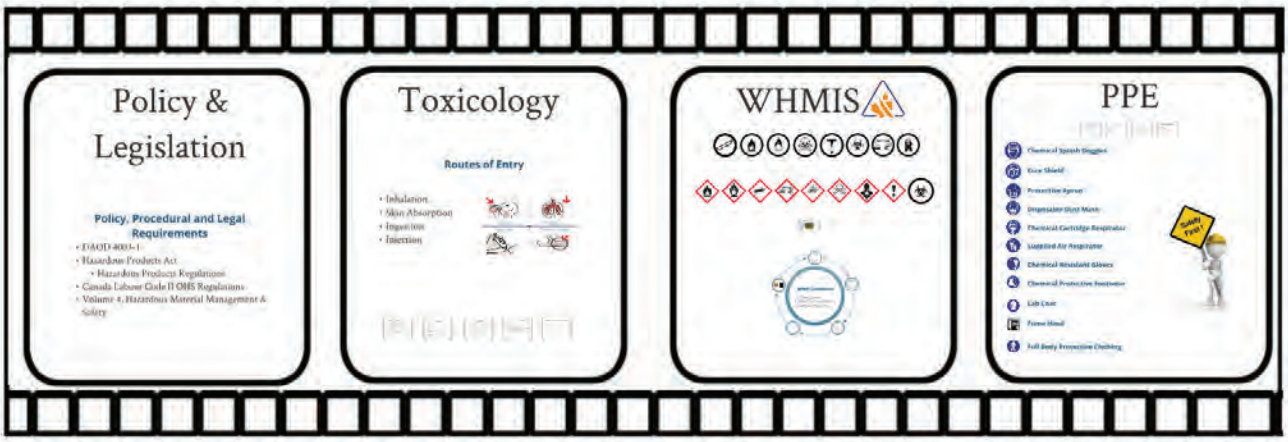
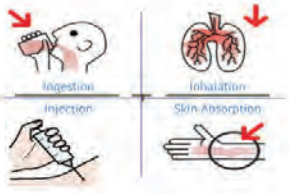


Toxicology

Routes of Entry

- Inhalation
- Skin Absorption
- Ingestion
- Injection



Toxicology

- The study of the adverse effects of chemicals on living systems:
  - Human
  - Animal
  - Plant
  - Microbe

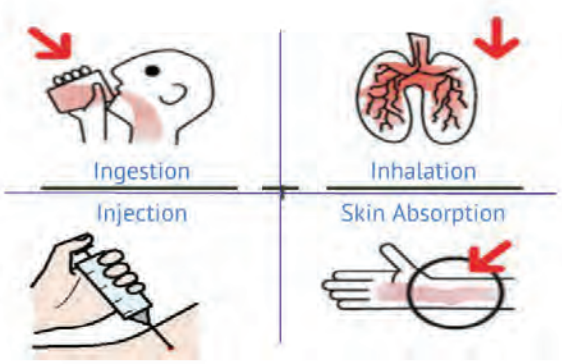
  - Source: Dr. F. Schrager (2011)

Toxicity

- Exposure route is important in determining toxicity
- Some chemicals are highly toxic by one route but not by others
- Differences in absorption and distribution within the body

Routes of Entry

- Inhalation
- Skin Absorption
- Ingestion
- Injection



Inhalation

- The most rapid and efficient route of entry for a chemical into the body
- It is the most important and serious route of entry

Skin Absorption

- The most common route of entry for chemicals
- Broken skin (cuts and scrapes) dramatically increase absorption
- Absorption through various membranes (nasal, optical, etc.) is more effective than through skin
- Local effects are most common
- Systemic effects can also occur

Ingestion

- Entry usually occurs due to contaminated food, drink, or smoking materials
- Poor hygiene practices are a major cause of toxin ingestion
- Effects may be local (e.g. Gastrointestinal) or systemic

Injection

- Occurs when an object punctures the skin
- Least common route of entry
- Poses the greatest concern when dealing with biological agents.

Effects of Chemical Exposure

- Acute vs. Chronic
  - Sudden and severe vs. long term exposure
- Local vs. Systemic
  - Point and area of contact vs. distant from POC
  - Example: arsenic effects blood, nervous system, liver, kidney and skin.
  - Substances with systemic effects often have target organs – e.g. benzene effects bone marrow.
- Know the overexposure symptoms!

Toxicology

- Asphyxiants
  - Simple – CO2
  - Chemical – CO & HCl
  - Deprive the body of oxygen
- Irritants
  - HCl, NaOH & Cl gas – severe burns & blisters
  - Dichloromethane (paint remover) – prolonged dermatitis/acnes.
- Sensitizers
  - Super sensitivity to that or other chemicals after original exposure e.g. epoxy resins & creosote

Toxicology

- Dose - measurement
  - Solids/liquids {mg/kg}
  - Inhalation {mg/m3}
- Lethal Dose
  - LD50 – lethal dose. Amount of material given at once to cause death to 50% of test animals.
  - LC50 – lethal concentration. Concentration in the air to cause death to 50% of test animals.
- Duration of exposure
- Frequency of exposure

Adverse Health Effects

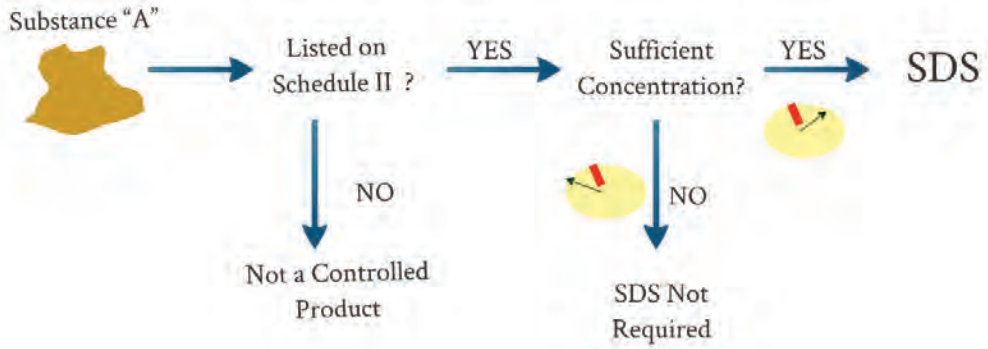
- May be irreversible
- Cancer or organ damage may be delayed
- Reversible are usually short lived
- Prolonged or high exposure

Identifying Toxicity in the Workplace

- SDS
- Labelling
- TDG Placards
- WHMIS pictograms

WHMIS

Controlled Product



The **flame** pictogram is used for the following classes and categories:

- Flammable gases (Category 1)
- Flammable aerosols (Category 1 and 2)
- Flammable liquids (Category 1, 2 and 3)
- Flammable solids (Category 1 and 2)
- Pyrophoric liquids (Category 1)
- Pyrophoric solids (Category 1)
- Pyrophoric gases (Category 1)
- Self-heating substances and mixtures (Category 1 and 2)
- Substances and mixtures which, in contact with water, emit flammable gases (Category 1, 2 and 3)
- Self-reactive substances and mixtures (Types B*, C, D, E and F)
- Organic peroxides (Types B*, C, D, E and F)

WHMIS 1988 Equivalent Symbol(s) 

The **flame over circle** pictogram is used for the following classes and categories:

- Oxidizing gases (Category 1)
- Oxidizing liquids (Category 1, 2 and 3)
- Oxidizing solids (Category 1, 2 and 3)

WHMIS 1988 Equivalent Symbol(s)

The **gas cylinder** pictogram is used for the following classes and categories:

- Gases under pressure (Compressed gas, Liquefied gas, Refrigerated liquefied gas, and Dissolved gas)

WHMIS 1988 Equivalent Symbol(s)

The **corrosion** pictogram is used for the following classes and categories:

- Corrosive to metals (Category 1)
- Skin corrosion/irritation - Skin corrosion (Category 1, 1A, 1B and 1C)
- Serious eye damage/eye irritation - Serious eye damage (Category 1)

WHMIS 1988 Equivalent Symbol(s)

The **exploding bomb** pictogram is used for the following classes and categories:

- Self-reactive substances and mixtures (Types A and B*)
- Organic peroxides (Types A and B*)

WHMIS 1988 Equivalent Symbol(s)

The **skull and crossbones** pictogram is used for the following classes and categories:

- Acute toxicity
  - Oral (Category 1, 2 and 3)
  - Dermal (Category 1, 2 and 3)
  - Inhalation (Category 1, 2 and 3)

WHMIS 1988 Equivalent Symbol(s) 

The **health hazard** pictogram is used for the following classes and categories:

- Respiratory or skin sensitization - Respiratory sensitizer (Category 1, 1A and 1B)
- Germ cell mutagenicity (Category 1, 1A, 1B and 2)
- Carcinogenicity (Category 1, 1A, 1B, and 2)
- Reproductive toxicity (Category 1, 1A, 1B and 2)
- Specific Target Organ Toxicity - Single exposure (Category 1 and 2)
- Specific Target Organ Toxicity - Repeated exposure (Category 1 and 2)
- Aspiration hazard (Category 1)

WHMIS 1988 Equivalent Symbol(s)

The **exclamation mark** pictogram is used for the following classes and categories:

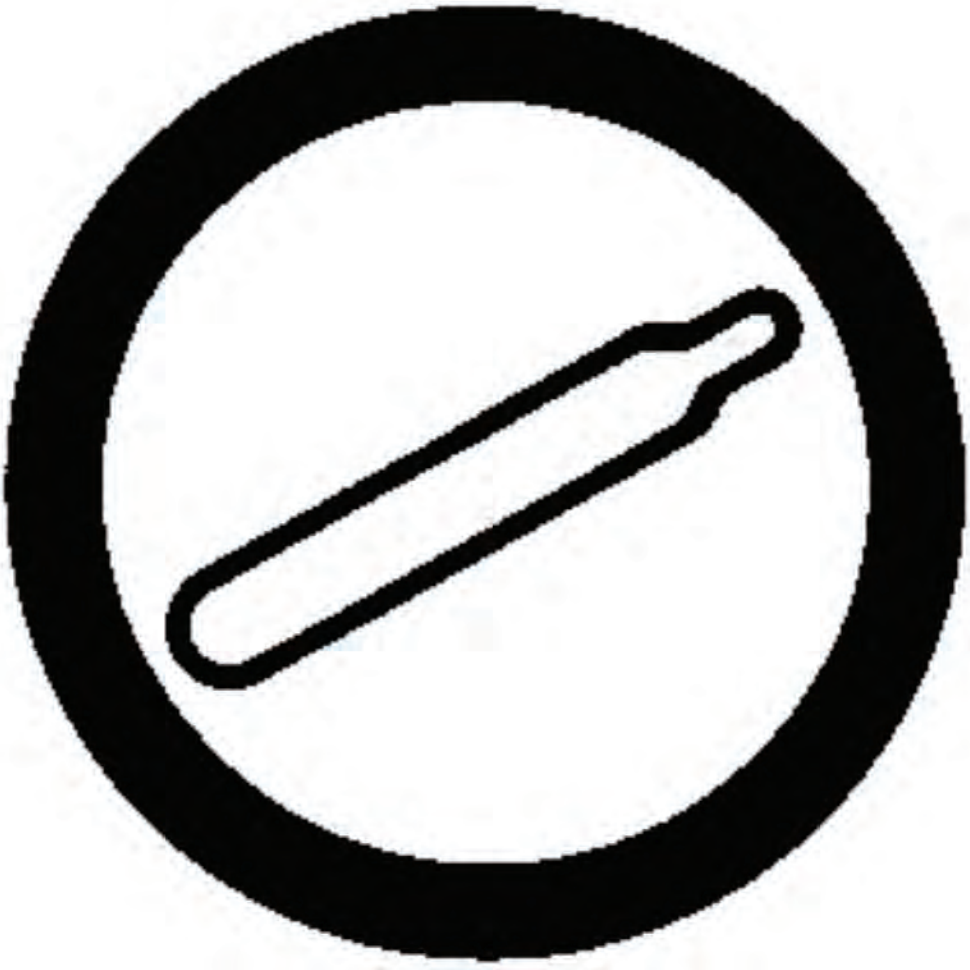
- Acute toxicity - Oral, Dermal, Inhalation (Category 4)
- Skin corrosion/irritation - Skin irritation (Category 2)
- Serious eye damage/eye irritation - Eye irritation (Category 2 and 2A)
- Respiratory or skin sensitization - Skin sensitizer (Category 1, 1A and 1B)
- Specific target organ toxicity - Single exposure (Category 3)

WHMIS 1988 Equivalent Symbol(s)

The **biohazardous infectious materials** pictogram is used for the following classes and categories:

- Biohazardous Infectious Materials (Category 1)

WHMIS 1988 Equivalent Symbol(s)



Class A – Compressed Gases

Any material that is normally a gas placed under pressure or chilled and contained by a cylinder

- Compressed Air
- Propane
- Welding Gasses
- Oxygen

Class B – Flammable and Combustive Materials

Flammable: burn or catch fire below 37.8C (100 F)
Combustible: burn or catch fire from 37.8 - 93.3C (100-200 F)

- Division 1 – Flammable Gases
  - Propane
- Division 2 – Flammable Liquids
  - Benzene, acetone
- Division 3 – Combustible Liquids
  - Kerosene
- Division 4 – Flammable Solids
  - Fuel Tabs
- Division 5 – Flammable Aersols
  - Propane, butane.
- Division 6 – Reactive Flammable Materials
  - Burn when touches air or water; or react with air or water to make a flammable gas
  - Lithium, steel wool

Class C – Oxidizing Material

Do not burn themselves but will help fire by providing more oxygen or cause materials that normally do not burn to catch fire (spontaneous combustion).

- Chlorate
- Permanganate
- Peroxide compounds
- Fertilizers (ammonium nitrate)
- Body fillers (dibenzoyl peroxide)

Class D – Poisonous and Infectious Material

- Division 1 – Materials Causing Immediate and Serious Toxic Effects
  - Burns, coma, death, loss of consciousness
  - Sodium Cyanide, hydrogen sulphide

Class D – Poisonous and Infectious Material

- Division 2 – Materials Causing Other Toxic Effects
  - Effects not quick; or if immediate are temporary
  - Asbestos, acetone, mercury, lead

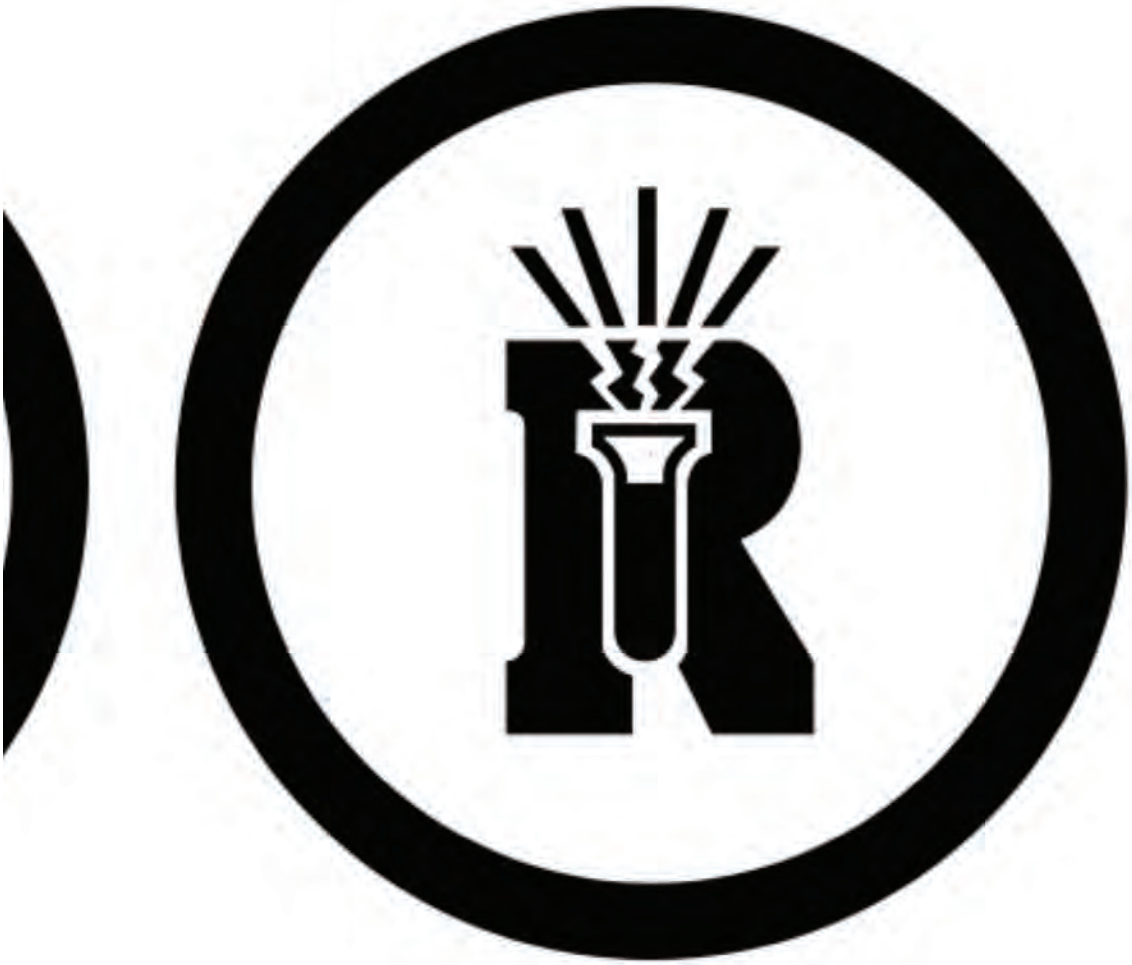
Class D – Poisonous and Infectious Material

- Division 3 – Biohazardous Infectious Materials
  - Organisms or toxins that cause diseases
  - HIV, Hepatitis A & B

Class E – Corrosive Material

Cause severe burn to skin and other tissues such as eye or lung. Can attack clothes or other materials such as metal.

- Acids: sulphuric acid, nitric acid
- Bases: ammonium hydroxide, caustic soda
- Other materials: ammonia gas, chlorine, nitrogen dioxide



Class F – Dangerously Reactive Material

- React vigorously with water to create a toxic gas
- React with itself if shocked or if temperature or pressure increases
- Join to itself (polymerization), break down, or lose extra water to be more dense (condensation)
    - Sulfuric acid
    - Lye
    - Ozone

WHMIS Symbols vs Consumer Symbols

Consumer Products

Poisonous Corrosive Flammable Explosive

Yield - The container itself is dangerous.

Stop sign - The contents inside the container are dangerous.

WHMIS Components

1 – Worker Education
2 – Labels (Supplier & Workplace)
3 – Safety Data Sheet (SDS)

WHMIS Exemptions

- Hazardous waste
- Pesticides – Pest Control Products Act
- Cosmetics, medical devices, drugs or foods – Food and Drugs Act
- Consumer products – Hazardous Products Act
- Tobacco products
- Any manufactured article
- Substances subject to Nuclear Safety and Control Act
- Explosives – Explosives Act
- Wood and products made of wood

Employee Education

- Label content
- SDS content
- Procedures for safe use, storage, handling, disposal, manufacture
- Fugitive emissions procedures
- Emergency procedures

SDS

Sixteen (16) headings of an SDS:

1. Identification
2. Hazard identification
3. Composition/Information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/Personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

Availability of SDS

- Must be available for all controlled products
- French and English
- Most current SDS required (was 3 years)
- Must be readily available to all employees

Labelling

Supplier Label

Supplier label requirements:

- Product identifier
- Initial supplier identifier
- Pictograms(s)
- Signal word
- Hazard statements(s)
- Precautionary statement(s)
- Supplemental label information

Workplace Label

- Product name
- Safe handling precautions, may include pictogram and other label information
- Reference to the SDS

Supplier Label

Supplier label requirements:

- Product identifier
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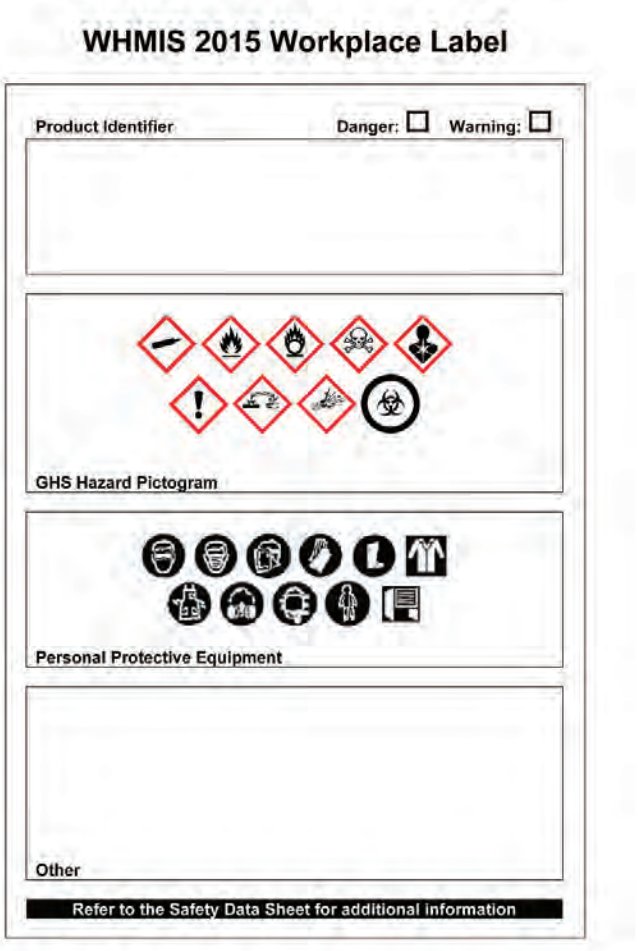
Supplier Label

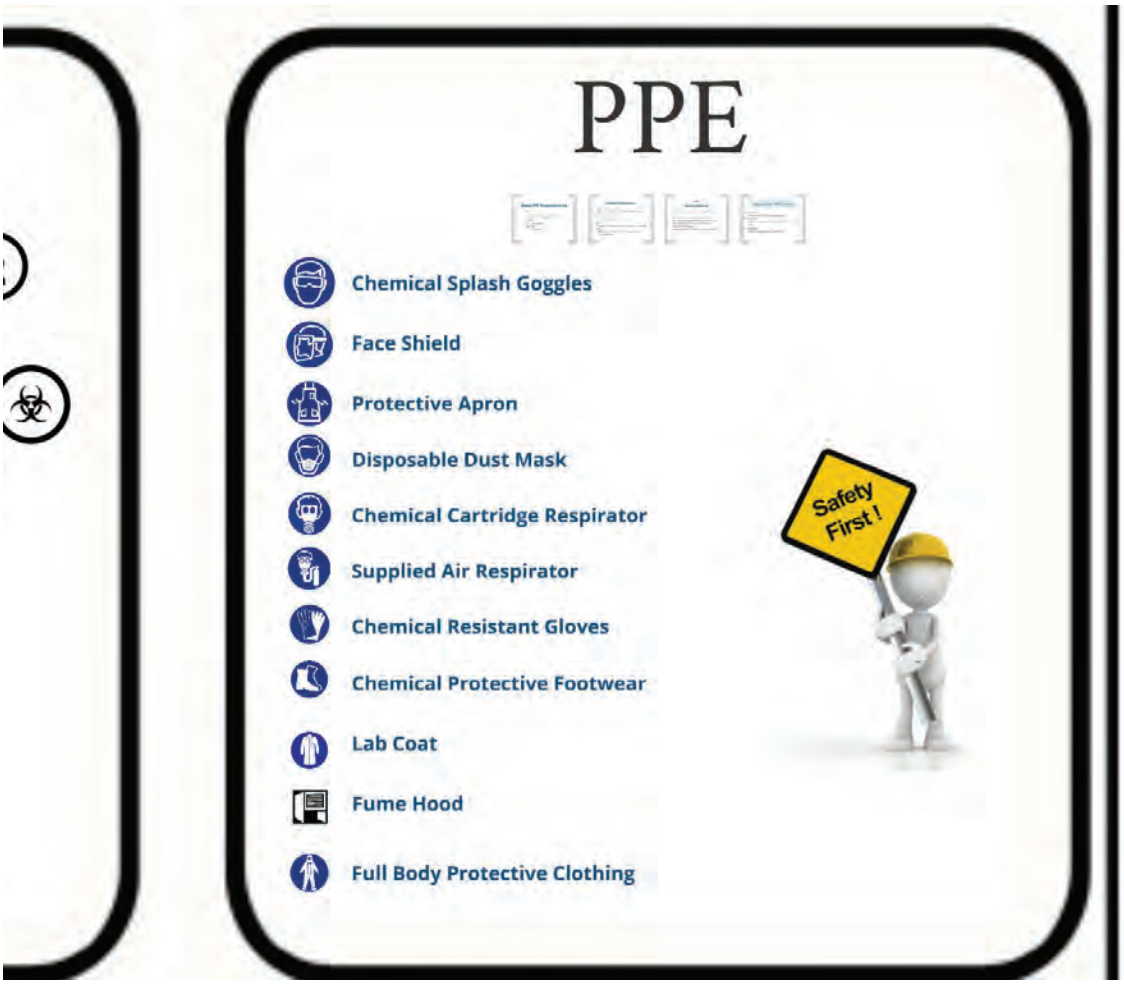
Workplace Label

- Product name
- Safe handling precautions, may include pictogram and other label information
- Reference to the SDS

WHMIS 2015 Workplace Label




Shell
Advance
METHANOL
DANGER



Basic PPE Requirements

Eyes

- No contact lenses around chemicals
- CSA or ANSI Approved eyewear

Hardhats

- CSA Approved

Footwear

- CSA Approved

Chemical Splash Goggles

Face Shield

Protective Apron

Disposable Dust Mask

Chemical Cartridge Respirator

Supplied Air Respirator

Chemical Resistant Gloves

Chemical Protective Footwear

Lab Coat

Chemical Protective Footwear

Lab Coat

Fume Hood

Full Body Protective Clothing

Hands

- Choose gloves based on the manufacturers recommendations from compatibility charts



Eyes

- Choose chemical resistant, splash protective goggles or face shield for added protection


Respiration

- The type of hazard will dictate the type of respirator protection required
- Particulate matter, irritants, oxygen displacing are typical criteria
- Fit-testing is a must (Respirator Protection Program - RPP)

Body Coverings

- Protection from splashing liquids may be necessary in decanting or mixing operations
- Particulate matter may also be a concern
- Biological or other hazards may require complete encapsulation.

Footwear

- Chemical resistant foot is a good practice anytime handling hazardous materials
- Types vary from chemical resistant soles to Firemans Boot for all encompassing

4 Basic PPE Groups

Level D

- Minimal protection – goggles/face shield, gloves and boots (all chemical resistant)

Level C

- Respiratory protection – air purifying

Level B

- Respiratory protection – positive pressure with coverall

Level A

- Respiratory protection – positive pressure and encapsulating suit

PPE Responsibilities

- Your Unit is responsible to determine PPE for small spills.
- The UHMC, BGSO and/or U Env O consult on PPE. Base staff can be consulted by Unit representatives.
- Base Fire Hall must be consulted and approve Respiratory Protection.
- See inside spill kits for information and inventories

Reasons for PPE Failure

Penetration

- Chemicals through physical openings

Permeation

- Molecular movement through the suit, no change in PPE

Degradation

- Molecular breakdown of the PPE