside.

NOTE: Where visible smoke is excessive, opacity testing, using the protocol in Society of Automotive Engineers (SAE) smoke test procedure J1667, or other applicable particulate emission test, may be needed in order to demonstrate that emissions have been minimized.

Work area assessment - section 5.73(b)
The extent of the work area assessment required will depend on the circumstances of each workplace. In most cases actual measurement of air contaminants or an indicator of them will be necessary on a regular basis, in order to meet the requirements of section 5.73(b).

Measurement of the air contaminant levels may not be needed in circumstances where contaminant levels measured are minimal and exhaust emission controls have been provided, an effective service maintenance program is in place, and workplace ventilation rates are adequate. If at any time the workplace assessment suggests that workers may be exposed to levels above the applicable exposure limit, then equipment operation should be suspended until additional controls are provided.

Measuring exposure to air contaminants must be conducted using occupational hygiene methods acceptable to WorkSafeBC (refer to OHS Guideline G5.53). Both the short term exposure limit as well as the 8-hour limit must be considered for contaminants such as CO. Since NO_2 is assigned a ceiling limit, maximum exposure must be anticipated and evaluated. Re-evaluation is required if circumstances of use are altered which could increase exposure.

Preliminary assessment
In most cases, a preliminary assessment to determine the general suitability of equipment should be conducted before the equipment is put into operation. An additional air contaminant assessment may also be required, depending on the results of the preliminary assessment.

The preliminary assessment should consider factors such as

- Is an alternative type of safer equipment available, which is practical to use under the circumstances, such as non-internal combustion engine options, or other equipment and engine fuel type options?
- Can engine exhaust be practicably vented to the outdoors? This may be feasible where the mobile equipment remains essentially in one area for extended periods of time or moves slowly. For example, where mobile equipment such as excavators, concrete saws, or elevating work platforms are being used in construction.
- Frequency and pattern of operation.
- Type of fuel. Gasoline powered engines generally emit higher levels of CO than other fuel types, while propane and diesel emit higher levels of NO_2. In general, unless the equipment is provided with emission controls, a gasoline powered engine is not recommended for use under circumstances where the equipment is regularly operated indoors or in enclosed work areas. Quality of fuel should also be considered.
- Engine size. Small engines generally emit proportionately higher levels of CO.
- Exhaust contaminant levels.
- Types of emission controls. With emission controls, contaminant levels can be expected to be significantly reduced.
- Natural ventilation rate. The larger the work area volume the greater the natural ventilation rate.
- Mechanical ventilation rate. The ACGIH Industrial Ventilation Manual, for example, stipulates a ventilation flow rate of 5000 cubic feet per minute (cfm) per forklift; studies have shown that this same ventilation rate is necessary to control the emissions from some small engines not designed for indoor operation.

Air contaminant assessment
Some guidance is provided below on the circumstances in which an additional air contaminant assessment is needed, and on acceptable levels of air contaminants for specific engine fuel types. In all cases, the employer must ensure that worker exposure does not exceed the exposure limits set out in section 5.48 of the *Regulation*.

The level of air contaminants emitted in the engine's exhaust will generally be significantly higher when the engine is first started from cold. Thus, whenever possible, the equipment should be brought to operating temperature outdoors or with the exhaust vented directly outside, before running the equipment inside.

The initial air testing should be conducted under the conditions in the workplace that are expected to result in the highest exposure levels. If air contaminant levels under these "worst case" conditions are well within the applicable exposure limits (e.g., meets with the low exposure level criteria described below), then additional air testing would not likely be required.

Air testing considerations are provided below for engines operating on different types of fuels. In some cases where more than one fuel type is involved (for example in vehicle parking garages or ferries) a broader range of air contaminants may need to be considered to adequately assess exposure.

Exposure levels are defined as follows:

- *Low exposure* refers to exposure levels of less than one-tenth of the corresponding exposure limit.
- *Moderate exposure* refers to exposure levels of from one-tenth to less than one-half of the exposure limit.
- *High exposure* refers to exposure levels of one-half or more of the exposure limit.

Gasoline/propane/natural gas
For engines not equipped with emission controls, carbon monoxide (CO) can generally be used as a good indicator of overall exposure levels. However, even if CO levels are low, nitrogen dioxide (NO_2) exposure levels will also need to be evaluated. (Very low CO levels usually indicate that engine is running lean, which will result in higher NO_2 emissions.) If the engine is equipped with a catalytic converter (which reduces CO and HC) or 3-way catalytic converter with air/fuel ratio feedback control system (which reduces CO, HC, and NO_2) then it is essential that NO_2 be evaluated as well.

Depending on the level of exposure, the suggested frequency for air contaminant assessment is as follows:

- *Low exposure* - no additional air testing is required provided the service and maintenance program (which includes exhaust gas analysis as outlined previously) is established and maintained. Re-evaluation should be done if conditions of operation change.
- *Moderate exposure* - frequency of air testing will depend on exposure levels, types of controls, and workplace experience. In any case re-evaluation should be done at least every six months.
- *High exposure* - continuous monitoring for contaminant(s) of concern should be conducted. In any case, at least weekly monitoring is required.

Special cases:

1. *Ice arenas* - Experience has shown that significant problems with indoor air quality can arise from the indoor operation of the ice resurfacing machine as well as the ice edger. Such workplaces should be equipped with continuous monitoring equipment for both CO and NO_2 and monitoring should be conducted at 1.8 metres (6 feet) or so above ice level. Periodic evaluations for CO and NO_2 levels should also be conducted in other areas of the arena complex not serviced by continuous monitors.
2. *Construction sites* - Since ventilation options may be limited on construction sites when working in relatively confined areas, consideration should always be given to use of mobile equipment which does not result in the accumulation of exhaust contaminants in the work area. Where this is not practical, ongoing monitoring for CO needs to be conducted to ensure that both the short-term exposure limit and 8-hour limit are not exceeded.
3. *Small engines* - Some small portable equipment such as power washers, concrete saws, floor burnishers, and generators may be powered by internal combustion engines. Such equipment is not considered to be mobile equipment under the *Regulation*, and hence is not subject to section 5.73. However, before using any such equipment indoors the employer should ensure the equipment is designed by the manufacturer for indoor use. Fatalities have occurred as a result of indoor use of equipment designed solely for operation outdoors. If no other options are practical, then the ventilation rate should be measured and shown to be at least 5000 cfm per engine or the engine exhaust must be effectively ventilated directly to the outside. In any case, ongoing monitoring for CO will be required to ensure exposure limits are not exceeded.

Diesel
Although evaluating worker exposure to air contaminants generated by diesel engines tends to be more challenging than with other common fuel types, due to the number of potential air contaminants, diesel exhaust emissions are usually more visible. For example, they contain over ten times more particulate matter or smoke than gasoline engine emissions. In addition they are more directly irritating. As such, a more subjective evaluation can also prove useful as a workplace exposure assessment tool.

Since diesel exhaust generally contains relatively low levels of carbon monoxide, CO alone cannot be used as a reliable indicator of exposure. Nitrogen dioxide NO_2) is a principal concern, but contaminants such as aldehydes and diesel particulate matter may also be significant.

As a minimum, exposure evaluation will need to include CO and NO_2. Where exposure to both of these contaminants is within the applicable exposure limits, and where particulate (smoke) levels are not significant and workers are not experiencing any irritant or other ill effects that may be attributable to exposure to diesel exhaust, direct evaluation of other air contaminants may not be required. Where diesel powered equipment is being regularly operated indoors or in an enclosed work area, air monitoring for air contaminants other than CO and NO_2 should be conducted, unless contaminant levels are well within their respective exposure limits.

Once the relationship between CO and NO_2 and other diesel exhaust contaminant levels has been established for a given set of workplace circumstances, a single gas such as CO may be used for continuous or ongoing monitoring purposes. In this instance, the CO level to be used as an indicator of acceptable air quality will be significantly less than the 8-hour TWA limit of 25 ppm. Ambient CO levels of less than 10 ppm are to be achieved before other contaminants can be assumed to be within acceptable levels.

For certain applications, such as where heavy duty or larger diesel engines are being operated, carbon dioxide (CO_2) may also be used as an indicator of contaminant levels. For example, where CO_2 levels are less than about 1000 ppm and the subjective criteria referred to above have also been met, then all contaminant levels associated with diesel exhaust are likely within acceptable limits. If representative indicators such as CO_2 are used as the only indicator of harmful exposure to exhaust components, the employer is expected to support this approach using additional assessment criteria.

The following table summarizes how CO_2 levels and/or a combination of CO and NO_2 readings could be used to assess the potential for worker exposure to harmful levels of diesel exhaust components. (The table is adapted from "Control of Diesel Exhaust Emissions in the Workplace" Health & Safety Executive, U.K.)

Table: Exposure levels and emission controls

Low	Medium	High
No visible haze in the workplace	Occasional white, blue, or black smoke visible in the workplace	Permanent white, blue, or black smoke
No visible soot deposits	Soot deposits visible	Heavy soot deposits especially near emission points
No complaints/reports of irritancy or other ill effects	A few complaints of irritancy or other ill effects	Worker complaints widespread
CO_2 levels less than 800 ppm and/or CO <8 ppm and NO_2 levels less than 50% of the exposure limit of 1ppm (ceiling)	CO_2 levels near 800 ppm and/or CO levels approaching 10 ppm or NO_2 levels approaching the exposure limit	CO_2 levels in excess of 1000 ppm and/or CO levels in excess of 10 ppm or NO_2 levels above the exposure limit
Controls likely to be adequate - periodic reevaluation	Controls may not be adequate. Additional assessment for other contaminants will likely be required or additional controls	Controls not likely adequate. Immediately cease operations and decide on new control strategy before resuming. Reevaluation required

G5.75 Mobile equipment emission controls

Issued: July 27, 2005

Regulatory excerpt
Section 5.75 of the *OHS Regulation* ("*Regulation*") states:

> Mobile equipment manufactured after January 1, 1999 that is regularly operated indoors must be
>
> (a) equipped with an emission control system that includes a feedback control for air/fuel ratio, and a three-way catalytic converter if the mobile equipment is powered by gasoline, propane or natural gas, or other measures acceptable to the Board, or
>
> (b) equipped with a scrubber or other emission control system that reduces particulate emissions by at least 70% when tested according to the procedures of the Mine Safety and Health Administration, US Department of Labour, or must meet another standard acceptable to the Board, if the mobile equipment is powered by diesel fuel.

Purpose of guideline
This guideline provides information on the circumstances in which emission controls are expected on mobile equipment powered by internal combustion engines, when used indoors. The guideline deals largely with section 5.75, but also discusses several related requirements. It explains what is meant by the terms "regularly operated" and "indoors" in section 5.75 and also points out a specific requirement in agriculture.

The context of section 5.75
This provision is one of a series of requirements on the use of internal combustion engines indoors, found in sections 5.72 to 5.75 of the *Regulation*.

Section 5.72 addresses the obligation to vent engine exhaust to the outdoors where possible. Typically this requirement applies to engines that are fixed in place and to those locations where vehicles undergo engine repair or maintenance.

For mobile equipment operated indoors or in enclosed areas, section 5.73 requires a risk assessment be done to assess the potential for exposure of workers to harmful levels of air contaminants. It also requires that engines be adequately maintained and serviced.

Section 5.74, which applies to both fixed and mobile equipment used indoors, requires that engineering controls be installed on the equipment, but only if workers are or may be exposed to harmful levels of air contaminants as a result of engine operation.

Section 5.75 is a technology-based requirement that establishes an obligation to install certain emission control equipment on newer mobile equipment manufactured after January 1, 1999, when the equipment is "regularly operated indoors" to help prevent any likelihood of the overexposure of workers to air contaminants.

Typically employers who own equipment will be expected to ensure any necessary modifications are made to ensure compliance with section 5.75. In cases where suppliers provide equipment in a lease or rental arrangement, and it is known that the equipment would be regularly operated indoors, then under the *Workers Compensation Act*, the supplier also carries responsibilities for compliance.

The remainder of this guideline discusses what is meant by the phrasing "regularly operated indoors" and provides information on its application to agriculture.

What is meant by "regularly operated"?
The term "regularly operated," as it applies to indoor use, means that the equipment is either typically used indoors (that is, for a majority of its use time), or is used indoors on a recurring and substantial basis.

Examples of equipment that is typically used indoors include ice-surfacing equipment at indoor skating rinks, and forklifts used inside warehouses to move product around the warehouse or to handle deliveries in the warehouse to and from loading bays. Such equipment, if manufactured after January 1, 1999, is required to have emission control equipment installed as per section 5.75.

Section 5.75 is also applicable to equipment that is used indoors on a recurring and substantial basis, even though it is typically used outdoors. There are two points of clarification in this case.

- The recurring use should be ongoing to require the installation of emission controls. For example, if a piece of equipment such as a bobcat is used indoors for a week or two to excavate some subsoil during the renovation of a foundation, but is otherwise always used outdoors, then emission control equipment would not be required.
- Where a piece of mobile equipment is used indoors on an ongoing recurring basis that use must also be reasonably substantial in extent. For example, if a forklift is used indoors on a recurring basis, but for no more than 15-20% of its total use time on a typical day, then normally section 5.75 will not apply. Under this scenario, section 5.75 is not expected to apply to a piece of mobile equipment that is operated indoors only for purposes such as parking the equipment, maintenance or repairs.

However, in both the above cases the areas in which the equipment is used must be assessed to determine the potential for workers to be exposed to harmful levels of exhaust components, as required by section 5.73(b). If usage of a piece of mobile equipment, regardless of its extent, (or date of manufacture) exposes or may expose a worker to concentrations of an exhaust gas component exceeding the applicable exposure limit, then section 5.74 applies and an exhaust gas scrubber, catalytic converter or other engineering controls must be installed.

What is meant by "indoors"?
This term is intended to apply to those buildings or other structures that will tend to prevent natural air flow, and trap exhaust contaminants within the structure. Typically, a four-sided roofed structure that is structurally open on at least two sides where the equipment is being operated will not be considered to be "indoors". If the area in which the equipment is being operated is enclosed on three of the four sides it would likely be considered to be an indoor environment, even if it has a number of doors that could be left open. If the area where the equipment is being operated is substantially open above, it may not be considered to be indoors if at least one side is also open.

Application to agriculture
Note that the requirements of the *Regulation* did not apply to agriculture until January 1, 2005. As a result, section 28.33 makes the requirements of section 5.75 applicable in agriculture only to equipment purchased for first use after January 1, 2006. This guideline also applies to that agriculture equipment.

G5.80 Hazardous wastes and emissions - Sharp-edged waste

Issued August 1999; Editorial Revision February 1, 2008; Editorial Revision consequential to December 1, 2023 Regulatory Amendment

Regulatory excerpt
Section 5.80 of the *OHS Regulation* (*"Regulation"*) states:

> Broken glass, metal or similar rigid, sharp-edged waste must be disposed of in separate, puncture proof waste containers and the contents of the containers must be clearly identified.

Purpose of guideline
The purpose of this guideline is to discuss disposal procedures for sharp-edged waste. It also discusses features of an acceptable puncture-proof waste container.

Sharp-edged waste
Under section 5.80 of the *Regulation*, sharp-edged waste must be disposed of in separate, puncture-proof waste containers and the contents of the containers must be clearly identified. This section applies to broken glass, metal, or other similar rigid sharp-edged waste. The requirements for needle sharps contaminated with either biological agents or cytotoxic drugs are addressed under sections 6.36 and 6.56.

An acceptable "puncture-proof waste container" should be rigid enough to contain whatever waste it was intended to hold. Thus, plastic or paper bags should not be used for broken glass, but metal or fibreboard (thick cardboard) chemical drums would be acceptable. In this section, "clearly identified" normally means affixing an identifier label on the container, for example "broken glassware."

G5.81 Combustible dust - Sawmills and other wood products manufacturing facilities

Issued April 25, 2012; Editorial Revision May 1, 2012; Revised December 19, 2013; Revised August 15, 2014; Revised March 11, 2016; Editorial Revision April 6, 2020

Regulatory excerpt
Responsibilities for worker health and safety are established by the *Workers Compensation Act* ("*Act*") and the OHS Regulation ("*Regulation*").

Section 21 of the *Act* states in part:

> **General duties of employers**
>
> (1) Every employer must
>
> (a) ensure the health and safety of
>
> (i) all workers working for that employer, and
>
> (ii) any other workers present at a workplace at which that employer's work is being carried out, and
>
> (b) comply with the OHS provisions, the regulations and any applicable orders.
>
> (2) Without limiting subsection (1), an employer must
>
> (a) remedy any workplace conditions that are hazardous to the health or safety of the employer's workers...
>
> (e) provide to the employer's workers the information, instruction, training and supervision necessary to ensure the health and safety of those workers in carrying out their work...

Section 22 of the *Act* states in part:

> **General duties of workers**
>
> (1) Every worker must
>
> (a) take reasonable care to protect the worker's health and safety and the health and safety of other persons who may be affected by the worker's acts or omissions at work....

Section 23 of the *Act* states in part:

> **General duties of supervisors**
>
> (1) Every supervisor must
>
> (a) ensure the health and safety of all workers under the direct supervision of the supervisor...

Section 3.5 of the *Regulation* states:

> **General requirement**
>
> Every employer must ensure that regular inspections are made of all workplaces, including buildings, structures, grounds, excavations, tools, equipment, machinery and work methods and practices, at intervals that will prevent the development of unsafe working conditions.

Section 3.7 of the *Regulation* states:

> **Special inspections**
>
> A special inspection must be made when required by malfunction or accident.

Section 3.9 of the *Regulation* states:

> **Remedy without delay**
>
> Unsafe or harmful conditions found in the course of an inspection must be remedied without delay.

Section 3.10 of the *Regulation* states:

> **Reporting unsafe conditions**
>
> Whenever a person observes what appears to be an unsafe or harmful condition or act the person must report it as soon as possible

> to a supervisor or to the employer, and the person receiving the report must investigate the reported unsafe condition or act and must ensure that any necessary corrective action is taken without delay.

Section 5.81 of the *Regulation* states:

> **Combustible dust**
>
> If combustible dust collects in a building or structure or on machinery or equipment, it must be safely removed before accumulation of the dust could cause a fire or explosion.

Prevention Policy Item ("Policy") P2-21-3 states in part:

> **Reasonable Steps to Address the Hazard**
>
> WorkSafeBC considers that reasonable steps by an employer to address the hazards of combustible wood dust include the following:
>
> (a) conducting a risk assessment to identify combustible wood dust hazards at the workplace;
>
> (b) developing and implementing a combustible wood dust management program to effectively address combustible wood dust hazards;
>
> (c) educating and training workers and supervisors about the hazards and measures in the combustible wood dust management program to control the hazards;
>
> (d) ensuring that the combustible wood dust management program is fully implemented;
>
> (e) undergoing a wood dust mitigation and control audit as soon as reasonably possible after implementing the program, then
>
> (i) promptly implementing recommendations from the audit, and
>
> (ii) conducting a new audit if there is any material change to work processes or equipment;
>
> (f) reviewing the combustible wood dust management program
>
> (i) annually, and
>
> (ii) simultaneously with any material changes to work processes or equipment to ensure that these changes are addressed; and
>
> (g) complying with the employer's combustible wood dust management program.

Policy P2-22-2 states:

> A worker's obligation to take reasonable care to protect the health and safety of themselves or others includes:
>
> (a) reporting unsafe conditions or actions relating to combustible wood dust in the workplace to a supervisor, or to the employer, as soon as possible; and
>
> (b) complying with the employer's combustible wood dust management program.

Policy P2-23-3 states:

> In addition to a supervisor's duties as a worker or employer, a supervisor's obligation to ensure the health and safety of workers includes:
>
> (a) investigating any reports received by the supervisor or inspection results identifying an unsafe condition or act relating to combustible wood dust and ensuring that necessary corrective action is taken immediately; and
>
> (b) complying with the employer's combustible wood dust management program.

Purpose of guideline
This purpose of this guideline is to provide information regarding the requirement for employers in the following eight classification units to mitigate the hazards associated with combustible wood dust:

1. Sawmill – 714022
2. Oriented Strand Board Manufacture – 714012
3. Planing Mill – 714015
4. Pressed Board Manufacture (not elsewhere specified and includes pellet plants) – 714019
5. Pulp and Paper Mill – 714044
6. Shake and Shingle Mill – 714023
7. Veneer or Plywood Manufacture – 714027

8. Wooden Component Manufacture (not elsewhere specified) – 714032

The intention of this guideline is as follows:

- Assist employers in understanding the hazards of combustible wood dust
- Provide guidance on developing a combustible wood dust management program, including risk assessment and training of workers and supervisors
- Provide information on conducting a wood dust mitigation and control audit
- Describe WorkSafeBC's inspection and compliance approach to wood product manufacturing operations in the classification units listed above

Background
Combustible wood dusts in the workplace present a risk of both fire and explosion if they are not managed effectively. A dust explosion or serious fire can cause catastrophic loss of life, injuries, and destruction of buildings.

Controlling combustible wood dust hazards requires a systematic long term approach contained in a combustible wood dust management program ("Program"). Following the implementation of the Program, an audit, which provides an objective and comprehensive evaluation of a facility's wood dust management practices and their effectiveness, must be conducted. The foundation for this systematic long term approach is a thorough risk assessment. The employer has the flexibility to evaluate the risk based on relevant criteria and considerations, such as wood dust properties and ignition potential.

The compliance standard that employers are required to meet will reflect the performance based nature of the obligations in the policies. WorkSafeBC inspections will focus on the quality of the risk assessment, the Program, and the requirement for an audit. The expectation will be that employers will ensure worker safety by identifying combustible wood dust hazards and effectively evaluating and managing the risks. The presence of dust in excess of acceptable limits may indicate non-compliance if that accumulation was not identified in the risk assessment or not adequately accounted for and controlled in the Program.

Understanding combustible wood dust
It is important to understand the science behind the generation of wood dust and how it relates to the risk it may present in wood product manufacturing industries.

Wood dust is a combustible material that can act as fuel in many situations. The combustibility of a given sample of wood dust is determined largely by two properties: the particle size and the moisture content. In the case of wood dust as a bio-fuel, these properties will change over time. The moisture content will continue to decrease in an indoor or covered environment. The rate at which the moisture content declines is impacted by the ambient conditions but it is also directly related to the particle size. A smaller particle loses moisture much faster than a larger particle due to a greater surface area to volume ratio. The greater surface area to volume ratio also increases the ignitability of the particle. This is why kindling is used to start a fire. As a dust particle loses moisture, the mass and volume also decline. This is why smaller particles are particularly dangerous. They are highly combustible, easily ignited, and can be easily mixed in air.

In wood product manufacturing processes, the type and speed of the process along with the characteristics of the wood create different dust profiles. These profiles may range from large particulate and debris (chipping operation) to very fine powdery dust (sanding). In most wood product manufacturing operations the dust produced contains a broad range of particle sizes ranging from several microns to several millimetres.

With many mixed particle size wood dusts, the moisture contained within the particle binds them loosely together; small particles bind to larger ones. However, as the dust dries out and they are subjected to mechanical forces which separate the various particles, the small fine particles will separate, migrate, and settle on surfaces and become a readily available fuel that could result in an explosion. As a result, dust profiles both in terms of moisture content and particle size will vary dramatically as one moves farther downstream and away from the point where the dust was produced or released.

Fire, deflagration, and explosion hazards
Different dust profiles present different hazards. A dust accumulation may present either a fire, deflagration, or explosion hazard. An explosion or deflagration can start with a dust fire that ignites finer dust which is dispersed into the air by some other mechanism.

The dust explosion pentagon
There are five elements of a combustible dust explosion, which are presented in the dust explosion pentagon illustrated below.

Dust explosion pentagon

Evaluating the risk of fire and explosion requires consideration of each of the components of the pentagon: fuel (dust), dispersion, oxygen, ignition, and confinement.

Deflagration is rapid combustion of fuel mixed with air. The only difference from an explosion is that deflagration does not have an element of confinement. In other words, an explosion is a deflagration in a contained environment.

Fire is the combination of three elements from the pentagon: fuel, oxygen, and ignition and, as set out above, can be the source of ignition for subsequent deflagration or explosion events.

Evaluating dust accumulations

To determine the extent and nature of the risk presented by an existing dust accumulation, the employer must evaluate the characteristics of the dust. The critical properties that determine whether or not the dust is a fire, deflagration, or explosion hazard are the particle size and moisture content. Based on its characteristics, dust can be classified as either "primary" or "secondary."

"Primary" dusts are those found on floors and surfaces near or below the dust producing or waste handling equipment. Primary dusts consist generally of greener, moister, and coarser particulate and can present a fire hazard if not actively managed. Unmanaged primary dusts will, over time, dry out and spread over a broad area and present a fire hazard. They will also release finer, drier secondary dusts that are often the fuel source for serious fires and explosions. Primary dust accumulations also present a fire hazard when they are in direct contact with equipment that produces heat or that might be a potential ignition source.

"Secondary" dusts are the finer, drier dusts that are broadly dispersed and that settle away from the points from which they are produced or released. "Secondary" dusts are to be considered deflagrable unless the employer has conducted appropriate and representative testing to show otherwise. Where deflagrable secondary dusts are present at a depth of 1/8" or more over 5% of a given work area, they present a fire or explosion hazard.

For the purposes of applying the 5% criteria, a "given work area" is considered to be an area of the workplace, whose boundaries are defined by the various physical structures around it, which may enclose, contain, or compartmentalize the area. These structures may include walls, floors, ceilings, process equipment, or any combination of these which have the effect of either fully or partially enclosing, containing, or compartmentalizing that work area within the facility. The greater the extent of confinement, enclosure, or containment in an area where dust has accumulated, the greater the risk that an explosion may occur.

Examples of fully or partially enclosed, contained, or compartmentalized areas that are commonly found in sawmills and other wood product manufacturing facilities may include, but are not limited to the following:

- Planer enclosures
- Conveyor tunnels or galleries
- Chipper and blower rooms
- Basement areas between enclosed waste conveyance lines
- Log in-feed, cut-off, and de-barker areas

This assessment is to be made with respect to all relevant areas of the facility that may create a deflagration hazard due to their physical properties. In some cases, depending on the circumstances (such as the size and layout of the facility, concentration of dust and other factors), the assessment will need to be made facility wide as the entire plant may constitute the relevant area.

The approach outlined above is informed by the approach taken in the 2012 edition of the NFPA 664: *Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities*. NFPA 664 states that a deflagration hazard will exist where accumulated fugitive deflagrable wood dust (i.e., deflagrable secondary dust) exceeds 1/8" over 5% of an area.

The classification of dust as either "primary" or "secondary" remains an acceptable approach to determine whether wood dusts present a fire, deflagration, or explosion hazard. However, employers may choose to carry out a more thorough or specific analysis of the risk presented by wood dust to gain a more detailed understanding of the nature of the hazard and to more precisely guide their control measures. For example, an employer may undertake representative sampling of wood dusts produced in its facility to more accurately determine particle size and moisture content or carry out a more thorough review of actual ignition potential from equipment in areas that may accumulate dust.

Combustible wood dust management program ("Program")

Prevention Policy Item P2-21-3 sets out the reasonable steps an employer should take to mitigate the hazards of combustible wood dust. Guidance on these steps is set out in the Combustible Wood Dust Management Program Development Guide ("Guide") available in the online Mitigation and Control of Combustible Wood Dust Resource Toolbox.

The Guide incorporates the policy items and expands on the following considerations that should be included in the development and implementation of the Program to effectively address combustible dust hazards.

The Program should be in writing and should contain the following elements:

1. **Policy statement** to define the overall aims, objectives, and responsibilities.
2. **Risk assessment process** to identify and evaluate combustible wood dust hazards and the impact of changing conditions.
3. **Implementation of controls** to effectively minimize combustible wood dust risks.
4. **Inspections** to ensure combustible dust risks are being effectively managed.
5. **Investigation** of fire incidents, reports of unsafe conditions, and work refusals to prevent the reoccurrence of similar or more serious incidents.
6. **Education, training, and supervision** to ensure workers understand the hazards associated with combustible dust and the measures to control the hazards; and to ensure they work in accordance with applicable rules and procedures.
7. **Program audit and review process** to ensure the Program has been fully implemented and is effective.
8. A **corrective action management process** to ensure that recommendations and remedial action identified through the Program activities are effectively implemented.
9. **Records and statistics** to facilitate internal and external reporting, track program activities and changes, and identify trends.

The online Toolbox also contains a Combustible Wood Dust Mitigation and Control Checklist that may be used to assist in the development and implementation of the Program. This checklist should not be used in place of an audit but may be used to prepare for an audit.

Wood dust mitigation and control audit

The employer must undergo a wood dust mitigation and control audit for each operating location as soon as reasonably possible after implementing the Program. The employer must promptly implement recommendations from the audit, and conduct a new audit if there are any material changes to work processes or equipment.

The purpose of the audit is to ensure that all elements of the Program have been effectively implemented and are functioning as intended. The audit identifies deficiencies and opportunities for continual improvement.

The online Toolbox contains two documents, made available by the Manufacturers' Advisory Group (MAG), which may be used to conduct an audit of the Program in all manufacturing facilities that produce or utilize combustible wood dust during their manufacturing activities. These documents are the Wood Dust Mitigation and Control Audit and the Wood Dust Mitigation and Control Audit Auditor Worksheet, Questionnaire and Guideline.

While the audit tool described above provides a useful framework for performing the audit, it is open to employers to use other audit tools. Any audit tool an employer uses should address the following elements:

- Evaluation of facility risk assessment that covers
  - Identification of areas where combustible dust may be produced or may accumulate
  - Identification of potential ignition sources
  - Means of dust dispersion
- Evaluation of combustible dust controls, including
  - Engineering or passive controls
  - Administrative or procedural controls
- Verification of assignment of dust management responsibility and qualifications of workers involved in dust management
- Verification of management review of the Program
- Review of change management plan
- Evaluation of inspection frequency and effectiveness
- Review of emergency management plan
- Evaluation of record keeping
- Evaluation of training and supervision with respect to combustible dust hazards and the Program

Auditors must be qualified to perform the audit. They should have a combination of education, experience, and training to demonstrate that they are knowledgeable about the hazards and mitigation controls related to combustible dust. Some suggested qualifications are found in the Auditor Worksheet referenced above and are based on the following criteria:

- Industry knowledge and work experience in the applicable type of wood product manufacturing facility
- Demonstrated understanding and knowledge of applicable codes, standards, and guidelines
- Relevant education and/or professional designations

WorkSafeBC engagement approach and inspection process

The scope of WorkSafeBC's inspections will primarily be operating areas of the operation that represent production and waste stream activity.

WorkSafeBC prevention officers will also selectively examine a representative number of infrequently accessed areas or areas not directly related to the production stream. The intention of this approach is to ensure the inspection covers a representative sample of potential combustible dust hazard areas in the facility.

WorkSafeBC inspections will focus on: evaluating selected areas; paying attention to processes that create, transport, or store combustible wood dust within the area; the risk assessment; and the Program. Where prevention officers observe accumulations of dust, their primary role is to evaluate the risk with consideration of the employer's risk assessment, determine whether all reasonable steps were taken to prevent the occurrence, and then determine if the Program would have controlled the risk within a reasonable period of time.

The presence of an accumulation of dust identified during an inspection is not assumed to be an automatic indication of non-compliance unless that accumulation

- Presents a high risk of fire or explosion
- Is from a source or in an area not identified in the employer's risk assessment
- Was not adequately addressed in the Program
- Resulted either from a failure of the employer to comply with its Program or a lack of worker training or supervision

Prevention officers will utilize the policies and this guideline to reference benchmarks of reasonable inspection, assessment, and control, and will use the necessary enforcement tools to achieve sustained compliance.

Additional resources
In addition to the documents referred to in the guideline, Mitigation and Control of Combustible Wood Dust Resource Toolbox contains additional combustible wood dust resources.

Section 4.42 of the *Regulation* sets out restrictions on cleaning with compressed air. Refer to *G4.42(1) Cleaning with compressed air - Hazards of combustible dusts* for guidance on the circumstances under which cleaning equipment or work areas with compressed air is permitted, and the controls that need to be put in place in order to ensure that cleaning with compressed air does not create a hazard due to fire, explosion, or other cause.

Section 5.71 of the *Regulation* provides requirements for exhaust ventilation systems and dust collection where operations or work processes present a risk of fire or explosion. Refer to *G5.71(3) Location and construction of dust collectors* for guidance on locating and constructing dust collectors used to control combustible dusts so that workers will not be endangered in the event of an explosion inside the collector. G5.71(3) also provides additional information on combustible dusts in general, and dust explosions.

G5.82 Employer's responsibility

Issued August 1, 1999

Regulatory excerpt
Section 5.82 of the *OHS Regulation* ("*Regulation*") states:

> (1) If a work process may result in harm to a worker from contamination of the worker's skin or clothing by a hazardous substance, the employer must
>
> (a) supply appropriate protective clothing,
>
> (b) launder or dispose of the protective clothing on a regular basis, according to the hazard,
>
> (c) provide adequate wash facilities, and
>
> (d) allow time for washing before each work break.
>
> (2) If work processes involving substances such as lead, mercury, asbestos, silica or pesticides are high hazard, the employer must also ensure that workers are provided with
>
> (a) clothing lockers in separate rooms for street clothing and work clothing,
>
> (b) heated shower facilities between the rooms, and
>
> (c) time for showering and clothing change before the end of the work shift.
>
> (3) In a remote location where provision of change rooms and shower facilities is not practicable, separate clothing storage and adequate washing facilities must be provided.

Purpose of guidelinee
The purpose of this guideline is to explain the employer's responsibility to provide effective means of removing hazardous substances defined in section 5.1 from a worker's skin or clothing as outlined in section 5.82 of the *Regulation*.

Contaminant hazard

This section applies to work processes where a worker's skin or clothing may become contaminated with substances that, if not removed prior to the completion of the work shift, would present a hazard from inhalation or ingestion. Examples include finely divided lead or lead compounds, mercury, silica dust, pesticides, and asbestos fibres.

Section 5.82(1)(b) requires the employer to "launder or dispose of the protective clothing on a regular basis, according to the hazard." Note that the provisions of section 12.157 of the *Regulation* also apply. That is, the employer must advise the operator of the laundry or dry cleaning facility in writing of any potential hazards.

If the work process is "high hazard", then the provisions of section 5.82(2) also apply. To determine whether the process is high hazard, the toxicity of the material should be considered, as well as the potential for exposure. If the material is highly toxic and there is a high potential for worker exposure, then the process should be considered high hazard. When evaluating the potential for exposure, the WorkSafeBC prevention officer should take into account that exposure can result not only from direct use of the substance, but also from cross-contamination (of food, clothing, cigarettes) and/or from ongoing contact with contaminated clothing or other personal materials. The requirements of sections 5.55 and 5.57 of the *Regulation* must also be considered. Under these sections, substitution of less hazardous materials must be considered where possible to reduce the level of hazard. Refer to OHS Guidelines G5.55 and G5.59 for further information.

Examples of high hazard substances include, but are not limited to, asbestos, lead, mercury, cadmium, cobalt, nickel, and pesticides. Examples of operations in which high hazard substances are likely to be handled are as follows:

- Lead or asbestos abatement
- Foundries
- Saw filing
- Cathode manufacturing
- Battery re-manufacturing
- Manufacturing operations using radioactive materials
- Smelting operations
- Coal tar/pitch operations
- Electrical repair
- Exploratory rock drilling
- PCB handling
- Abrasive blasting
- Environmental remediation
- Broadcast spraying of pesticides
- Steel manufacturing

In remote locations where provision of change rooms and shower facilities may not be practicable, the employer is permitted, under section 5.82(3) of the *Regulation*, to provide separate clothing storage and adequate washing facilities. In these circumstances, the employer may need to use personal protective equipment that can be easily decontaminated and implement other contaminant control measures to minimize the likelihood of accidental contact with the high hazard materials. Refer to OHS Guideline G5.91 for additional information on the requirements for emergency washing facilities in remote work sites.

G5.83 Worker's responsibility

Issued August 1, 1999; Editorial Revision April 6, 2020

Regulatory excerpt
Section 5.83 of the *OHS Regulation* ("*Regulation*") states:

> A worker engaged in a work process described in section 5.82 must
>
> (a) wear the supplied protective clothing,
>
> (b) wash effectively before each work break and the end of the work shift, and
>
> (c) shower at the end of the work shift, if required by the hazard.

Purpose of guideline
The purpose of this guideline is to specify the requirements that workers engaged in a work process covered by section 5.82 wear the personal protective equipment supplied by the employer, wash effectively before each work break and at the end of the work shift, and shower at the end of the work shift, if required by the hazard, pursuant to section 5.83 of the *Regulation*.

Compliance
To evaluate compliance with this requirement, the WorkSafeBC prevention officer should first consider whether the employer

- Has fulfilled its responsibility to adequately train, instruct and supervise workers in the required procedures, as per section 21 of the *Workers Compensation Act* ("*Act*")
- Used disciplinary action to further discourage the use of unacceptable work procedures, where necessary

One can determine if the employer has met its responsibilities for training by asking the worker the following questions:

- Do you work with hazardous materials? If so, what are they?
- What precautions are required to prevent or minimize exposure?
- What do you do to remove the material(s) from your skin or clothing?
- Where are the wash and/or shower facilities?
- What are the consequences of not following the instructions regarding personal hygiene?

It is possible to issue orders on both the worker and the employer if both are at fault. Section 22 of the *Act*, "General duties of workers," also applies. Depending on whether the employer has fulfilled its responsibilities to train and supervise and the worker followed that training and supervision, orders may be issued on the employer and/or the worker for violations of sections 21, 22, and 32 of the *Act*.

G5.85 Where required

Issued August 1, 1999

Regulatory excerpt
Section 5.85 of the *OHS Regulation* ("*Regulation*") states:

> The employer must ensure that appropriate emergency washing facilities are provided within a work area where a worker's eyes or skin may be exposed to harmful or corrosive materials or other materials which may burn or irritate.

Purpose of guideline
The purpose of this guideline is to specify the requirements that the employer provide appropriate emergency washing facilities within a work area pursuant to section 5.85 of the *Regulation*.

Background
This section applies to workplaces where there is a risk of exposure to harmful or corrosive materials or other materials that may burn or irritate. Work activities for which emergency washing facilities will likely be required include, but are not limited to, maintenance of ammonia refrigeration equipment, chlorine unloading operations, and caustic degreasing processes.

The selection of appropriate facilities will depend on the degree of risk associated with the workplace or work activity. Refer to Table 5-2 for guidance in identifying workplaces where emergency washing facilities are required. Before selecting emergency washing facilities, the potential hazard for workers must be identified, followed by an assessment of the level of risk, as required by section 5.88 of the *Regulation*. Refer to OHS Guideline G5.88 for further assistance. Table 5-3 outlines the type of equipment required, as well as where such equipment should be located.

G5.86 Water supply

Issued August 1, 1999; Editorial Revision September 30, 2021

Regulatory excerpt
Section 5.86 of the *OHS Regulation* (*"Regulation"*) states:

> (1) For a plumbed emergency eyewash facility, the employer must ensure that only a potable water supply is used.
>
> (2) For a portable (non-plumbed) eyewash unit, the employer must ensure that only potable water or an isotonic saline flushing solution is used.

Purpose of guideline
The purpose of this guideline is to specify the water supply requirements for emergency eyewash facilities pursuant to section 5.86 of the *Regulation*.

Water supply
Emergency eyewash facilities may be plumbed or portable (non-plumbed). Under this section, only a potable water supply is to be used for plumbed facilities. For non-plumbed units, either a potable water supply or an isotonic saline flushing solution (such as 0.85% to 1.0% sodium chloride buffered to a pH of 7.3 ‹ 7.4) may be used. Potable water means water fit for human consumption.

Although portable, self-contained emergency eyewash units should deliver a buffered anti-bacterial saline solution over a 15-minute flush. Any effective antibacterial agent, suitable for ophthalmic use, added to tap water will help preserve the water and reduce the possibility of pathogens developing in the flushing solution. Buffered solutions may be less irritating to the eye than tap water and can improve the effectiveness of portable eyewash units because small amounts of these solutions can be very efficient at partially neutralizing the contaminant.

G5.88 Risk assessment

Issued August 1999; Editorial Revision consequential to August 4, 2015 Regulatory Amendment

Regulatory excerpt
Section 5.88 of the *OHS Regulation* ("*Regulation*") states:

> The employer must ensure that the selection of emergency washing facilities is based upon an assessment of the risks present in the workplace, according to Table 5-2.

Purpose of guideline
The purpose of this guideline is to describe the factors that are taken into consideration when selecting emergency washing facilities.

Factors to be considered
Section 5.88 of the *Regulation* requires that the employer conduct a risk assessment before selecting emergency washing facilities. Emergency eyewash and/or shower facilities should be selected to address the potential hazard(s) associated with the substances used, the tasks performed, and the work area. Refer to Tables 5-2 and 5-3 respectively for guidance in evaluating risk and selecting appropriate facilities.

The general approach to be taken in conducting a risk assessment is discussed in OHS Guideline G5.54-3 ("Risk identification, assessment and control"). Some of the specific factors that should be considered when evaluating the need for emergency washing facilities include the nature and the quantities of the hazardous material involved, as well as the potential for contacting the material during work activities. The table below provides some guidelines that may be helpful for assessing whether a work activity poses a risk to the eyes or skin.

Affected Organ	Nature of the Exposure	Risk Level
Eyes	• Any volume of "very hazardous materials" splashed into the eyes	High
Skin	• More than 100 mL of "very hazardous materials" splashed above the waist, or • More than 1 litre of "moderately hazardous materials" splashed onto the body, with possible splashing above the waist	High
Eyes	• Any volume of "moderately hazardous materials" splashed into the eyes	Moderate
Skin	• Less than 100 mL of "very hazardous materials" splashed onto unprotected skin above the waist, or • less than 1 litre of "moderately hazardous materials" splashed onto unprotected skin, with possible splashing above the waist	Moderate
Eyes	• Any volume of "low hazard materials" splashed into the eyes	Low
Skin	• Less than 100 mL of "very hazardous materials" splashed below the waist, or • Less than 1 litre of "moderately hazardous materials" splashed below the waist	Low

Notes:

Very Hazardous Materials: materials classified as Corrosive to Metal, Skin Corrosion/Irritation (Category 1), Serious Eye Damage/Irritation (Category 1), Acute Toxicity (Categories 1 and 2), and Specific Target Organ Toxicity — Single Exposure (Category 1).

Moderately Hazardous Materials: materials classified as Acute Toxicity (Category 3), Serious Eye Damage/Irritation (Categories 2 and 2A), and Specific Target Organ Toxicity — Single Exposure (Category 2).

Low Hazard Materials: materials that may irritate skin or eyes due to physical, as opposed to their chemical, nature (e.g., particulates generated from grinding). For these materials, the availability of emergency flushing equipment is less critical than the availability of first aid.

G5.89 Table 5-3 Provision and location of emergency washing equipment

Issued August 1, 1999; Editorial Amendment November 18, 2009

Regulatory excerpt
Section 5.89 of the *OHS Regulation* ("*Regulation*") states:

> (1) The employer must ensure, except where it is not practicable to provide a permanent water supply, such as at a remote or transient worksite, that emergency eyewash and shower facilities are provided and located as specified in Table 5-3.
>
> (2) Requirements for tempered water in Table 5-3 do not apply if the advice of a medical professional indicates that tempered washing would increase the risk of injury in a particular application.

Purpose of guideline
The purpose of this guideline is to describe how to determine whether the water supply for emergency washing equipment must be tempered.

Background
Examples of workplaces where it may be impracticable to provide permanent facilities include remote or transient work sites. Refer to *Regulation*

sections 5.90 and 5.91, and the associated OHS Guidelines, for emergency washing requirements at transient and remote worksites, respectively.

Table 5-3 in the *Regulation* lists the emergency eyewash and shower equipment required for high, moderate, and low risk workplaces. In addition, it prescribes where the required equipment must be located in relation to the hazard area. Equipment should be located in readily accessible, well marked locations, and there must be unobstructed access.

Depending on the outcome of the risk assessment conducted under section 5.88, the employer may be required to install one or more of the following:

- Continuous flow emergency shower facility
- Continuous flow eyewash facility
- Drench hose
- Personal eyewash unit
- Supplementary eyewash facility

Tempered or non-tempered
The results of the risk assessment will also determine whether the water supply must be tempered or non-tempered. Each of these terms has been defined in section 5.1 of the *Regulation*. For more detailed information on emergency washing facilities and design criteria, including acceptable temperature ranges, inlet water pressures, and water flow rates, refer to ANSI Standard Z358.1-1998 (*American National Standard for Emergency Eyewash and Shower Equipment*).

For both high and moderate risk workplaces, Table 5-3 requires the provision of tempered water in primary emergency washing facilities. However, under section 5.89(2), tempered water is not required if the advice of a medical professional indicates that tempered washing would increase the risk of injury in a particular application. A medical professional is a physician registered under the *Medical Practitioners Act*. Examples of situations in which the use of tempered water may not be appropriate include

- **Cryogenic chemicals**: irrigation water should not exceed body temperature
- **Thermal burns**: application of cold water to the burn immediately after contact may be preferable to reduce the potential for tissue damage
- **Caustic soda and potassium**: because both are very reactive with water, an immediate flush with a neutralizing or buffered solution may be appropriate, followed by a tempered water flush

For high and moderate risk work locations, non-tempered drench hoses are not an approved substitute for a tempered continuous flow shower or eyewash facilities, although they can be used as supplementary washing facilities to commence the flush. In moderate risk work areas where the risk assessment conducted under section 5.88 indicates that a hazard exists only for small areas of the body or face, WorkSafeBC would consider non-tempered drench hoses to be acceptable supplemental emergency shower and eyewash facilities. See Table 5-3 for specific information.

G5.90 Mobile shower units

Issued April 1, 2006; Editorial Revision December 14, 2012; Editorial Revision November 21, 2017

Regulatory excerpt
Section 5.90 of the *OHS Regulation* ("*Regulation*") states:

> (1) The employer must ensure that portable self-contained units are provided, where it is not practicable to provide a permanent water supply at transient worksites such as construction sites.
>
> (2) The employer must ensure that portable self-contained units at these transient worksites are capable of delivering a minimum flush duration of 15 minutes (or more if required by the nature of the material) if there is a high or a moderate risk of injury to the eyes or skin.

Purpose of guideline
This guideline provides recommendations to the oil and gas sector for the use of mobile shower units. This guideline applies only to oil and gas worksites where it is not practicable to provide a permanent water supply but where a portable self-contained unit (e.g., mobile shower unit) is available.

Recommended use of mobile shower units
Energy Safety Canada's DACC (Drilling and Completions Committee) Industry Recommended Best Practice (IRP) Volume #08 â€“ Pumping of Flammable Fluids (2016), available at https://www.energysafetycanada.com/_Resources/DACC-IRP-Volumes/DACC-IRP-VOLUME-08-PUMPING-OF-FLAMMABLE-FLUIDS) in section 8.10 (attached as Appendix A) has specifications for mobile shower units related to

- The capabilities and capacities of the mobile shower/eyewash units and drench hoses
- Training requirements for, and responsibilities of, the operators of these units
- Equipment requirements for operators of the mobile shower units
- Personal protective equipment requirements for mobile shower unit operators
- Factors determining the use of mobile shower units

Employers should follow the specifications for mobile shower units outlined in *IRP 8*, where applicable.

Where combination fire-shower truck units are used as portable self-contained units under section 5.90, in addition to the specifications in *IRP 8*, the following should be met:

- Procedures should reflect that the combination fire-shower truck is present at the site primarily for personnel emergencies and that the truck must be positioned in a safe place that provides ready access by workers.
- The combination fire-shower truck unit should be configured so that the onboard water supply is used for emergency washing equipment only. If the fire system can draw from the onboard water storage tank, the fire system should be isolated from the onboard storage tank by physically disconnecting them, installing a blind, or locking a valve.

Note: Where there is any conflict between the requirements of the *Regulation* and *IRP 8* the *Regulation* applies.

Appendix A

Excerpt from "Pumping of Flammable Fluids", Industry Recommended Practice (IRP), Volume 8 - 2009

8.10 Mobile Safety Shower Requirements

8.10.1 Scope

Shower units are intended to provide standby safety services for workers whenever hazardous fluids (see WHMIS guidelines) are being pumped or handled. There are several different designs of shower units available on the market.

The intent of this section is to recommend MINIMUM standards for:

The capabilities and capacities of the shower/eyewash units, and drench hoses

Training requirements for, and responsibilities of, the operators of these units

Equipment requirements for operators of the shower units

Factors determining the use of shower units

8.10.2 Capabilities and Capacities of Mobile Shower Units

In order to meet the requirements set out in the O H & S Code Section 23 and the First Aid Regulation Part 11, suitable on-site facilities shall be provided as defined in Provincial/Territorial Regulations and ANSI - Z358.1 - 1998). On-board water supplies are typically 1.9m^3 - 2.3m^3 (500 - 600 US gallons). Each person that could be exposed to hazardous fluids requires 1.15m^3 (300 US gallons) of potable water available for safety shower use. Seasonal weight restrictions (road bans) may limit the amount of water allowed on-board the mobile shower units. This factor will have to be taken into account when determining the need for a supplemental potable water supply.

ANSI Standard Z358.1 - 1998, Sections 4, 5 and 8, set out the following minimum standards for shower units, eyewash units, and drench hoses:

Each shower head shall be capable of delivering a minimum of 76 liters per minute (20 US gpm) of "flushing solution" for a minimum of 15 minutes. This requires a minimum of 1.14m^3 (300 US gallons) for each person exposed to hazardous fluids.

Each eyewash unit shall be capable of delivering flushing fluid to the eyes at a rate of not less than 1.5 liters per minute (0.4 US gpm) for 15 minutes

Each drench hose shall be capable of delivering a minimum of 11.4 liters per minute (3 US gpm) of flushing fluid for a minimum of 15 minutes

The delivered flushing fluid temperature shall be "tepid". Tepid is defined in the ANSI Standard as "moderately warm; lukewarm"

If the number of persons required to be in the **HOT ZONE** exceeds the on-board water supply of a mobile shower unit, supplemental (tepid) potable water shall be required.

Refer to ANSI Standard Z358.1 - (latest edition) for more information on the performance requirements and inspection and maintenance of safety shower equipment.

The following minimum standards should also be observed:

The showering area must be fully enclosed and heated and large enough to comfortably accommodate one adult per shower head

The showering area shall be provided with forced air ventilation

The "recovery area" shall not be used for transportation of the victim, and may only be used for first aid purposes until medical aid arrives at the scene. The shower stalls must not be used as a "recovery area"

A First Aid Kit in accordance with Provincial/Territorial First Aid Regulations

Two self-contained breathing apparatus (SCBA)

The shower unit must be fully mobile in order to change position on location to effectively compensate for changes in wind direction or movement of other equipment on location

The shower unit must be separated from any potential hazard, shall not be located within the **HOT ZONE** and be within 10 second walking distance from the **HOT ZONE**.

Shower units located on tank trucks delivering acid or other fluids to the location are to be used by the tank truck operator only and shall not be factored in when determining the number of shower heads required to provide adequate protection for personnel working in the HOT ZONE.

Ordinary showers installed in travel trailers etc. do not meet the ANSI standard and shall not be not be factored in when determining the number of shower heads required to provide adequate protection for personnel working in the **HOT ZONE**.

8.10.3 Training and Responsibilities of Safety Shower Operators

Operators of shower units shall be competent in the operation of the unit they will be required to operate.

Operators of shower units shall have current and valid training certificates in the following:
Standard First Aid/CPR
H_2S Alive®
Transportation of Dangerous Goods (TDG)
WHMIS

The shower unit operator's duties and responsibilities shall be limited to the following:

The administering of first aid to on-site personnel exposed to chemical/corrosive substances

Provide assistance for on-site first aid

The safe operation of the shower unit; eyewash unit, and drench hose

Review of hazard awareness with all personnel

Instruction of personnel who may be exposed to hazardous materials in the location and proper use of the emergency shower units

8.10.4 Personal Protective Equipment (PPE) Requirements for Safety Shower Operators

Operators of shower units shall be equipped with a complete acid/chemical resistant wet suit including gloves, rubber boots, eye protection, Fire Retardant Clothing (FRC) and a hard hat. FRC must meet CSA or CGSB Standards.

8.10.5 Determining Factors for the Number of Safety Shower Units Required

The following should be taken into account when determining the number of shower units, eyewash units, drench hoses and supplemental supply of potable water required:

The number of personnel working in the HOT ZONE. The HOT ZONE area will differ from job site to job site, and will have to be determined at the job site

Some acid job HOT ZONEs are on the rig floor when the treating iron is suspended

The number of pumping units and volume of acid on-site

The shower unit(s), eyewash unit(s), and drench hose(s) should be on location when the acid is being transferred, mixed, or under pressure on the surface. This shall include the time when back pressure is being used to circulate the acid to the bottom

The shower unit(s), eyewash unit(s), and drench hose(s) shall remain on location until all pumping equipment has been rigged out

G5.91 Remote workplaces

Issued August 1, 1999

Regulatory excerpt

Section 5.91 of the *OHS Regulation* ("*Regulation*") states:

> The employer must ensure that effective means to flush the eyes or skin, based upon an assessment of the risk, is reasonably available at a remote worksite if it is not practicable to provide a portable self-contained unit.

Purpose of guideline
The purpose of this guideline is to provide guidance that under section 5.91 of the *OHS Regulation*, the employer is permitted to provide an effective means of flushing the eyes or skin at remote work sites if it is not practicable to provide a portable self-contained unit.

Remote worksites
Examples of remote worksites include remote logging operations, tree-planting activities, other forestry operations, and remote field pumping stations. The selection of "effective means" must be based on the results of a risk assessment conducted in accordance with section 5.88 of the *Regulation*. Factors that would affect the practicability of providing portable units include, but are not limited to, the availability of a plumbed water supply or a source of heat.

In high-risk, remote worksites, the employer should consider the following:

- Substituting a material that reduces the risk to workers, as required under section 5.55(1)(a) of the *Regulation*
- Isolating or enclosing the material to minimize the likelihood of accidental contact with the eyes or skin
- Providing personal protective equipment that is impenetrable, provides good coverage, and can be easily decontaminated or disposed of

Workers should be trained in both the location and use of the emergency facilities.

Regardless of the level of risk, a clean source of water should be provided to wash exposed body parts. Some options that employers in remote and/or transient work locations might consider using include the following:

- Portable, electrically-tempered shower systems (these are available for both indoor and outdoor use and can provide pressurized water meeting ANSI requirements)
- Portable shower trailers
- Collapsible solar bags
- IV saline drip (to permit continuous flush during transport to a plumbed facility),
- Nearby lakes or streams (in the summer months)
- Water baths

G5.93 Testing

Issued August 1, 1999; Editorial Revision August 2004

Regulatory excerpt
Section 5.93(2) of the *OHS Regulation* ("*Regulation*") states:

> (2) The employer must ensure that a plumbed emergency eyewash or shower facility is full flow tested at least once per month, for a sufficient length of time to completely flush the branch of the water line supplying the eyewash.

Purpose of guideline
The purpose of this guideline is to explain the requirement requires that the employer test emergency washing facilities pursuant to section 5.93 of the *Regulation*.

Manufacturer requirements
Section 4.3 of the *Regulation* requires that equipment must be used and maintained in accordance with the manufacturers' requirements. This means that the facility must be tested upon initial installation in accordance with manufacturers' instructions. Where manufacturers' instructions address other issues, such as flushing or otherwise protecting solutions from micro-organisms, those instructions must be complied with as well. Plumbed facilities must be tested after initial installation and on a monthly basis thereafter. Portable (i.e., non-plumbed) eyewash units must be protected from contamination and refilled regularly with fresh solution to prevent the growth of microorganisms.

Record management
It is good practice to maintain records of testing, inspection, and maintenance of plumbed and non-plumbed eyewash facilities. These records could be in the form of a log book, preventative maintenance cards, tagging, or other similar method and should include the date and time of the test, any defects noted, and corrective action taken.

G5.94 Training

Issued August 1, 1999

Regulatory excerpt
Section 5.94 of the *OHS Regulation* ("*Regulation*") states:

> The employer must ensure that workers who are required to use emergency eyewash and shower facilities are adequately trained in their location and proper use.

Purpose of guideline
The purpose of this guideline is to explain the requirement that the employer provides adequate training to workers on the location and proper use of emergency washing facilities pursuant to section 5.94 of the *Regulation*.

Compliance questions
To evaluate compliance with this section, WorkSafeBC prevention officers ask the worker the following questions:

- Do you work with hazardous materials? If so, what are they?
- What precautions are required to prevent or minimize exposure?
- What do you do to remove the material(s) from your skin or clothing?
- Where are the emergency wash and/or shower facilities?
- How do you activate the unit?
- How long should you remain in the shower (or how long should you run the eyewash unit)?

G5.95 Protection from freezing

Issued August 1, 1999

Regulatory excerpt
Section 5.95 of the *OHS Regulation* ("*Regulation*") states:

> The employer must ensure that an emergency eyewash or shower facility and the piping from the supply are protected against freezing.

Purpose of guideline
The purpose of this guideline is to explain that the employer is to ensure that emergency washing facilities, as well as the piping from the water supply, are protected from freezing pursuant to section 5.95 of the *Regulation.*

Protection from freezing
Measures to protect water supply lines from freezing, include the following:

- Heat or steam tracing lines
- Locating water supply lines and actuation valves underground beneath frost line
- Installing special valves that allow water to drain down automatically to a point below the frost line after the equipment is used
- Providing thermostatically controlled induction-heated shower and piping systems
- Circulating warm water in the pipes
- Using dry pipes from a warm building

If emergency washing facilities are attached to an existing building, a pull cable can be installed on the inside valve to bring warm water from the neighbouring building into the facilities on demand. If the washing facilities are not attached, heated, self-contained units are recommended.

G5.97 Emergency procedures — Emergency plan

Issued August 1, 1999; Revised August 29, 2016; Editorial Revision November 21, 2017; Revised April 9, 2019; Editorial Revision September 25, 2019; Retired consequential to February 3, 2025 Regulatory Amendment

G5.97-1 Application of emergency planning requirements

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.97(2) of the *OHS Regulation* ("*Regulation*") states:

> (2) Sections 5.98 to 5.104 apply in relation to
>
> (a) an emergency arising within or outside a workplace, and
>
> (b) a hazardous substance at a workplace if the hazardous substance could
>
> (i) cause an emergency, or
>
> (ii) aggravate the effects of an emergency, including a risk to a person.

Purpose of guideline
The purpose of this guideline is to clarify what constitutes a "hazardous substance" and "an emergency" for the purpose of sections 5.97 to 5.104 of the *Regulation.*

General and specific emergency planning requirements
Sections 4.13 to 4.18 of the *Regulation* require employers to develop emergency rescue and evacuation procedures for any risk that may impede a worker from leaving the workplace safely in the event of an emergency. Section 4.13(3) includes a reference to hazardous substances that are expanded in sections 5.97 to 5.104. Other sections of the *Regulation* also require employers to develop safe work procedures and control risks when working with hazardous substances. Where other sections of the *Regulation* also apply, employers do not need to create separate

documentation to comply with each part, as long as the required elements of each section of the *Regulation* is included.

Application of emergency planning regulation
When hazardous substances pose a reasonably foreseeable risk to workers in an emergency, employers must develop plans to minimize this risk, regardless of the origin of the hazardous substance. Furthermore, when hazardous substances that are present in the workplace could pose a risk to people outside of the workplace, employers must take reasonable steps to alert others to risks posed by these substances in an emergency. Sections 5.97 to 5.104 of the *Regulation* are intended to address these requirements.

Hazardous substances that should be contemplated under the *Regulation* include those substances defined by Section 13 of the *Workers Compensation Act* ("*Act*"). Section 13 defines a hazardous substance, in part, as "a biological, chemical or physical agent that, by reason of its properties, is hazardous to the health or safety of persons exposed to it." Examples of hazardous substances include, but are not limited to:

- Hazardous products covered by the Workplace Hazardous Materials Information System (WHMIS)
- Explosives
- Pesticides
- Radioactive materials
- Hazardous wastes
- Consumer products
- Combustible dusts

Refer to OHS Guideline G5.3-1 for additional information on the classes of hazardous substances. Physical agents within the scope of this section should generally be limited to radioactive materials.

Emergencies within the scope of sections 5.97-5.104 of the *Regulation* include any unintended situations involving hazardous substances that require an appropriate and typically urgent response to prevent harm to people and to mitigate risk. Even if the employer has implemented control measures to mitigate the risk of such an emergency, if it is reasonably foreseeable that these control measures could fail, a plan to respond to a failure must be in place to minimize risk to workers and other persons.

For the purpose of emergency planning, employers should consider all hazardous substances used or stored at the workplace that could cause or worsen an emergency, even if the hazardous substance is fully contained in a closed system (e.g., refrigerants, process gases).

Employers must also establish emergency plans for hazardous substances that could impact employers' workers in the event of an emergency at another workplace, where such a risk is known or reasonably foreseeable. Refer to OHS Guidelines G5.97-2 and G5.100 for additional information.

Despite these broad definitions, employers are not expected to contemplate every possible emergency for every hazardous substance used or stored at the workplace. The emergency planning requirements established by the *Regulation* are limited under section 5.99 to those hazardous substances that may cause harm to a person in an emergency. Many hazardous consumer products that comply with the Canadian Consumer Chemicals and Containers Regulations and *Hazardous Product Act* may not exceed this threshold, unless they are stored in large quantities. The application of these emergency planning requirements is further limited by section 5.100 of the Regulation to those emergencies that are "reasonably foreseeable." Refer to OHS Guideline G5.97-2 for additional guidance on reasonably foreseeable emergencies.

Employers who have already addressed emergency planning through the development of an exposure control plan, or compliance with other regulatory requirements (for example the federal Environmental Emergency Regulations) do not need to create a separate document for the purpose of these requirements if the document contains all of the requirements under sections 5.97 to 5.104 of the *Regulation*.

Defining "the workplace" for the purpose of emergency planning
Section 13 of the *Act* defines a workplace as "any place where a worker is or is likely to be engaged in any work and includes any vessel, vehicle or mobile equipment used by a worker in work." OHS Guideline G3.16 provides guidance on determining the boundaries of a single workplace, which may assist employers when developing emergency plans.

Employers should structure their emergency plans (including inventories of hazardous substances, risk assessments, and emergency procedures) in a way that best supports the plans' effectiveness and workers' abilities to easily access and understand these plans in the event of an actual emergency. Some factors to consider in the development of effective emergency plans, include:

- The nature of the emergency being contemplated
- The area or persons who may be impacted by the emergency and/or hazardous substance
- The response procedures necessary to control the risk

G5.97-2 Reasonably forseeable emergencies

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.97(2)(a) of the *OHS Regulation* ("*Regulation*") states:

> (2) Sections 5.98 to 5.104 apply in relation to

(a) an emergency arising within or outside a workplace, and

Purpose of guideline
The purpose of this guideline is to provide guidance and examples on what emergencies should be considered "reasonably foreseeable" for the application of sections 5.97 to 5.104 of the *Regulation*.

Reasonably foreseeable emergencies
Although sections 5.97 to 5.104 of the *Regulation* are intended to encompass a broad range of emergencies involving hazardous substances, employers are only expected to develop emergency plans for those emergencies that are reasonably foreseeable and for those which could involve hazardous substances in a quantity that would present a risk to workers or other persons.

Whether a particular emergency is "reasonably foreseeable" should be based on whether a person familiar with the workplace, industry, process, and hazards of the substance could reasonably anticipate the emergency occurring. Conducting a risk assessment in accordance with section 5.100 of the *Regulation* will assist employers to identify emergencies that meet these criteria.

Some types of emergencies that may be determined to be reasonably foreseeable through this process include:

- Equipment failure
- Fires or explosions caused by flammable or combustible substances
- Spills or accidental release, or containment failure
- Reasonably foreseeable equipment or process malfunctions that could upset safe operating conditions
- Human error in identifying or handling substances or operating equipment
- Cyber or other security vulnerabilities to equipment
- Loss of power or cooling, if these could impact hazardous substances

Environmental emergencies (fire, flood, earthquake, etc.) that may impact storage or other processes involving hazardous substances must also be considered, if these types of environmental emergencies are foreseeable for the location of the workplace.

This list of reasonably foreseeable emergencies is not exhaustive. Identifying foreseeable emergencies should be done in consultation with workers based on a reasonable assessment of possible risks.

When identifying hazardous substances that may enter the workplace as a result of an emergency at another workplace, employers need only plan for the risks associated with hazardous substances that they are made aware of or should reasonably be aware of. Some examples in this category may include:

- Being advised of a risk by a neighbouring employer, fire department, or other authority of a risk posed by hazardous substances in the area
- Knowledge of prior releases or emergencies publicly reported
- Visible presence of large storage tanks with hazard labelling at neighbouring facilities
- Proximity to railways where hazardous goods are likely transported
- Environmental hazards such as flooding or forest fires known to be a local risk that could bring hazardous substances into the workplace

Employers are not expected to ask neighbouring facilities to provide detailed information about hazardous substances maintained at their workplace. However, if an employer or workers have reason to believe that a neighbouring facility may maintain hazardous substances in sufficient quantities to pose a risk to the employer's workers in the event of an emergency (for example, observing large chemical storages tanks), reasonable inquiries should be made. Reasonable inquiries may include contacting the organization directly but could also include identifying hazardous substances from tank labeling or other sources of publicly available information. Refer to OHS Guidelines G5.100 and G5.102 for additional information.

Emergency planning for temporary workplaces in areas where hazardous substances are known to be present
Where hazardous substances are observed or known to be at or near a temporary workplace, employers should consult with workers to determine if it is reasonably foreseeable that an emergency involving those hazardous substances could pose a risk of serious injury or illness to workers in the event of an emergency. Consideration should also be given to how long the work will take, the types of work activities being performed, and the ability for workers to leave or escape the area in the event of an emergency. If risk is identified, then employers should make reasonable efforts to notify the owner of the hazardous substance of the presence of the temporary workers so the owner can consider these workers in the event of an emergency. Employers of workers who are dispatched to temporary workplaces should also develop generic procedures to provide guidance to workers on how to respond to emergencies that may involve hazardous substances where specific risks are unidentified.

G5.99 Risk assessment

Issued August 1, 1999; Revised April 9, 2019; Retired consequential to February 3, 2025 Regulatory Amendment

Refer to OHS Guideline G5.100 for the requirements for risk assessment.

G5.99-1 Inventory of hazardous substances

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.99 of the *OHS Regulation* ("*Regulation*") states:

> An employer must ensure that a written inventory is prepared and maintained containing
>
> (a) the identity of each hazardous substance present at the workplace in a quantity that may endanger a person in an emergency, and
>
> (b) in relation to each hazardous substance identified, all of the following information:
>
> (i) a description of the physical state and hazardous properties of the hazardous substance;
>
> (ii) the maximum capacity of any container or system in which the hazardous substance may be stored or used at the workplace;
>
> (iii) the maximum quantity of the hazardous substance that may be stored or used at the workplace;
>
> (iv) the location of the hazardous substance;
>
> (v) how to access information about the possible effects of the hazardous substance on worker health and safety and any precautions required to protect the health and safety of a worker.

Purpose of guideline
The purpose of this guideline is to provide guidance on developing a written inventory of hazardous substances required by section 5.99 of the *Regulation*.

Inventory of hazardous substances
Developing and maintaining an inventory of hazardous substances as part of the emergency planning process assists an employer to:

- Perform an accurate assessment of the risk posed to workers in the event of an emergency in accordance with section 5.100
- Develop effective emergency procedures in accordance with sections 5.101 to 5.103
- Communicate risk to responding agencies in the event of an emergency

To ensure emergency plans are effective, employers should contemplate the likely maximum quantity of all hazardous substances that could cause or contribute to an emergency.

Inventories created under this section need only include hazardous substances that are present in quantities that could reasonably endanger a person in an emergency. The specific quantity of material that could reach this threshold depends on a number of factors, including:

- The hazardous properties of the material
- The quantity of material used or stored at the workplace
- The proximity of the material to where workers or other persons may be located
- The response expected or required by workers or other persons in the event of an emergency

The initial determination of whether a hazardous substance could pose a potential risk in the event of an emergency must be made in consultation with workers. Unless there is clear agreement that a particular substance would not pose a risk to workers, it should be included on the inventory for further assessment. Many consumer products may be excluded from an inventory under this section during this initial determination, unless they are stored in large quantities. For employers that maintain an inventory of all hazardous substances to ensure compliance with Workplace Hazardous Materials Information System (WHMIS) or other requirements, the subset of hazardous substances that must be considered for the purpose of developing emergency procedures may be indicated on this master list, as long as the specific information required under section 5.99 of the *Regulation* is included.

When considering hazardous substances that could either cause an emergency at the workplace or enter the workplace in the event of an emergency, employers and workers may identify substances where the specific information required under section 5.99 cannot be fully known, or is not applicable. For example:

- Manufactured items (e.g., concrete products containing silica, products with lead-containing paint)
- Hazardous substances entering the workplace from the natural environment or from other workplaces (e.g., carbon monoxide, wildfire smoke, methane)
- Hazardous substances that are generated at the workplace but are not captured, stored, or contained (e.g., combustion engine exhaust, reaction emissions, combustible dusts)
- Hazardous substances that may be brought into the workplace by workers for personal consumption or use unrelated to the employer's work activities (e.g., tobacco products)
- Biological agents contained within living organisms

While these substances do not need to be captured as part of an inventory under section 5.99 of the *Regulation*, the risk posed by these substances may need to be assessed according to the requirements outlined in section 5.100 of the *Regulation* if the substance is known or reasonably expected to enter the workplace and could endanger a person in the event of an emergency.

Transient storage and temporary workplaces
When establishing compliance with section 5.99 of the *Regulation*, employers should develop an inventory based on the expected "worst case

scenario" and establish their emergency plans and procedures accordingly. Employers are not expected to update inventories on a real-time basis as quantities of materials are consumed or restocked, as long as the emergency plan is sufficient to address the quantity of material identified in the inventory. If an employer wishes to implement alternative emergency response procedures that are contingent on different quantities or types of hazardous substances maintained at different times or locations, then it is expected that the employer's inventory will accurately reflect these differences.

Under the requirement of section 5.101(3) of the *Regulation*, employers are expected to review the inventory for accuracy at least annually, and whenever there is an emergency that causes or has the potential to cause death or serious injury or illness, or if there are other reasons to believe that the employer's emergency response plan is not adequate. Employers are expected to include in their inventory all hazardous substances that will remain in the workplace for more than one shift, even if the substance is only on site occasionally or on a seasonal basis. Inventories must be updated when new or additional substances are brought on site that could impact the risk to workers.

For employers that dispatch workers to temporary worksites, hazardous substance inventories may be developed based on tasks performed, or a template list of substances may be developed that can be completed by the crew on site. It is important for employers to develop accurate inventories of hazardous substances used on multiple-employer worksites, and to provide these inventories to the owner or prime contractor of the workplace so appropriate risk assessments and emergency procedures may be developed.

Structure of inventory
The inventory of hazardous substances should be structured in a manner that will assist employers and workers to identify and assess the potential risk to persons. Employers of large workplaces comprised of multiple buildings may choose to create separate inventories for each different building or area of building if it assists in developing emergency procedures. If hazardous substances are moved between buildings or areas, the same quantity of material may be represented on multiple inventories. Employers may choose to include an inventory of substances with relevant hazards with the specific emergency plan developed to address the risk posed by those substances, depending on the complexity of the emergency response procedures.

A template is available on worksafebc.com to assist employers in creating their inventories: Emergency planning: Inventory of hazardous substances.

G5.100 Risk assessment for hazardous substances

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.100 of the *OHS Regulation* ("*Regulation*") states:

> (1) An employer must ensure that, for a workplace, an assessment of the following risks is conducted:
>
> (a) a risk posed in an emergency by any hazardous substance identified in the inventory for the workplace;
>
> (b) a risk posed by any other hazardous substance if it is known or reasonably foreseeable that the hazardous substance could be generated at the workplace or, because of an emergency, enter the workplace.
>
> (2) An assessment must be conducted in consultation with a qualified person and recorded in writing and must consider the following matters in relation to a hazardous substance referred to in subsection (1):
>
> (a) any known or reasonably foreseeable cause of an emergency;
>
> (b) the hazardous properties, location and, where applicable, the quantity of the hazardous substance;
>
> (c) the area or areas within or outside the workplace in which a person may be at risk, in an emergency, from the hazardous substance and the nature and extent of that risk;
>
> (d) the persons who are likely to enter an area within the workplace identified under paragraph (c);
>
> (e) the conditions necessary to ensure the safe handling, processing and storage of the hazardous substance if it is identified in the inventory for the workplace;
>
> (f) the existing and planned control measures at the workplace and whether they are effective to minimize the risk, in an emergency, from the hazardous substance, taking into account
>
> (i) any applicable SDS for a hazardous product, information from a manufacturer or supplier, good engineering practice and generally accepted standards for industry,
>
> (ii) the nature and complexity of the measures and the ability of the workers to employ those measures, and
>
> (iii) the ability of the measures to detect, and warn persons of, a potential emergency;
>
> (g) the methods for verifying and maintaining the effectiveness of the control measures and the frequency with which those methods are assessed;

(h) the ability of workers and any other persons involved in emergency response to effectively respond to an emergency, the nature of such a response and the estimated time of the emergency response;

(i) any other relevant matters.

Purpose of guideline
The purpose of this guideline is to provide considerations for employers when conducting a risk assessment involving hazardous substances at the workplace.

Assessing the risk posed by hazardous substances
Under section 5.100 of the *Regulation*, the employer must assess the risks posed by hazardous substances from accidental release, fire, or other such emergency. This assessment must be conducted for both hazardous substances identified as part of the employer's inventory under section 5.99 of the *Regulation*, as well as other hazardous substances that may enter the workplace as a result of an emergency or that may be generated at the workplace as a result of chemical reaction, physical disruption, or other means.

The objective of a risk assessment conducted under section 5.100 of the *Regulation* is to determine the relative risk that the hazardous substance poses to workers and others, considering:

- How likely an emergency caused by or involving the hazardous substance is to occur
- The potential consequences to people exposed to the hazard in the event of an emergency
- The controls that are currently in place to minimize the risk of an emergency occurring
- How likely a hazardous substance is to endanger a person in the event of an emergency, given the employer's controls and current emergency response procedures

A risk assessment can also help identify areas of vulnerability or where additional controls could further reduce the risk of an emergency occurring or the risk to persons in case of an emergency. Workers who work with or around hazardous substances are in the best position to help identify areas of potential risk, and must be consulted in the assessment process in accordance with the requirements of section 5.98 of the *Regulation*.

The level of detail of the risk assessment required by this section will depend on the number and complexity of the processes involving the hazardous substance, the degree of hazard the substance presents, and the measures necessary to reduce risk in an emergency. Where all of the required elements of section 5.100 have already been contemplated as part of an exposure control plan or other safe work procedures, a separate assessment may not be necessary.

The general approach to be taken when conducting a risk assessment is discussed in OHS Guideline G5.54-3. Some of the specific factors that should be considered when performing a risk assessment are outlined in the following table. Not all factors will be relevant for all workplaces and/or substances.

Considerations when determining the risks posed by a hazardous substance in an emergency

General	Specific
Known or reasonably foreseeable cause of an emergency	Consider events or circumstances, failures, or errors that could cause conditions leading to an emergency. Examples include: • Process upset conditions • Unsafe conditions or work practices associated with the operation, maintenance, installation, testing, or emergency response • Equipment and/or control failure • Uncontrolled reactions • Oxygen-deficient atmospheres • Natural disasters • Fire or explosions • Spills, leaks, or containment failure within the workplace or originating from beyond the workplace • Unplanned detonations of explosives (not otherwise covered by the requirements of Part 21 of the *Regulation*) • Power failures • Security vulnerabilities
Hazardous properties, location, and quantity	• What are the risks, given the properties, quantity, and location of the substance? • What are the possible effects of exposure (e.g., irritation, burns, breathing difficulties, death)? • Is there a possibility for hazardous substances to interact, given their location?

Potentially affected areas where persons may be at risk in an emergency	• What area could potentially be affected in the event of an emergency (including areas beyond the workplace)? • What is the likely severity of affected areas that may be experienced (e.g., size of fire, leak, explosion, predicted concentrations)? • Possible points of failure where workers may be exposed (e.g., ruptured flange or pipes)? • In the event of a fire, how would workers be exposed (e.g., to substances themselves, to the products of combustion)? • How many workers would be at risk? • Who else might be at risk (e.g., emergency responders, adjacent workplaces, nearby community)?
Who might be at risk during an emergency	• Determine who may be working or enter areas that could be affected in the event of an emergency. • Consider workers, contractors, visitors, and people who have responsibilities for responding to an emergency. What risks could they be exposed to? • Consider neighbouring workplaces or other areas where people may be at risk, if the risk may extend past the boundaries of workplace.
Conditions necessary to ensure the safe handling, processing, and storage of hazardous substances identified in inventory	• Temperature, pressure, or other limitations for safe storage, stability, process, or containment • Possible interactions with other substances • Long-term integrity of storage containers, process vessels, or any other equipment intended to handle the substance • Current condition, maintenance, inspections, and testing protocols used to ensure process equipment remains in safe operating condition
Effectiveness and limitations of existing or planned control measures for the emergency being contemplated	• Do emergency response procedures align with those identified on the safety data sheet (SDS)? • Does the SDS identify additional hazards that could arise during an emergency, or that could exacerbate emergency conditions (e.g., toxicity that could arise as a result of a spill, oxidation, or explosiveness that could impact a fire)? • Would control systems and response plans be effective under emergency conditions (i.e., loss of power or containment)? • Are control systems and response procedures aligned with manufacturer's instructions, industry safety codes, sound engineering practice, and/or relevant safety standards? • Are system controls and emergency procedures designed in a way to limit the potential for human error, including how operators are likely to respond to an alert or process upset condition? • Are there opportunities to introduce automatic, fail-safe, or fault-tolerant control systems that would reduce the potential for human error? • How will emergencies be detected and communicated? • How will the scale of an emergency be assessed to ensure that appropriate decisions are made to warn those at the workplace and beyond, as applicable? • How are systems monitored for process upset conditions? • How would workers recognize and protect themselves and others from dangerous conditions (including workers who evacuate and those who are expected to respond)? • Have muster and/or shelter-in-place locations been established? How would people safely reach those locations? Will these locations be appropriate for all emergencies or how will a safe location be determined?
Methods for verifying and maintaining effectiveness of control measures	• How often are workers trained on emergency response procedures? • How often are control measures inspected, tested, and maintained (e.g., pressure relief valves exercised, emergency ventilation tested, automatic control switches tested)? • How often is protective gear and other emergency response equipment inspected, calibrated, and maintained (e.g., alarms tested, air monitors calibrated, respirator cartridges changed, spill kits inspected)? • How often are drills conducted and how effective are the drills in preparing workers and other response agencies for potential emergencies?

Effectiveness of workers and other persons involved in emergency response to respond	• How quickly can an emergency be detected and communicated? • How quickly can emergency response persons be contacted and respond? • Will enough trained people always be available to respond appropriately? • How quickly can emergency response equipment be obtained and deployed? • How effectively can risk be mitigated while emergency response is summoned and prepared?
Any other relevant matters	• Consider emergencies that may happen after hours, on weekends, or at specific times of year when key personnel involved in emergency response may not be available. • Consider the potential for one emergency to lead to another (e.g., loss of power or fire leading to loss of containment). Are emergency procedures adequate to minimize risk? • What training will people need to perform their roles effectively? • What equipment will people need to perform their roles effectively and safely? • What circumstances are beyond the capacities of responders to effectively and/or safely respond, and how will those be recognized during an emergency?

Assessing hazardous substances used in simple processes
For workplaces that use hazardous substances in small quantities or as part of simple processes (e.g., spills when handling or transferring substances), a less formal method of risk assessment (such as a job hazard analysis) that documents consideration of the applicable factors listed above may be sufficient. Hazardous substances may also be grouped by hazard class for the purpose of documenting a risk assessment pursuant to section 5.100 of the *Regulation*. WorkSafeBC has developed a risk assessment template that may be used to document the risk posed by hazardous substances used in simple processes.

Assessing hazardous substances used in complex processes
When assessing the risk posed by hazardous substances that are present in large quantities, used in complex processes, or those which pose a high risk of harm to workers, a more structured risk assessment method may be necessary to fully evaluate the risk. There are many formal risk assessment methods that could be used to evaluate risks posed by hazardous substances. For example:

- Hazard and operability study (HAZOP): A structured technique that uses guidewords to examine deviations from intended design or operation and their consequences
- What-if analysis: A flexible method using brainstorming and open-ended questions to identify potential hazards and failures
- Screening level risk assessment (SLRA): A simplified, conservative approach to evaluating potential environmental and health risks associated with contaminated sites
- Bow-tie analysis: A graphical risk assessment method used to visualize and manage potential hazards and their consequences
- Failure mode and effects analysis (FMEA): A bottom-up technique that analyzes how individual components can fail, why they fail, and the consequences of failure
- Fault tree analysis (FTA): A top-down technique using logic diagrams to represent causal relationships between a specific event and the basic events leading to
- Layer of protection analysis (LOPA): A semi-quantitative technique that evaluates the frequency and severity of hazardous scenarios and compares them with existing protection layers
- Process hazard analysis (PHA): A systematic approach to identifying and analyzing hazards associated with processing or handling hazardous chemicals
- Systems theoretic process analysis (STPA/STAMP): A hazard analysis method based on systems theory used for complex systems
- Quantitative risk assessment (QRA): An advanced technique used for large-scale, complex hazard sites in industries like nuclear and oil and gas
- Dispersal modelling: A mathematical and computational approach used to simulate the movement and spread of toxic or dangerous materials in the event of a loss-of-containment emergency

These risk assessment methods analyze potential dangers from different perspectives, focusing on aspects such as the severity of emergencies, possible causes, consequences, and the selection of appropriate safety measures. Additional guidance on selecting an appropriate assessment method, and assessing and managing the risk posed by hazardous substances, may be found in ISO/IEC 31000 and 31010 standards or the Technical Guidelines for the Environmental Emergency Regulations (PDF).

Sound engineering practice and inherently safer design
Employers are expected to consider "sound engineering practice" when assessing the effectiveness of controls put in place to reduce the risk associated with hazardous substances — particularly those that are used in complex processes. While this term is not defined in the *Workers Compensation Act* or the *Regulation*, it is meant to communicate the selection and application of appropriate engineering, operating, and maintenance knowledge when designing, operating, and maintaining facilities and equipment, with the purpose of ensuring safety and preventing process safety incidents.

The concept of inherently safer design is used to describe a process of integrating a variety of risk reduction and risk management strategies that consider the hierarchy of controls throughout the life cycle of the process — from facility and equipment design, through initial startup, to ongoing operations. Additional information on the topic of inherently safer design is available in the following resource from the US Environmental

Protection Agency: Chemical Safety Alert: Safer Technology and Alternatives (PDF).

Qualified persons
Risk assessments conducted for hazardous materials do not need to be conducted by a qualified person; however, they do require consultation with persons with specialized knowledge to:

- Adequately identify substances and conditions that may pose a risk
- Select an appropriate risk assessment method (or methods), to ensure the risk is effectively assessed and understood (which includes understanding the intent and limitations of the risk assessment method selected)
- Conduct a fulsome assessment to qualify the level of risk posed
- Identify and assess appropriate controls to minimize the risk

Under section 1.1 of the *Regulation*, "qualified" means being knowledgeable of the work, the hazards involved, and the means to control the hazards, by way of education, training, experience, or a combination.

A qualified person for the purpose of this section does not have to be one individual. A qualified person may be a team of people who bring different areas of knowledge about the *Regulation*, the hazardous substance used, the various work processes that may expose workers to the hazardous substance, and the means to control exposure.

The degree of knowledge required to assess the risk posed by a hazardous substance or group of hazardous substances may vary depending on the risk posed, and the quantity of material handled. Employers who use or store large quantities of hazardous substances identified as being acutely toxic, highly corrosive, or highly flammable should consider seeking the advice of a qualified person. Individuals with specialized knowledge in the following areas may be able to assist employers assess the risks posed by hazardous substances:

- Toxicology: Assist in understanding the toxic effects of chemicals on human health and the environment. They can assist employers assess potential risk caused by hazardous substances that are poorly understood or defined.
- Occupational or industrial hygiene: Assist in the identification, assessment, and controls of workplace hazards.
- Chemistry: Assist in understanding the chemical properties, reactions, and behaviors of hazardous substances. Can assist employers in identifying potential interactions between substances in the event of an emergency.
- Occupational health and safety: Assist in identifying and understanding regulations, standards, and best practices for minimizing risk. Can assist employers in developing effective and compliant emergency procedures.
- Process, mechanical, or industrial design engineering: Assist in evaluating and designing workplaces and equipment to prevent emergencies and ensure safe operation.
- Fire prevention: Can assist employers to identify, assess, and control risk posed by flammable substances.
- Hazmat response: Can assist employers to develop robust procedures for responding to incidents involving hazardous substances.
- Industry or equipment experts: Can assist employers to understand industry best practices or equipment safe operation.

Note that this is not an exhaustive list. Other occupations may be qualified to provide assistance. Employers are responsible for selecting qualified persons and must exercise due diligence in the selection of the qualified person. This includes a review of the person's knowledge and experience as well as their accredited credentials. Reliance on a person holding a recognized credential in a relevant area of expertise would normally be considered reasonable, provided the employer also verifies the person's experience in the specific area of expertise sought.

For substances that are less hazardous or present in smaller quantities, it may be sufficient to base a risk assessment and emergency procedures on literature reviews or other reliable sources of information. Employers are encouraged to consider the input of workers when determining who is qualified for the purpose of assessing risks pursuant to section 5.100 of the *Regulation*.

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Assessing the risk posed by hazards outside of the workplace
In addition to assessing the risk posed by hazardous substances used and stored at the workplace, employers are also required to assess the risk posed by hazardous substances that may enter the workplace as a result of an emergency at another workplace. Examples of other hazardous materials that might enter some workplaces include:

- Wildfire smoke from forest fires
- Natural gas from broken gas lines
- Methane from neighbouring landfills
- Ammonia released from neighbouring ice arenas
- Explosions that may result from bulk fuel tanks

Where an employer is notified by a neighbouring workplace of a potential risk posed by a hazardous substance, or becomes aware of risk through other means (refer to OHS Guideline G5.97-2 for additional information), employers should use information available to estimate the risk posed to workers. As employers are unlikely to have the information necessary to conduct a fulsome assessment of risk for hazardous substances that arise outside the workplace, assessments should be based on a review of potential health effects of the substance identified and a reasonable estimation of the likely quantity of hazardous material that may be involved, where possible. Employers may find the Emergency Response Guidebook published by Transport Canada helpful for identifying and estimating the risk posed by specific hazardous materials.

G5.101 Procedures for spill cleanup and re-entry

Issued August 1, 1999; Retired consequential to February 3, 2025 Regulatory Amendment

G5.101-1 Emergency response plans

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.101 of the *OHS Regulation* ("*Regulation*") states, in part:

> (1) An employer must ensure that, for a workplace, a written plan is developed and implemented to respond to an emergency involving a hazardous substance in a manner that will minimize the risk to a person.
>
> (2) An emergency response plan must
>
> (a) be based on the inventory and risk assessment for the workplace,
>
> (b) include the inventory, the risk assessment and any emergency procedures for the workplace,
>
> (c) include assigned roles and responsibilities, and
>
> (d) include a program for training and drills required under section 5.104.
>
> …

Purpose of guideline
The purpose of this guideline is to provide guidance on the development of emergency response plans.

Development of emergency response plans
For each emergency identified by a risk assessment conducted under section 5.100 of the *Regulation*, a written emergency response plan (ERP) must be developed. Where the same response plan applies to multiple types of emergencies, this should be made clear in the employer's documentation. Each ERP should also make clear the specific workplace, areas of the workplace, and/or process to which the plan applies.

Emergency response plans must include or make reference to, at a minimum, the following components:

- The inventory of hazardous substances that may pose a risk to workers or others as a result of the emergency (or reference to the employer's complete inventory under section 5.98)
- Any risk assessments related to hazardous substances that could cause or potentially affect the risk to workers posed by the emergency — ERPs may reference risk assessments conducted as part of exposure control plans or other documentation, where relevant, as long as other documents are also made readily available to workers and are accessible in the event of an emergency
- Assigned roles and responsibilities for tasks identified in the ERP, including:
  - Preparing and maintaining the inventory
  - Conducting and reviewing the risk assessment
  - Developing and reviewing safe work procedures
  - Arranging and executing emergency response drills
  - Determining when then ERP will be activated
  - Responding to emergencies
  - Notifying authorities and/or neighbouring areas (if relevant)
  - Liaising with first responders
  - Communicating with media (if required)
  - Determining when emergency is over
  - Determining when it is safe to re-enter and re-start operations
  - Reviewing and updating ERPs
    When assigning responsibilities for emergency response plans, employers should consider assigning oversight of the entire plan to a single person (and an alternate) to ensure all the components of the plan align and are maintained, and to reduce potential confusion about who is in charge in the event of an emergency.
- Emergency procedures developed under the requirements of sections 5.102 and 5.103 of the *Regulation* that are relevant to the ERP
- Training and drill requirements developed under the requirements of section 5.104 of the *Regulation* that are relevant to the ERP

Emergency response plans should be organized in a way that is understandable to workers and easily referenced in the event of an emergency. Employers should consider the impact of the emergency on the employer's ability to access ERPs. In some cases, it may be necessary to keep copies of key documents in a secondary location not likely to be impacted by the emergency, or to arrange electronic access to these documents in the event of evacuation.

All elements of an ERP must be developed, implemented, reviewed, and updated in consultation with workers and be made readily available to workers in accordance with the requirements of section 5.98 of the *Regulation*.

Multiple-employer workplaces and prime contractor responsibilities
Under section 25 of the *Workers Compensation Act*, prime contractors of multiple-employer workplaces (or owners, where prime contractor

responsibilities have not been delegated) are responsible for ensuring the activities of employers, workers, and other persons at the workplace are coordinated. This general requirement includes the management of hazardous substances.

Some reasonable actions that owners or prime contractors should take to reduce risk associated with the use of hazardous substances include:

- Require all employers and other persons performing work at the workplace to maintain and provide safety data sheets (SDSs) or other hazard information for all hazardous substances to be used or stored on the workplace.
- Require all employers and other persons performing work at the workplace to maintain and provide emergency plans (including an accurate inventory and risk assessment) for all hazardous substances that are expected to be used or stored at the workplace.
- Consider any potential interactions or additional risk created through the use and storage of hazardous substances by different employers and take appropriate steps to minimize risk.
- Develop and/or coordinate appropriate emergency plans and procedures for the workplace, based on the risk posed by all hazardous materials on site.
- Ensure ERPs are adequately communicated to all workplace parties.
- Ensure workers who are expected to respond to emergencies involving hazardous substances are adequately trained.
- Conduct drills of emergency procedures. Drills should be conducted as soon as practicable after emergency procedures have been developed, and at least annually in accordance with the requirements of section 5.104 of the *Regulation*.

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Emergency plans for workers who transport hazardous substances
The transportation of many hazardous substances falls under the *Transportation of Dangerous Goods Act*, which sets out requirements for classifying, documenting, labelling, and packaging or containing hazardous materials. However, the emergency planning requirements under section 5.101 of the *Regulation* must also be met, as vehicles are considered workplaces when workers are conducting the business of the employer. This includes when they are transporting hazardous substances.

When developing emergency plans for transporting hazardous substances, employers must consider the potential for a motor vehicle accident to impact hazardous substances, ensure any risk to workers is minimized, and ensure workers are adequately trained and/or equipped to respond appropriately.

Alignment with Environmental Emergency Regulation
The Canadian Environmental Emergency Regulations (E2 Regulation) applies to fixed, land-based workplaces that use or store any of 249 hazardous substances in certain concentrations, quantities, and/or container sizes. Under the E2 Regulation, employers must develop an environmental emergency plan (E2 plan) to ensure the environment and human life and health are protected. This E2 Regulation also has notification and annual drill (simulation exercise) requirements. Employers who have developed an E2 plan do not need to develop a separate emergency plan for the purpose of complying with B.C.'s OHS *Regulation*, although employers must ensure the plan includes the required elements of both regulations.

Alignment with provincial emergency plans
Where applicable, employers should consider aligning emergency plans with those already in place by various levels of government. Refer to Provincial emergency plans, as well as to websites for municipal governments and regional authorities.

G5.102-1 Emergency Procedures - Protection and notification

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.102 of the *OHS Regulation* ("*Regulation*") states, in part:

> (1) An employer must ensure that, for a workplace, written procedures are established that provide for the following matters in an emergency involving a hazardous substance:
>
> (a) notifying a person specified in subsection (2) about the nature and location of the emergency;
>
> (b) evacuating persons from the workplace, or an area within the workplace, or otherwise protecting persons at the workplace, including by sheltering persons in place or providing an area of refuge;
>
> (c) preventing access to the workplace, or to an unsafe or potentially unsafe area within the workplace, except by a person involved in a response to the emergency;
>
> (d) confirming that an evacuation or other protective measure has been undertaken and confirming the safety of persons who remain at or assembled near the workplace.
>
> (2) For the purposes of subsection (1)(a), the following persons are specified:
>
> (a) any person in an unsafe or potentially unsafe area of the workplace when the emergency arises;
>
> (b) any person identified as having an assigned role or responsibility in the emergency, including any first aid attendant;

(c) if the effect of a hazardous substance at the workplace may, in the emergency, extend outside the workplace,

(i) any person who may be at risk of serious injury, serious illness or death because of exposure to the hazardous substance, and

(ii) any person whose ability to reach a place of safety unassisted may be impaired because of exposure to the hazardous substance.

…

Purpose of guideline
The purpose of this guideline is to provide guidance on developing emergency procedures and considerations for appropriately notifying persons in the event of an emergency involving hazardous substances.

Developing emergency procedures
For each type of emergency identified under section 5.100 of the *Regulation*, employers must develop written procedures for reference by workers that clarify what actions are to be taken in the event of emergencies. These are outlined in sections 5.102 and 5.103 of the *Regulation.* Procedures must, at a minimum, address the following topics:

- How workers and others who may be affected by an emergency will be notified of the nature and location of the emergency (refer to OHS Guideline G5.102 for additional information)
- How workers and others will be evacuated or otherwise protected in the event of an emergency
- How the safety of workers and other persons who remain at or assembled near the workplace will be confirmed
- How access to potentially unsafe areas will be prevented (except for those persons trained to respond to the emergency)
- How, who, and when emergency response or other agencies will be contacted (refer to OHS Guideline G101-2 for additional information)
- How any unsafe conditions will be identified and appropriately addressed (refer to OHS Guideline G5.103 for additional information)
- How it will be determined when the affected area is safe to re-enter (refer to OHS Guideline G5.103 for additional information)

Where procedures are the same for multiple emergencies, procedures do not need to be repeated as long as the applicable procedure is clearly referenced and readily available to workers.

Alerting workers and others to an emergency
Owners of workplaces that maintain hazardous substances have a general requirement under section 25 of the *Workers Compensation Act* to provide information necessary to identify and eliminate or control hazards to the health and safety of persons at the workplace. Employers who maintain hazardous substances also have a specific requirement under section 5.102(2) of the *Regulation* to notify people who may be at risk of serious injury, illness, or death, or whose ability to reach a place of safety unassisted may be impaired because of exposure to the hazardous substance.

One of the key elements of emergency response planning is developing an effective method of communicating the nature and location of an emergency, including for those emergencies involving hazardous substances. For some emergencies, a quick response may be necessary to control risk. In others, the best response may be to evacuate to a safe distance before establishing a safe method to investigate and correct the hazardous condition. Careful assessment, planning, and training are key to preventing serious injury or illness.

For workplaces with more than one emergency response plan (ERP), it may be necessary to establish procedures for notifying workers that vary depending on the nature and/or location of the emergency, or by the expected response from workers. Some examples of variable emergency signals include:

- Audible alarms (e.g., bells, air horns, sirens, public announcement systems) where the signal can be varied to communicate different information depending on the nature of the emergency or the expected response
- Electronic notification systems that can provide additional information about the nature of the emergency and expected response
- Visual alerts (e.g., flashing lights) where different colours or patterns may be used to communicate different types of emergencies

When choosing an appropriate method of communicating emergencies, employers are expected to consider the likely effectiveness of the signal to be recognized and understood by workers, considering the conditions of the workplace, and reasonably anticipated human limitations or error. In some cases, more than one method of notification may be required, or automated systems may be available that reduce the potential for human error when responding to emergency alerts.

Location information does not have to be provided at the same time as alerting persons to the occurrence of an emergency, unless this information is required to evacuate safely (e.g., for emergencies involving hazardous substances with poor warning properties, or those that could impeded workers' ability to reach areas of safety).

Notifying visiting workers and other persons at the worksite
Employers are also responsible for ensuring the safety of visiting workers and other persons who may be impacted by an emergency at the workplace. Emergency procedures must consider how visitors will be notified of an emergency involving hazardous substances, which could include orienting visitors on emergency procedures (including methods of notification), or assigning a worker who is familiar with emergency procedures responsibility for ensuring the visitor responds appropriately in the event of an emergency.

Alerting persons outside of the workplace
The requirement for emergency notification extends to persons outside of the workplace, if those persons could be at risk of serious illness or injury or impaired in a way that prevents their ability to reach a place of safety because of an emergency involving hazardous substances. Predicting

the potential impact of hazardous substances depends on many factors, including the conditions of release, the chemical properties of the substance (e.g., atmospheric stability), wind speed and direction, terrain features, etc. There are dispersal models available that can assist employers to determine the likely area that may be impacted by a release or other emergency involving hazardous substances; however, employers are encouraged to consult with a qualified person to ensure modelling is as accurate as possible.

Once the potential impact is known, employers can determine an appropriate method of notification, which may involve some sort of emergency call-out procedures, audible alarms, or other means. Section 5.102(3) of the *Regulation* also requires employers to notify affected parties of recommended actions to minimize the risk to other persons. This may include information about actions that could assist to minimize exposure, how to recognize exposure, and what to do in the event of exposure to minimize health risks. Employers may find it more effective to provide this information to neighbouring facilities that could be affected in an emergency ahead of time, to simplify messaging requirements during an actual emergency. This could be done through a combination of:

- Information sessions
- Signage
- Mailouts
- Electronic notification
- Establishing local emergency planning committee
- Coordination with other municipal or provincial organizations (fire departments, EmergencyInfoBC, etc.)

Notifying facilities in advance that may be potentially impacted in the event of an emergency with risk and response information allows other employers to develop emergency plans of their own, thus reducing the risk of someone being seriously injured in the event of an emergency involving hazardous substances.

Where emergency notification methods rely on contacting neighbouring facilities by phone, email, or other electronic means, employers must make reasonable efforts to ensure contact information is kept up to date.

If reasonably practicable, employers should also consider how temporary worksites (e.g., construction sites) would be notified of emergencies meeting the requirement of section 5.102 of the *Regulation*.

G5.102-2 Notifying emergency response agencies

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.102 of the *OHS Regulation* ("*Regulation*") states, in part:

> (1) An employer must ensure that, for a workplace, written procedures are established that provide for the following matters in an emergency involving a hazardous substance:
>
> (a) notifying a person specified in subsection (2) about the nature and location of the emergency;
>
> …
>
> (2) For the purposes of subsection (1)(a), the following persons are specified:
>
> …
>
> (b) any person identified as having an assigned role or responsibility in the emergency, including any first aid attendant;
>
> …

Purpose of guideline
The purpose of this guideline is to provide guidance on the various agencies an employer may be required to notify in the event of an emergency involving hazardous substances.

Agencies that may need to be notified in the event of an emergency involving hazardous substances
Emergency response plans (ERPs) should identify external agencies whose assistance may be required to address the emergency. Even when no outside assistance is required to address the risk to workers and other persons, employers may still be obligated to inform relevant local, provincial, and/or federal government or regulatory agencies in accordance with environmental or other legal requirements.

Employers should also include emergency contact details for key personnel with responsibilities under the employer's ERP if an emergency involving hazardous substances could occur after hours or when key personnel may not be at the worksite.

As notification requirements will vary depending on the location and nature of the emergency, it is not possible to provide a complete list of agencies that may need to be notified. Employers should make their own inquiries, be familiar with applicable reporting obligations with other agencies, and develop a comprehensive list of agencies and contact numbers to include in their emergency plans.

Local agencies
Employers should determine appropriate contact information for local agencies such as:

- Local fire departments (section 11 of the *Fire Services Act* requires that fires be reported to the local fire department or district police)
- Municipal agencies (municipal bylaws may require notice of certain incidents be provided to local government and bylaw enforcement)
- Utility providers (FortisBC, BC Hydro)
- Contracted hazmat response companies

Provincial and federal agencies

Agency	Notify when	Regulation	Contact information (current as of Dec 2024)
WorkSafeBC	- Serious injury to or death of a worker - Major release of a hazardous substance - Major structural failure or collapse of a building, bridge, tower, crane, hoist, temporary construction support system, or excavation - Fire or explosion with potential for causing serious injury to a worker - Blasting incident causing injury, or other dangerous incident involving explosives (whether or not it causes injury)	*Workers Compensation Act* (section 68) and *OHS Regulation* (section 21.3)	1-888-621-7233
Canadian Coast Guard	Marine pollution or threats of marine pollution	Vessel Pollution Dangerous Chemicals Regulations, section 132(1)	Report marine pollution 1-800-889-8852 Marine spills in international waters: 1-800-645-7911
Technical Safety BC	Incidents involving: - Amusement rides - Boilers, pressure vessels, or refrigeration - Electrical systems - Passenger ropeways (including ski lifts) - Elevating devices - Gas	BC *Safety Standards Act*	Report an Incident or Hazard 1-866-566-7233
BC Ministry of Environment - Environmental Protection & Sustainability	Any escape, spill, or introduction of a polluting substance that threatens the environmental quality of water, land, or air	*Environmental Management Act*, section 79	Report a spill 1-800-633-3456
Environment and Climate Change Canada	A spill or release of any listed substance, including an oil or chemical	Canadian *Environmental Protection Act, 1999*, section 201	Report an environmental emergency 1-800-663-3456
Transport Canada	Any accidental release of dangerous goods that occurs in the course of transport, loading, unloading, or handling	Transportation of Dangerous Goods Regulations, section 8.1	CANUTEC 1-888-226-8832 613-996-6666 or *666 on a cell phone
Transportation Safety Board of Canada (TSB)	Marine, pipeline, rail, and air transport incidents	TSB Regulations	Report to the TSB 1-800-387-3557 819-994-3741
Canada Energy Regulator	Firms under the Canada Energy Regulator's jurisdiction that experience specified events relating to oil and gas drilling, processing, or pipelines	Canada Energy Regulator Event Reporting Guidelines — 4.0 Immediately Reportable Events	Event Reporting System 819-997-7887

Canadian Nuclear Safety Commission	Dangerous occurrences involving radioactive material	*Nuclear Security Regulations* *Nuclear Safety and Control Act*	Report a Nuclear Incident 1-844-879-0805 613-995-0479

Note: This is not a complete list of agencies, nor is it a complete list of reporting obligations, required under all legislation and regulation.

To avoid confusion in the event of a real emergency relating to hazardous substances, ERPs should clarify reporting threshold requirements, and only include contact information for those agencies relevant to the emergency response plan.

Incident command systems
Many public first response organizations follow an incident command system (ICS) when responding to major emergencies, such as environmental emergencies or major spills of hazardous substances. ICS is an approach to emergency management that organizes the functions, tasks, and response personnel within the overall emergency response.

When developing emergency response plans that are likely to involve first responders or other public agencies, employers may find it helpful to understand the basics of the incident command system (ICS) so that they understand what to expect and can develop emergency plans to efficiently coordinate with these groups. Employers that use or store hazardous substances that may require a more complex response to minimize risk in the event of an emergency may wish to integrate the concepts of an ICS into their own emergency plans, as this approach is scalable and is a well-tested approach to emergency management.

More information on the ICS can be found in an Introduction to the Incident Command System (PDF) published by the Province of B.C.

G5.103 Emergency procedures - Safe work

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.103 of the *OHS Regulation* ("*Regulation*") states:

> (1) An employer must ensure that, for a workplace, written procedures are established for the carrying out of any of the following work activities in a safe and effective manner:
>
> (a) determining the location and extent of a spill or release of a hazardous substance;
>
> (b) controlling the spill or release of a hazardous substance;
>
> (c) cleaning up a spill or release of a hazardous substance and taking other remedial action related to the spill or release;
>
> (d) disposing of a hazardous substance;
>
> (e) evaluating, for the purpose of re-entry, the safety of the workplace or an area within the workplace.
>
> (2) Before any work activity referred to in subsection (1) begins, the employer must ensure that a copy of the work procedures for that work activity is readily available to every person who will carry out that work activity.

Purpose of guideline
The purpose of this guideline is to provide considerations for employers when developing safe work procedures for responding to emergencies involving hazardous substances, and for evaluating the safety of the workplace for the purpose of re-entry.

Developing safe work procedures
When emergencies occur, quick action may be necessary to reduce the risk and limit the possible damage. As such, employers must identify potential emergencies and develop robust procedures for responding to the emergency in a way that minimizes risk to workers and other people.

Some considerations include:

- Are there steps workers can take to avoid or limit the potential risk associated with an impending emergency?
- How quickly will an emergency involving hazardous substances be identified? Are there immediate actions that can be taken to limit the extent of the emergency without undue risk to workers or others?
- How will the location and extent of the area affected by the hazardous substance be determined?
- Do emergency response procedures ensure the safety of workers and others for an emergency involving the largest quantity of hazardous substances that could reasonably be involved?
- How, when, and to whom should emergencies be reported? Who determines what actions are appropriate (e.g., when to evacuate, when to call emergency services)?
- If there are limits to the type or size of emergencies the employer's workers are expected to respond to (e.g., a limit to the quantity of substance spilled), are these clearly communicated in the employer's procedures? How will workers recognize when those limits have been surpassed?
- Is there a way to reduce the risk posed by the hazardous substance prior to response or clean-up (e.g., neutralization, dilution, ventilation)?

- Are appropriate materials and equipment available to respond to emergencies?
- Is protective equipment available to workers that is appropriate for the majority of emergency response scenarios? Can all workers who may respond to the emergency wear the protective equipment safely and effectively? Is there a process to ensure emergency response equipment is regularly inspected and maintained?
- How will materials contaminated with hazardous substances be disposed of safely?
- How will the safety of the workplace be evaluated after the emergency and prior to re-entry? Who will make this determination?

Safe work procedures when workers are not expected to respond
Employers should not rely on public agencies, such as fire departments, to respond to emergencies involving hazardous substances as these agencies may not be available or equipped to provide an appropriate response. Even where fire departments are trained to respond to emergencies involving hazardous substances, their primary role will be to protect life and limit property damage, which will usually leave cleanup, decontamination, and assessment for re-entry to the employer. As such, employers should develop comprehensive emergency procedures to address the full lifespan of an emergency — from initial identification to business continuity.

If an employer chooses to contract an external provider (e.g., a specialized emergency response company) to respond to an emergency involving hazardous substances, then the employer's own safe work procedures may be limited to:

- Emergency notification of workers and other persons who may be affected
- Ensuring the safety of workers and other persons affected by the emergency (primarily through safe evacuation or shelter in place)
- Preventing access to unsafe areas of the workplace
- Contacting response providers and other regulatory agencies where required
- Communicating workplace hazards and the nature of the emergency to emergency response agencies
- Any key information likely to be required by the emergency response provider — such as where hazardous materials are stored, de-energization points, and shutoff valve locations
- Evaluating the safety of the workplace prior to re-entry

Employers should identify appropriate emergency response providers prior to an actual emergency to ensure they can provide the required response and are familiar with the employer's facility, equipment, and hazardous substances.

Ensuring emergency safe work procedures are readily available
Copies of emergency safe work procedures and facility hazard information must be readily available to every person who will carry out emergency response activities, including external emergency response agencies. Employers should consider how emergency procedures will be provided to responding agencies in the event of an evacuation. Employers may wish to have printed copies of required documents kept in a secure area outside of the building, or available electronically on a device that will be accessible in the event of an emergency. Employers may also consider providing response organizations with this information as part of pre-emergency planning activities, as long as the information is kept up to date and the response organization has capacity to maintain this information on file (refer to section 4.17 of the *Regulation* for additional requirements).

Despite the requirement to make emergency safe work procedures accessible to response agencies, these agencies are under no obligation to follow the employer's safe work procedures when responding to an emergency. It is expected that emergency response agencies will develop their own procedures for mitigating risk to their workers, which may consider the information provided by the client.

Evaluating the safety of workplaces after an emergency
Employers should consider business continuity plans in the development of emergency procedures. At some point, the emergency will end and the employer may wish to re-enter the workplace. Depending on the nature of the emergency, an assessment may be necessary to ensure it is safe to re-enter the workplace. Developing plans for ensuring the safety of the workplace following an emergency can assist employers to reduce downtime.

Fire always carries some risk of structural damage — either caused directly by the fire or indirectly through fire suppression activities. It may be necessary to engage a structural engineer to verify the integrity of the building prior to re-entry. Even if the building is structurally sound, substances released by fire will impact air quality, and wet building materials will quickly develop mould if remediation is not conducted quickly and thoroughly. After remediation is complete, it may still be necessary to conduct indoor air quality testing to ensure levels of airborne contaminants have been reduced to safe levels.

Air or surface sampling may also be required after spills or unintentional release of hazardous substances to verify that contaminants have been effectively removed and surfaces cleaned. The method of testing will depend on the substance released and should be conducted by a qualified person familiar with appropriate sampling protocols.

Where hazardous substances are volatile or gaseous, employers may wish to install fixed air monitoring equipment that can be used to assess when it is safe to reoccupy. Portable air monitors may also be used; however, employers must ensure that workers who conduct assessments are adequately protected. If concentrations of air contaminants could reach levels that are immediately dangerous to life and health (IDLH), or an oxygen-deficient atmosphere may be present, supplied-air respiratory protection must be used when entering contaminated areas (refer to section 8.35 of the *Regulation*). Air monitoring equipment that may be relied upon in the event of an emergency must be properly maintained and calibrated in accordance with manufacturers' instructions to ensure accuracy. Persons who engage in post-emergency assessments must also be aware of potential limitations of direct reading air monitoring equipment, which include sensor cross-sensitivity, sensor inhibitors (poisoning), or limitations in detection range. Potential limitations should be assessed as part of emergency planning, where applicable.

Where emergencies are localized or involve smaller quantities of less hazardous substances, quantitative assessment prior to re-entry may not be necessary. This decision should be made by a qualified person in consultation with workers.

G5.104 Training and drills

Issued consequential to February 3, 2025 Regulatory Amendment

Regulatory excerpt
Section 5.104 of the *OHS Regulation* ("*Regulation*") states:

> (1) An employer must ensure that workers are provided with training on known and reasonably foreseeable emergencies and the hazards to which they may be exposed in an emergency.
>
> (2) Without limiting subsection (1), an employer must ensure that, for all workers who may be affected by a hazardous substance in an emergency,
>
> (a) training in the emergency procedures for the workplace and the workers' roles and responsibilities in the emergency is provided, and
>
> (b) drills to ensure that the emergency procedures for the workplace are effective and that workers are familiar with and able to fulfill their roles and responsibilities in the emergency are conducted.
>
> (3) Drills must be conducted at least annually and after any significant change to the emergency response plan for the workplace.
>
> (4) An employer must ensure that a record, including the following information for each drill conducted under this section, is prepared and retained for a period of 5 years:
>
> (a) a description, and the date and time, of the drill;
>
> (b) the identity of every person who participated in the drill;
>
> (c) whether the drill is effective for the purposes set out in subsection (2)(b);
>
> (d) any action the employer must take to improve or correct the effectiveness of the drill.

Purpose of guideline
The purpose of this guideline is to outline expectations for conducting training and drills when hazardous substances are maintained at the workplace.

Worker training in emergency procedures
Employers must ensure workers are adequately trained on all emergency procedures. The degree of instruction and training needed to meet this objective will vary depending on several factors, including:

- Complexity of emergency procedures
- Expected response from workers
- Severity of risks posed to workers

Training may need to be tailored to the different roles workers may be expected to perform. It is recommended that employers keep records of all training provided to workers.

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Drills of emergency response plans
Employers who use or store multiple hazardous substances may be required to develop multiple emergency response plans for a variety of potential emergencies. Section 5.104(3) of the *Regulation* requires annual drills; however, this does not mean that employers must conduct a drill of every emergency response plan every year. The type and frequency of drills should be determined based on the relative risk associated with the emergency. Emergencies that are most likely to occur, or those that pose the greatest risk to workers or others, should be drilled more frequently than those that are less likely to occur or pose a lower risk. Appropriate drill schedules should be developed in consultation with workers. At a minimum, employers should conduct one drill for each emergency response plan that is significantly different each year, at each fixed location.

For employers that primarily conduct work at temporary work locations, an annual drill for each emergency response plan conducted at one location will be sufficient to fulfill this requirement, unless emergency procedures vary substantially between locations.

When determining the type and frequency of drills to conduct, employers should also consider the expected response from workers and other people, and include drills where the expected response is substantially different to ensure workers are able to respond appropriately.

Types of drills
Drills should be conducted in a way that test the effectiveness of the employer's emergency response plan. This may include the evacuating workers and other persons at the workplace, donning protective equipment, simulated use of emergency equipment, and simulated actions to respond to and/or control the hazard. Where particular elements of a drill may pose an undue risk to workers or other persons, a tabletop exercise

may be used, if it is designed to effectively test that element of the employer's emergency response plan.

Where large numbers of non-workers are typically present at the workplace during normal operating hours, emergency drills may be conducted after-hours with staff simulating the role of non-workers who could be impacted by an emergency occurring during normal operating hours.

Drills for multiple emergency types may be combined (for example with first aid drills) if all procedures can be tested effectively.

Where other agencies are expected to respond to a workplace emergency involving hazardous substances, employers should incorporate communication with the agency into the drill, where practicable. Employers may also consider arranging occasional joint drills (where possible) to ensure elements of the emergency response plan that require coordination are effective and that the agency is familiar with the workplace.

What should be assessed as part of a drill

When conducting a drill of a response plan for emergencies involving hazardous substances, several key aspects should be assessed to ensure the effectiveness of the plan, including:

Notification and communication

- Effectiveness of the alarm system in alerting all workers and other affected people
- Clarity and timeliness of notifications about the nature and location of the emergency
- Functionality of the communication chain, including the ability to contact outside assistance

Worker protection procedures

- Safe and efficient evacuation of all workers (or other actions to protect workers)
- Adequacy of evacuation routes and emergency exits
- Proper accounting for all workers and visitors at assembly areas
- Accommodation for persons with disabilities or special needs during evacuation

Emergency response actions

- Proper assessment of hazards by responders
- Availability and use of appropriate equipment to be used in response to an emergency
- Effectiveness of shutdown procedures, if applicable

Worker knowledge and response

- Workers' familiarity with their roles and responsibilities
- Understanding of emergency procedures and protocols
- Ability to identify and locate hazardous substances
- Proper use of personal protective equipment, if required

Specific hazardous substance considerations

- Accuracy of the hazardous substance inventory and risk assessment
- Effectiveness of containment measures for potential spills or releases
- Adequacy of decontamination procedures, if applicable

Following the drill, an evaluation of drill performance should be conducted to identify deficiencies or areas of improvement in the emergency response plan. Where deficiencies are identified that require significant changes to the plan, the changes should be implemented and a new drill conducted as soon as practicable to ensure effectiveness.