

# CHEMSTORE

**Chemical Storage  
System**

**O H G**  
**Consulting**

# CHEMSTORE

## Chemical Storage System

### Introduction

Many industrial and laboratory operations have a large number of chemicals on site. Logistics requires that chemicals be stored on site so that they are readily available when they are needed. Each chemical possesses its own type and degree of hazard. The combination of a large number of chemicals stored on site with each chemical having its own type and degree of hazard makes the safe storage of these products a formidable challenge.

There are many examples of cases where improper storage has resulted in chemical accidents resulting in injury to workers, damage to property and, in some cases, prosecution by regulatory agencies. Proper storage of chemical involves 2 facets:

- the separation and isolation of chemicals from other incompatible chemicals, and
- the use of appropriate storage conditions for the chemical and toxicological properties of each chemical.

For ease of locating chemicals, many storerooms organize chemicals alphabetically. However, chemical storage based upon an alphabetical arrangement of chemicals may inadvertently locate incompatible materials in close proximity. A few examples of this potentially dangerous storage method are demonstrated by the following pairs of incompatible materials:

#### **Examples of Incompatible Pairs of Chemicals and Potential Reactions Caused by Alphabetical Storage of Chemicals**

<b>Chemicals</b>	<b>Reaction</b>
acetic acid and acetaldehyde	polymerization of acetaldehyde
copper (II) sulfide and cadmium chlorate	explosive reaction
hydrogen peroxide and iron (II) sulfide	reacts vigorously
sodium nitrite and sodium thiosulfate	explosive when heated

Federal legislation requires the manufacturers and transporters of hazardous products to classify their hazardous products into different groups based on sets of defined chemical and toxicological criteria. This legislation includes both the Workplace Hazardous Material Information System (WHMIS) and the Transportation of Dangerous Goods (TDG).

The classification of all products falling under these legislations must conspicuously bear warning labels. These labels bear symbols which, at a glance, provide insight into the nature of the chemical and/or toxicological hazard that the package presents. CHEMSTORE was designed to take advantage of this required labeling of hazardous products.

CHEMSTORE separates hazardous products into twelve storage groups. Those products that represent the greatest potential hazard and require the most stringent storage conditions are separated first (e.g., explosives, radioactive sources).

## **Advantages of CHEMSTORE**

- Separates products into compatible groups quickly and easily.
- Applicable to both pure products and mixtures
- Provides direction for the proper storage conditions for each storage group.
- Utilizes and consistent with existing worker training in WHMIS and TDG.

CHEMSTORE makes worker WHMIS training easier. WHMIS legislation requires that workers who work with or in proximity to controlled products be trained with respect to the hazards that that product represents. This is very difficult to do if a worker is working in proximity to a chemical shelf where the chemicals do not share common properties or hazards. However, when chemicals and products are grouped together on the basis of common chemical, physical or toxicological traits, generic training may be given to address the hazards and precautionary measures of that chemical group.

## **Additional Information**

Like all chemical storage systems, CHEMSTORE is not a perfect system. Although it divides products into groups of chemicals as defined by the Hazardous Products Act and Transportation of Dangerous Goods Regulation, it does have all the hazard information available on a full Material Safety Data Sheet. In addition, CHEMSTORE relies on the accurate classification and labeling of manufacturers and suppliers of the products as well as the employee training required for existing legislation.

CHEMSTORE is a generic classification system that takes advantage of relatively broad classification definitions of existing federal legislation. Therefore, where the user has additional specific information with respect to a controlled product that conflicts with the CHEMSTORE system, the user should base the classification of the product on that specific information.

## **Comparison of Classification under WHMIS and TDG**

A small number of chemicals may fall into different CHEMSTORE groups depending on whether the WHMIS or TDG symbols are used in the classification process. An example of this would be sodium cyanide. Based on the WHMIS symbols, sodium cyanide would be classified as a Group 10 - Base. However, when evaluated using the TDG symbols, sodium cyanide would be classified as Group 12 - Toxic. Due to the fact that the WHMIS and TDG criteria for the various classifications are technically very similar, this is not a difference of interpretation of the properties of the product but rather a difference in the requirements for labeling under the different legislations.

Although TDG recognizes both the toxic and corrosive nature of sodium cyanide, only the toxic hazard symbol is required to appear on the product label based on a rather complicated "precedence of classification" system. However, the WHMIS system

requires the label to bear the symbols of all of the classifications that apply to the product. Thus, the WHMIS label would bear both the corrosive and toxic hazard symbol on a sodium cyanide container. This difference in labeling format results in the product being directed to a different CHEMSTORE group depending on which legislation symbols are used. Fortunately, WHMIS is much more widely used than TDG whose use is restricted to when products are being transported while WHMIS is used in workplaces where chemicals are used, handled, and stored.

In the event that the product is labeled under both the WHMIS and TDG systems, and the user is not aware of any information to the contrary, the WHMIS system should be the preferred system for classification.

## **Using the CHEMSTORE System**

The CHEMSTORE System leads the user through a series of decisions based on the chemical, physical and toxicological properties of the product. For simplicity of use, it does this with the use of two simple flowcharts.

### **Text Flowchart**

The first flowchart is a training flowchart where the decisions are described in text. The text flowchart presents a series of questions to the user regarding the product to be classified. Because the process is described in text, it allows the user to see the intent and logic behind each of the decisions and allows the user to become familiar with the system.

### **Symbol Flowchart**

The second flowchart is the working flowchart normally used by the system. This flowchart, in essence, asks the same questions as the text flowchart. However, it asks these questions by asking the user if the product bears a particular symbol from either the WHMIS system or the TDG system. The worker simply starts at the top of the flowchart and sees if the symbols on the product match the symbols at that decision point. Simply put, the answer to the question at each decision point can be answered by the presence or lack of the WHMIS or TDG symbol on the product. As each question is answered, the flowchart directs you to the next question until the product lands in one of the 12 chemical storage groups.

The key to using the CHEMSTORE flowcharts is to simply start at the top of the flowchart and see if the symbols on the product match the symbols given at the decision point and follow the path indicating that response. If there is no match, the user is directed vertically downward to the next decision point. Where there is a match, the flowchart directs the user horizontally to the right to the next decision point or to the final CHEMSTORE group.

Any product labeled under the WHMIS or TDG legislation will be classified into one of the 12 CHEMSTORE groups. CHEMSTORE also provides information regarding each of the 12 storage groups. This information includes the following:

- working definition (essentially the technical definitions used in the legislation with some rewording to make them easier for the average worker to understand);
- common or classic examples of chemicals that would fall into this group;
- typical storage conditions for this type of chemical based on good practice and general principles; and
- incompatible products including text and WHMIS symbols where appropriate.

## **CHEMSTORE as Part of a Complete Chemical Storage Program**

Chemstore provides direction in the separation of incompatible chemicals and products as well as the appropriate storage conditions for each of those groups. However, a complete chemical storage program requires more than just proper separation and storage of chemicals. The following points provide the five essential aspects of a complete chemical storage program.

### **1. Minimize Volumes**

The first step in ensuring safe chemical storage in your laboratory is to store as little of each chemical as possible. Ideally, your laboratory should have an inventory control system to keep track of all chemicals in storage. If you do need to buy a chemical, use the "just-in-time" system of ordering, i.e., order only what you need over the short term. Mark chemicals that decompose over time with the date they are received, the date they are opened, and if appropriate, the date they should be discarded. A well-managed inventory control system minimizes the amount of chemicals ordered, stored, and disposed of, which saves money and reduces chemical hazards.

### **2. Separate Incompatible Products**

The second principle of safe storage is segregate incompatible chemicals. This is provided by the Chemstore System. For further information about storage of chemicals, read the MSDS's and manufacturer's labels. Note any unusual storage restrictions or cautions. For further information, consult your Industrial Hygienist or Chemical Safety Officer, the safety literature, and standards such as NFPA 45 from the National Fire Protection Association.

### **3. Label All Products**

Label all chemicals clearly and completely. Each container should bear the components, the hazards, and the disposal date. Use markers that do not smear or run when exposed to the contents of the container. Check the chemical's MSDS to

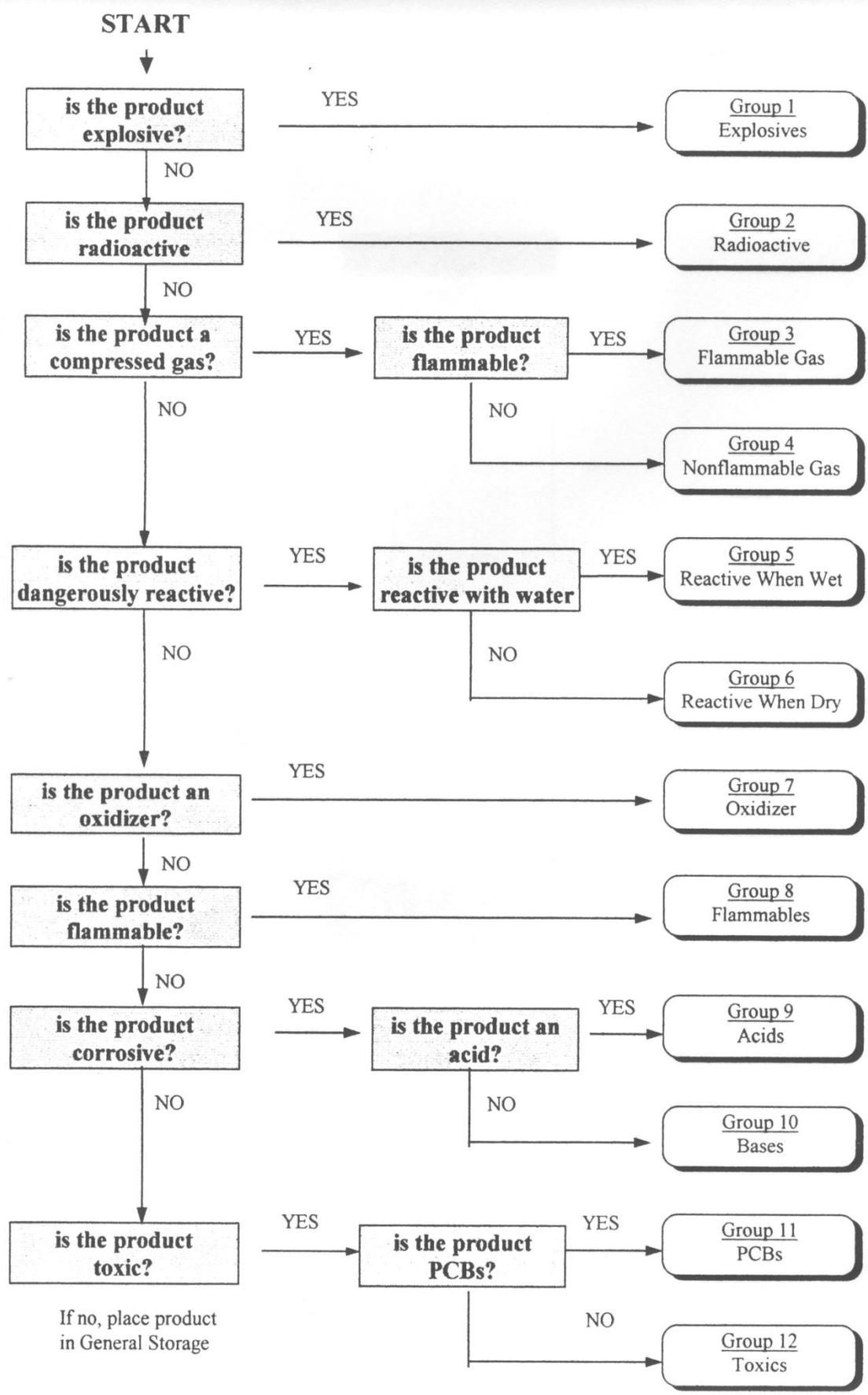
determine the proper storage container for that product, (e.g., one that protects against exposure to light and heat). Be sure to seal it securely and use secondary containment if the chemical presents a serious hazard.

#### **4. Shelf Management**

Practice good shelf management techniques. Cabinets should be clearly marked, with shallow shelves that have lips. Organize containers in staggered rows with the labels facing out. Keep heavy and large items on lower shelves. Don't overload or overcrowd shelves. Keep shelves and cabinets clean and well organized. Use secondary containment (e.g., drip trays) whenever possible. In earthquake-prone areas, install shelves with extra bracing and special edges to secure bottles. Storage areas should be inspected periodically for leaks, damage to shelving, overcrowding, or expired chemicals.

#### **5. Emergency Preparedness**

Ensure that your organization's emergency response plan is complete and up-to-date. Make sure that workers are adequately trained to deal with chemical spills and that the appropriate spill cleanup materials and personal protective equipment are readily available.





# Group 1 Explosives

## Definition

A product or substance that:

1. is capable of self-sustained chemical reactions, of producing gas at such a temperature, pressure and speed as to damage the surroundings or injure nearby personnel; or
2. is manufactured for the purpose of producing a practical explosion or a pyrotechnic effect

## Examples

- 2,4,6-trinitrotoluene (TNT)
- nitroglycerin
- blasting caps

## Storage Conditions

A cool, dry area protected from shock, elevated temperatures, or rapid temperature changes. Site should be remote from traffic or other chemical storage areas. The storage should be of solid construction with explosion-proof lighting. Access to this storage area should be controlled.

## Incompatibilities

Corrosives				
Dangerously Reactives				
Oxidizers				
Flammables				
Heat / Ignition Sources				

## Group 2 Radioactive

### Definition

A product or substance that has the following characteristic:

A radioactivity greater than 74 kBq/kg.

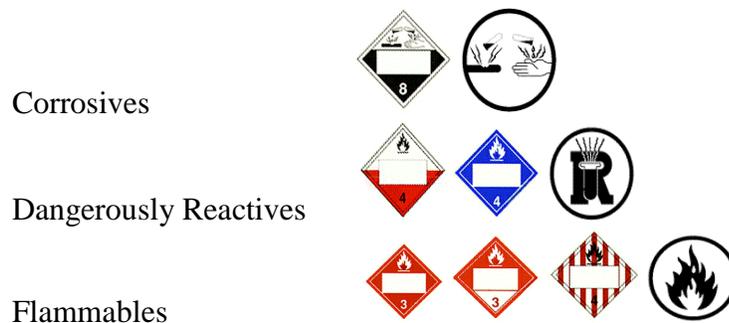
### Examples

- Cobalt-60 ( $\text{Co}^{60}$ )
- Iodine-131 ( $\text{I}^{131}$ )

### Storage Conditions

Normally, exposure is controlled by a combination of shielding and distance in combination to reduce potential exposure to non-radiation workers to background levels. Access to this storage group should be controlled.

### Incompatibilities



## Group 3 Flammable Gas

### Definition

A product or substance which has both of the following characteristics:

1. a compressed gas; and
2. forms a flammable mixture at normal atmospheric pressure over a significant range of concentration.

### Examples

- propane
- acetylene

### Storage Conditions

A cool, dry ventilated area away from heat and ignition sources. Cylinder temperature should never exceed 51°C (125 °F). Cylinders should be stored secured in an upright position. Care should be taken to avoid impact or damage to the cylinder valves. Full cylinders should be separated from empty ones.

### Incompatibilities

Oxidizers	
Reactive Materials	
Explosives	
Heat / Ignition Sources	

## Group 4 Nonflammable Gas

### Definition

A product or substance which has one or more of the following characteristics:

1. a compressed gas; or
2. a dissolved gas; or
3. a gas liquefied by compression

### Examples

- argon
- compressed air

### Storage Conditions

A cool, dry ventilated area away from heat and ignition sources. Cylinder temperature should never exceed 51°C (125 °F). Cylinders should be stored secured in an upright position. Care should be taken to avoid impact or damage to the cylinder valves. Full cylinders should be separated from empty ones.

### Incompatibilities

Flammables



Reactive Materials



Explosives



Heat / Ignition Sources

## Group 5 Reactive When Wet

### Definition

A product or substance which has the following characteristics when in contact with water:

1. emits a flammable or toxic gas; or
2. becomes spontaneously combustible under conditions of shock or increase in temperature or pressure; or
3. can undergo hazardous decomposition.

### Examples

- calcium carbide
- methyl chlorosilane

### Storage Conditions

Store in a cool, dry, ventilated area. Building should be waterproof. No water sprinkler system should service this area. alternative fire fighting systems (e.g., halon suppression) are advisable. The area should be diked to prevent water from flowing into the area or the materials should be stored raised off of the floor.

### Incompatibilities

Corrosives				
Flammables				
Reactive When Dry				
Oxidizers				
Water and Water Solutions				

## Group 6 Reactive When Dry

### Definition

A product or substance which has the following characteristics:

1. can undergo spontaneous heating under normal conditions, or shock or increased temperature or pressure; or
2. is liable to heat in contact with air to the point where it begins to burn..

### Examples

- pentaborane
- carbon

### Storage Conditions

A cool, dry ventilated area away from heat and ignition sources. Great care should be taken to handle the products carefully and gently. Store only one high - do not stack containers. Efforts should be made to minimize volumes on hand of these types of products.

### Incompatibilities

Corrosives				
Flammables				
Oxidizers				
Heat / Ignition Sources				
Mechanical Impact / Shock				

# **Group 7** **Oxidizer**

## **Definition**

A product or substance which has one or more of the following characteristics:

1. can cause or contribute to the combustion of other material by yielding oxygen or other oxidizing material; or
2. is an organic peroxide that contains the bivalent O-O bond structure.

## **Examples**

- nitrates
- nitrites
- hypochlorites
- benzoyl peroxide

## **Storage Conditions**

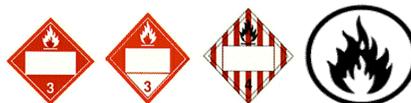
A cool, dry ventilated area away from heat and ignition sources. keep out of direct sunlight. Protect from extreme temperatures or rapid temperature changes. Fire fighting procedures for this area are should be reviewed as normal procedures are not very effective with oxidizer fires. Use only non-organic materials in the spill kit for this area.

## **Incompatibilities**

Corrosives



Flammables



Organic Material

Ignition Sources / Heat

## **Group 8** **Flammable**

### **Definition**

A product or substance which has one or more of the following characteristics:

1. can be ignited at normal temperatures; or
2. can cause a fire through friction or retained heat.

### **Examples**

- gasoline
- white phosphorous

### **Storage Conditions**

A cool, dry ventilated area away from heat and ignition sources. Provide adequate ventilation to eliminate any build-up of vapours. Proper firefighting capacity should be ensured. Explosion proof lighting should be used. Grounding bars should be used to prevent static electricity discharge when filling or decanting from containers. See the local fire code for additional information.

### **Incompatibilities**

Oxidizers				
Reactive Materials				
Heat / Ignition Sources				

## Group 9 Acids

### Definition

A product or substance which has both of the following characteristics:

1. significantly corrodes steel or aluminum or is corrosive to skin; and
2. has a pH of less than 7.

### Examples

- hydrochloric acid
- sulphuric acid

### Storage Conditions

A cool, dry, well-ventilated area away from direct sunlight. Store only in appropriate and/or approved containers. Storage area should not be subject to rapid temperature changes. Structural and shelving materials should be non-corrosive or metal covered with acid-resistant paint. Area should be inspected periodically for signs of corrosion to the structure or shelving material.

### Incompatibilities

Flammables				
Oxidizers				
Organic Material				

# Group 10 Bases

## Definition

A product or substance which is has both of the following characteristics”

1. significantly corrodes steel or aluminum or is corrosive to skin; and
2. has a pH greater than 7.

## Examples

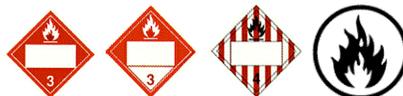
- sodium hydroxide
- potassium hydroxide

## Storage Conditions

A cool, dry, well- ventilated area away from direct sunlight. Store only in appropriate and/or approved containers. Storage area should not be subject to rapid temperature changes. Structural and shelving materials should be non-corrosive or metal covered with caustic-resistant paint. Area should be inspected periodically for signs of corrosion to the structure or shelving material.

## Incompatibilities

Flammables



Oxidizers



Organic Material

# Group 11 PCBs

## Definition

This group is reserved for polychlorinated biphenyls only.

## Storage Conditions

A cool, dry ventilated area away from heat and ignition sources. Cylinder temperature should never exceed 51°C (125°F). Cylinders should be stored secured in an upright position. Care should be taken to avoid impact or damage to the cylinder valves. Full cylinders should be separated from empty ones.

## Incompatibilities

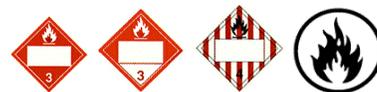
Oxidizers



Reactive Materials



Flammables



# Group 12 Toxics

## Definition

A product or substance which does not fall into any of the other classes and may have the following characteristics:

1. a toxic or poisonous substance; or
2. a product hazardous to the environment; or
3. a pesticide; or
4. irritants.

## Examples

- DDT
- strychnine
- calcium chloride

## Storage Conditions

A cool, dry, ventilated area away from heat and ignition sources.

## Incompatibilities

Oxidizers				
Reactive Materials				
Flammables				