CHEMICAL HAZARD INFORMATION

CONTENTS

Overview

Many chemicals have minimal hazards, making them relatively safe to use. Others pose inherent risks and require specific precautions. Still, other chemicals must be handled with such extreme care that they are not practical or safe for school usage. This chapter provides a link to information on hazards for nearly 600 chemicals to help teachers, schools and divisions select and safely use chemicals. Schools and jurisdictions may use this information as a starting point for reviewing chemicals currently on its shelves (particularly where chemicals have accumulated over the years), and reassessing the scope and contents of chemical inventories.

The information in this chapter includes numeric ratings for health, flammability and reactivity, plus supplementary comments on the scope and severity of hazards. It also includes WHMIS and storage classifications, as well as transportation hazard classes and disposal methods. This information has been compiled from the most reliable and accurate sources available at the time of writing.

Inclusion of a chemical in the link listing does not signal appropriateness for school use, but is provided as preliminary information on potential concerns. Given the nature and severity of hazards involved, some of the chemicals listed are designated as not appropriate for use in schools due to safety considerations. Readers are advised to consult MSDS sheets and other current sources of more detailed information before using any of the chemicals listed in the link. **Omission from this list is also not an indication of safety.**

It remains the responsibility of school jurisdictions and individual teachers to use this information carefully and cautiously and assume responsibility for the consequences of using this information. If one recalls the information in Chapter 1, due diligence is an important factor of science safety. Teachers and divisions must be aware that their choices make them liable for the health and safety of other staff and students should an incident take place.

Reactive nature of chemicals

Chemicals can be grouped according to their chemical properties and general behaviour on exposure to other substances or environmental conditions. The following table provides information on types of reactive chemicals, which can be useful when designing a chemical storage scheme or deciding whether or not a chemical should be stocked for classroom use.

Reactive Nature of Chemical	Substances	Notable Characteristics	Handling and Storing
Explosive	Fulminates* Nitroglycerin* Peroxides* Picric acid* Azides* Perchlorates (Na, K)* Hydrazines* Dioxane* Ether* (excluding petroleum ether)	Substances that decompose with such speed that they cause a rapid expansion of air, sometimes accompanied by burning gases and flying objects. Explosion may be caused by shock, friction or heat. May form explosive by-products on slow decomposition during storage; e.g., ether and dioxane may form explosive peroxides with varying storage time. These appear as greygreen precipitates.	Do not order, use or store concentrates of this group of chemicals in schools. Lower concentrations of some explosive substances (e.g., hydrogen peroxide at 3 to 7%) are safe.
Acid sensitive	Alkali metals Alkaline hydroxides Carbonates Carbides Nitrides Metals Sulfides Cyanides*	Substances that react with acids to release heat, hydrogen and/or other explosive gas and toxicants.	Isolate from reactive substances. Wear and use adequate protection.

Reactive Nature of Chemical	Substances	Notable Characteristics	Handling and Storing
Water sensitive	Strong acids and bases Acid anhydrides Alkali metals Alkali metal hydrides Carbides* Aluminium chloride (anhydrous)	Substances that react with water, releasing heat and/or flammable gases. Ignition in moist air can cause explosions. May produce acetylene or methane. Spontaneous decomposition during extended storage may cause container to explode upon opening.	Isolate from other reactive substances. Store in cool, waterproof area. Wear protective gear.
Oxidation-reduction sensitive (oxidizers only)	Oxygen Mineral acids Perchlorates* Peroxides* (excluding H_2O_2) Chromates and dichromates Permanganates Halogens and Chlorates*	Substances that undergo rapid oxidation or reduction releasing heat in the process. Some are explosive.	Isolate from each other and other potentially reactive substances. Use adequate protection.
Special case-organic substances	Acrolein* Benzene* Diethyl ether*	Organic substances that are flammable may polymerize violently or form explosive peroxides. May explode when exposed to many oxidants. May be carcinogenic (benzene).	Store in an airtight container in a cool place. Isolate from oxidants.
Pyrophors	Phosphorous (white or yellow)*	Substances that burn spontaneously when exposed to air.	Protect from air.

* These chemicals are not recommended for schools because of their **reactive** nature.

Organization of the chemical hazard information table

The link to the Chemical Hazard Information Table in this chapter provides information to assist teachers and schools in deciding what chemicals to stock and use. The table lists hazard ratings for almost 600 chemicals, including a number of substances that have been used in schools in the past and have serious risks associated with their use. It also provides additional information necessary for safe storage and disposal of chemicals.

The absence of chemicals from the table does not imply that they are safe. Other sources should be consulted for information on these chemicals.

The Chemical Hazard Information Table is organized with the following column headings:

1. Chemical Abstract Service (CAS) Number.
2. Chemical name(s), state and formula.
3. Appropriateness for school use.
4. Hazard ratings and comments for health, flammability and reactivity.
5. WHMIS hazard classes.
6. Chemical storage classes.
7. TDG hazard classes, and
8. Chemical disposal methods.

The content of each section, as well as the codes and conventions used in the table, is briefly explained below.

CAS number

The Albertan Chemical Hazard Information Table has been updated to include CAS numbers. The CAS number is a unique identifier for a chemical and has been included to compliment *OHS Act, 1993* and *OHS Regulations, 1996* information. One chemical can be called a number of names depending on what naming system is used. The CAS number is a unique identifier for that one chemical which can be called a number of different names. For example, benzene (CAS 71-43-2) can be called Coal naphtha, Benzol, Phenyl hydride and more. The CAS number makes it easier to find a particular chemical and it makes data base searches more convenient. The CAS number is also a good way to verify the info in the table is for the chemical in your laboratory, as CAS numbers are included on labels of chemicals purchased from chemical supply companies.

Chemical name(s), state and formula

In addition to CAS numbers, the table lists chemicals alphabetically using names conforming to those of IUPAC and the Merck Index. Where an alternative name is acceptable, the substance will appear in the table under both names. The state or form of the substance is included since it implies

concentration — a factor that must be known if the hazard levels are to be meaningful. The formula is provided as a means to cross-reference the names of substances, ensuring that the name used for a specific substance actually correlates with the correct substance by formula.

Appropriateness for school use

To assist teachers, schools and districts in making safe choices, the chemicals listed in the table have been grouped into one of three categories, based on their relative safety. The hazards of a chemical tend to increase with its concentration. Keeping this in mind, it should be noted that some chemicals in the table are rated in the "B" or "C" category in concentrated form, but may be rated in the "A" or "B" category in the diluted form. Many acids and bases are rated in this way. For example: Hydrochloric acid [HCl (aq)].

Concentration	Category
5% or less	A
Above 5%	B

Category A – Chemicals appropriate for use in schools under controlled conditions of use.

Chemicals in this category are ones for which the risks can be managed if used in limited quantities and concentrations, in controlled situations and following safe procedures. Use of these chemicals should take into account the maturity and skills of the students, the knowledge and skills of the teacher, and the needs of the curriculum.

Category B – Chemicals not appropriate for student use in schools except in middle years and secondary science courses under highly controlled conditions of use.

This category of chemicals is not appropriate for use by students in elementary science, but may be appropriate for use in middle years and secondary science courses when used in limited quantities under close, competent supervision in appropriate facilities. If these chemicals are used, keep quantities and concentrations to a minimum, instruct students in safe use procedures, and ensure waste storage and disposal have been addressed. These chemicals may be appropriate for demonstration purposes in elementary schools by teachers with appropriate knowledge and skills.

Category C – Chemicals not appropriate for student use.

Chemicals placed in this category pose significant safety risks in one or more hazard categories (health, flammability or reactivity), making them dangerous to use unless major precautions are taken. Conditions required for safe use by students exceed what can be consistently and reliably provided by schools. Some chemicals in this category may be used for demonstration purposes by well qualified secondary school teachers following a thorough risk assessment.

Category D – Chemicals not recommended for school use by teachers or students because of excessive hazard levels.

For quick reference, category D chemicals have been itemized in alphabetical order in **Appendix 16**.

Hazard rating and comments for health, flammability and reactivity

Hazard ratings given in the Chemical Hazard Information Table are based on the NFPA Hazchem Code, which is also used by most large North American chemical suppliers. This hazard identification system attaches numerical values to hazard levels for health, flammability and reactivity of a chemical. Each hazard category is rated on a scale of 0 to 4 (low to high). In addition, a special precautionary symbol may be used where necessary. In most cases, the hazard ratings given are for the pure form of the chemical.

The hazard ratings for each chemical listed in the chart are based on information from multiple sources. Sources used in compiling the ratings were primarily the MSDSs provided by major supply companies. In many cases the ratings found in these MSDSs showed different values for the same chemical, which reflected different interpretations of the hazards involved. For example, it appears that in determining health ratings, some companies factor in the effects of prolonged and chronic exposure whereas others do not. In case of disagreements between sources, a further assessment was made of the information available before determining the rating given in the chart. To assist the user, additional information on the specific nature of the hazards posed by each chemical is provided in the comments section.

The health ratings given in the chart, (as derived from MSDSs), focus primarily on short-term health effects. Information available on long-term effects – including carcinogenicity – is in many cases limited. More recent information may become available over time and will be reflected in current MSDSs.

In general, chemicals with a rating of three or four in one or more categories, but especially in health, are classified as inappropriate for student use. There are some exceptions to this rule, particularly in cases where the risks can be substantially reduced by using the substance in a less concentrated form, as is in the case with solutions. In general, powdered or pure forms of carcinogenic substances or chemicals that produce toxic substances when they react will be identified as not appropriate for student use and in a number of cases will be identified as not appropriate for school use at all.

- **Note**: **The information in the chart is provided primarily to assist schools in determining what chemicals are appropriate for use. After the chemicals have been acquired, school staff should consult the MSDS for more detailed information before using any of the chemicals.**

Sample N.F.P.A Hazchem Code

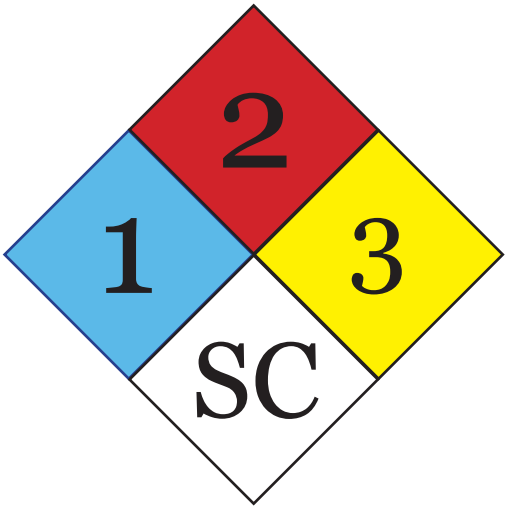
Key:

1 = Health

2 = Flammability

3 = Reactivity

4 = Special



- **Note**: The colour coding is often not consistent among manufacturers. Some omit colour entirely.

Following are the three categories and 5-point rating scale used in the NFPA. Hazchem codes are described in the Hazard Rating Chart below.

Health (blue)			Examples
4	Danger	May be fatal on short exposure. Specialized protective equipment required.	Hydrogen cyanide
3	Warning	Corrosive or toxic. Avoid skin contact or inhalation.	Chlorine gas
2	Warning	May be harmful if inhaled or absorbed.	Ammonia gas
1	Caution	May be irritating.	Turpentine
0		No unusual hazard.	Peanut oil

Flammability (red)			Examples
4	Danger	Flammable gas or extremely flammable liquid.	Propane gas
3	Warning	Flammable liquid flash point below 100°F.	Gasoline
2	Caution	Combustible liquid flash point of 100°F.	Diesel fuel oil
1		Combustible if heated.	Corn oil
0		Not combustible.	Water

Reactivity (yellow)			Examples
4	Danger	Explosive material at room temperature.	Trinitrotoluene (TNT)
3	Danger	May be explosive if shocked, heated under confinement or mixed with water.	Fluorine gas
2	Warning	Unstable or may react violently if mixed with water.	Calcium metal
1	Caution	May react if heated or mixed with water but not violently.	Phosphorus (red or white)
0	Stable	Not reactive when mixed with water.	Liquid nitrogen

Special Notice (white)	
₩	Water Reactive
OX	Oxidizing Agent

❖ **Note**: See http://www.nfpa.org/ for further information on the NFPA rating system.

WHMIS hazard classes

The Workplace Hazardous Materials Information System categorizes controlled substances into 6 classes and provides symbols for each of these. The classes are:

A. Compressed Gases

B. Flammable and Combustible Materials

C. Oxidizing Materials

D. Poisonous and Infectious Materials

Division 1: Material causing immediate and serious toxic effects

Division 2: Material causing other toxic effects

Division 3: Biohazardous infectious material

E. Corrosive Materials

F. Dangerously Reactive Materials

This column of the Chemical Hazard Information Table shows which of these classes each chemical falls into. Substances that are not controlled are identified as NC on the table.

For more information about WHMIS, refer to **Chapters 1, 4 and 8**.

Chemical storage classes

The chemical classes assigned in this section of the table and outlined below are useful in devising a scheme for the safe storage of chemical groups in laboratories or chemical storage rooms. In some cases, a chemical may fall into more than one class. In such instances, flammability is the primary overriding property for storage classification.

Class#	Chemical Category and Symbol
1	Inorganic Acids (IA)
2	Strong Bases (SB)
3	Organic Acids (OA)
4	Flammable Solids (FS)
5	Flammable Liquids (FL)
6	Oxidizing Agents (OX)
7	Halogens (element form) (H)
8	Miscellaneous (M)

Chemical storage classes were discussed in some detail in **Chapter 8** as an important aspect of chemical management.

TDG hazard classes

The classes and divisions of chemicals defined by TDG regulations are important for a number of reasons, including the classification of chemical waste when preparing for disposal pick-up. The hazard classes are numbered 1 to 9. Certain classes are further subdivided into numbered divisions. A waste's classification is stated as the class number followed by a point and the division number. For example, a classification of 4.3 means that the waste is categorized as Division 3 of Class 4.

The table below briefly summarizes the nine classes and types of hazards involved. Refer to Part II of the *Transportation of Dangerous Goods Act, 1992* and Regulations for specifics about the criteria and procedures needed to determine hazardous waste classes, divisions and packing groups.

Class 1 – Explosives	Explosives are classified into 6 divisions according to sensitivity and explosive potential. Note: This class of compounds is not recommended for school use.
Class 2 – Gases	Class 2 substances can be a gas, a mixture of gases, a mixture of gases with one or more vapours of substances included in other classes, an article charged with a gas, an aerosol or tellurium hexafluoride. These substances fall into one of three divisions: Divisions 2.1 Flammable gases. 2.2 Nonflammable, nontoxic gases. 2.3 Toxic gases.
Class 3 – Flammable liquids	This class includes liquids (or liquids containing solids in solution or suspension) that have a flashpoint less or equal to 60.5°C, or liquids that are intended or expected to be at a temperature that is greater than or equal to their flashpoint at any time while the substance is in transport.
Class 4 – Flammable solids	Divisions 4.1 Flammable solids. 4.2 Substances liable to spontaneous combustion. 4.3 Substances which on contact with water emit dangerous quantities of flammable gases.

Class 5 – Oxidizing Substances and Organic Peroxides	Divisions 5.1 Oxidizing substances. 5.2 Oxidizing peroxides.
Class 6 – Toxic and Infectious Substances	Divisions 6.1 Toxic substances. 6.2 Infectious substances.
Class 7 – Radioactive Materials	This class includes radioactive materials with an activity greater than 74 kBq/kg.
Class 8 – Corrosive Substances	This class includes materials that: 1. Cause full thickness destruction of human skin; for example, lesions that are permanent and destroy all layers of the outer skin. 2. Exhibit a corrosion rate that exceeds 6.25 mm/year at a temperature of 55°C.
Class 9 – Miscellaneous Products, Substances or Organisms	This includes any substance that does not meet the criteria for inclusion in classes 1 to 8 and contains one or more of the following: a) Genetically modified micro-organisms that may endanger human life. b) A marine pollutant. c) Material to be transported at high temperatures. d) Material that releases toxic substances through leaching, or e) Environmentally hazardous substances.

Chemical Disposal Methods

The appropriate disposal methods for various chemicals depend on a number of factors, and must meet federal, provincial, territorial and local regulations. The Chemical Hazard Information Table uses the following symbols to indicate disposal methods for each chemical.

Symbol	Disposal Methods	Comments
WF/I	Chemical Waste Facility/ Incinerator (government approved)	Substances identified as controlled/hazardous products must be disposed of through a waste facility by federal/provincial law. Non-regulated chemical waste may be disposed via a waste facility.
A	Dissipate into Air	Atmospheric gases only.
D	Drain	Dilute acids and bases containing no regulated constituents (pH of 5.5 to 10) and non-hazardous, non-controlled salts can be disposed of this way.
R	Recycle	Local metal and plastic recycle depots.
N/P-T or N/P-D	Neutralize/Precipitate and dispose of in Trash or Drain	Follow neutralization/precipitation procedure and dispose of non-toxic by-products in trash (T) or drain (D).
RS	Return to Supplier	Containers with remaining substance can be returned to supplier.
T	Trash (Landfill)	Dry, non-controlled, non-hazardous wastes.

“Controlled products” are substances that fall into one or more of the WHMIS hazard classes. These include compressed gases, oxidizing materials and substances that are poisonous, infectious, flammable, combustible, corrosive or dangerously reactive. There is no master list of controlled products; however, any product with a hazard warning could be a controlled product.

To reproduce the chemical hazard information table, go to: http://www.worksafesask.ca.

This information was current as of the 2006 Albertan publication.

- ❖ **Note**: One should become familiar with the background information to the chemical hazard information table before proceeding to the table for specific chemical details. The information within this table (aside from the CAS numbers) has not been changed from the original content.