



Compatible Chemical Storage Reference

Appropriate chemical storage plans are designed to control physical and health hazards associated with laboratory chemical storage. There are several chemical compatibility schemes or methods available. Each one is somewhat different but they have many similarities. No one system can address every possible undesired chemical combination. This guideline discusses some of the compatible storage schemes that may be used so that chemicals of different hazard classifications can be safely stored together. The (material) safety data sheet from the manufacturer should be consulted as a primary reference for storage guidance for that material.

EHS offers a safety course through ICON that provides more detailed information about safe chemical storage. This may be accessed through HR Self Service and/or via the EHS web site. **Chemical Storage Safety – W126CM**; this EHS training is recommended initially and annually. The audience is persons who work with and/or store chemicals in research labs.

General Guidelines for Safe Chemical Storage

Designate a safe storage location for each chemical. Storage location should be marked on each chemical container.

- Always store chemicals by recommended compatible storage group. Alphabetical storage is only used within a compatible storage group, never as a chemical storage plan.
- When determining how to store the chemical, always check the chemical label and MSDS/SDS first for the manufacturer's recommended compatible storage.
- Keep chemicals away from ignition sources. Store flammable and combustible chemicals in an approved flammable chemicals storage cabinet.
- Avoid storing chemicals in direct sunlight or near a localized heat source.
- Store flammable and potentially explosive chemicals according to the manufacturer's directions or according to MSDS instructions.
- Use secondary containers to physically segregate incompatible chemicals when they are stored in the same physical location.
- Label and date chemical containers when received and opened. Label working solutions or chemicals removed from their original container so that all individuals know what is in a given container.
- Maintain chemical identification labels, containers, and lids in good condition.
- Keep chemical containers closed with properly fitted caps when not in use.
- Hazardous chemicals must not be stored above shoulder height.
- Do not store stock chemical supplies in a fume hood. This interferes with proper hood airflow and can provide fuel if there is a fire within the fume hood. Flammable chemicals should not be stored in a fume hood.
- Chemicals should never be stored on the floor.
- Chemical shelving should have containment lips or trays to contain small leaks/spills. Chemical cabinets should have a leak proof door sill.

- Shelving should be strong enough to hold the weight of chemicals being stored on them. Do not overload shelves. Always secure shelving to a permanent structure. Shelves should be coated with a chemical-resistant material such as chemical-resistant paint or another coating such as epoxy.
- Do not store chemicals in a domestic refrigerator or walk-in cooler. These refrigeration devices contain ignition sources such as unsealed electrical contacts. Flammable-safe refrigerators should be used whenever flammable chemicals need to be refrigerated. Additionally, walk-in coolers are not vented, creating the potential for accumulation of chemical vapors.
- Every 60 days, as stated in the DHS Chemicals of Interest reminder e-mail sent by EHS, check that your documented chemical list matches your lab's physical chemical inventory (or at least once a year if your lab purchases or uses few chemicals). At the time you perform your inventory, look for expired chemicals and dispose of them properly.

Secondary Containment Guidelines



Secondary containment is recommended to segregate chemicals from other incompatible chemicals within the same storage cabinet. Segregating incompatible chemicals using secondary containment is helpful when chemical storage space is limited. Secondary containment is also recommended when storing highly toxic materials to minimize exposure should the primary container become damaged. For example, store liquid mercury inside a labeled unbreakable secondary container. Small containers of compatible chemicals may be stored in a desiccator or other secure device. Secondary containers should be compatible with the chemicals stored in them. They should not corrode or degrade easily.

Chemical Storage Groups and Code Systems

It is important that you segregate hazardous materials according to Compatible Storage Groups. The storage groups allow you to safely organize chemicals with different or multiple hazards. There are several appropriate chemical storage strategies that may be used. The first example below is a list of compatible groups developed by Stanford University (ChemTracker) into which chemicals can be segregated.

Examples of laboratory chemicals in the following Compatible Storage Groups are found on page 4 below.

Compatible Storage Groups, Stanford University ChemTracker

- A** Organic Bases, Flammables, and Poisons
- B** Pyrophoric Materials and Water Reactive Materials
- C** Inorganic Bases, Oxidizers, and Poisons
- D** Organic Acids, Flammables, and Poisons
- E** Oxidizers, Organic Peroxides, and Acids
- F** Inorganic Acids not including Oxidizers and Combustibles
- G** Not Intrinsically Reactive or Flammable or Combustible
- J** Poison Compressed Gases, not Flammable or Reactive
- K** Compatible Explosives or Other Highly Unstable Material
- L** Non-Reactive Flammable and Combustible Materials, including Solvents
- X** Incompatible with all other storage groups


Another system of compatible storage groups consists of nine chemical categories. In this plan there are nine storage groups. Seven of these groups cover storage of liquids because of the wide variety of hazards posed by these chemicals. Specific instructions must be followed for metal hydrides (Group VIII) and certain individual compounds, but otherwise, dry solids are in Group IX. *Many liquid chemicals pose hazards that correspond to more than one storage group. These chemicals should be stored in the lowest group number.*

Compatible Storage Groups, Fred Hutchinson Cancer Research Center

Group I	Flammable Liquids
Group II	Poisons - volatile
Group III	Acids - Oxidizing
Group IV	Acids - Organic and Mineral
Group V	Bases - Liquid
Group VI	Oxidizer - Liquid
Group VII	Poisons - Non-volatile
Group VIII	Reactives
Group IX	Solids

Additional information about this storage group system including 2 storage plan illustrations can be found on the EHS web site in the document [“Chemical Storage: Nine Compatible Storage Group System”](#).

General Summary of Several Manufacturer’s Chemical Storage Code Systems

<u>Hazard</u>	<u>Color Code</u>
Flammables	Red
Health Hazards/Toxins	Blue
Reactives/Oxidizers	Yellow
Contact Hazards	White
General Storage	Gray, Green , Orange
Isolate Separately	Stripe 

Other systems include manufacturer storage code systems on product labels. For example, Fisher has the following colored storage group codes on chemical labels:

- Red = flammable storage
- Blue = health hazard; store in secure area
- Yellow = reactive and oxidizing agents; may react violently with air, water, or other substance; store away from flammables and combustibles
- White = corrosive; store away from red-, yellow-, and blue- coded reagents,
- Gray = general chemical storage).

Mallinckrodt/J.T. Baker/Macron also has a color code system:

- Blue = store in secure poison area
- Red = store in flammable liquid storage
- Yellow = store separately and away from flammables or combustibles
- White = store in corrosion-proof area
- Green/formerly orange = general storage area
- Striped = indicates incompatible with other materials in the same color class; assess individual storage

Examples of Chemicals in the Compatible Storage Groups, Stanford University ChemTracker

<p>Group A – Compatible Organic Bases</p> <ul style="list-style-type: none"> Ethanolamine Isopropylamine Triethanolamine Triethylamine TEMED (Tetramethylethylenediamine) Diaminobenzidine (DAB) 	<p>Group D – Compatible Organic Acids</p> <ul style="list-style-type: none"> Butyric acid Citric acid monohydrate Formic acid Glacial acetic acid (also - store with flammables if segregated) 4-Morpholinepropanesulfonic acid (MOPS buffer) Propionic acid 	<p>Group G – Not Intrinsically Reactive or Flammable or Combustible (solids, store separately above liquids)</p> <ul style="list-style-type: none"> Acrylamide, bis-acrylamide Agarose Ammonium thiosulfate Chloroquine diphosphate Coomassie brilliant blue Dextrose Dithiothreitol Guanidine hydrochloride Magnesium chloride Methotrexate Sodium citrate Sodium phosphate, monobasic Potassium chloride Potassium ferricyanide X-Gal (5-Bromo-4-chloro-3-indolyl-B-D-galactopyranoside) 	<p>Group L – Non-Reactive Flammables and Combustibles, including Solvents</p> <ul style="list-style-type: none"> Alcohols Acetaldehyde Acetone Acetonitrile Amyl acetate Benzene Carbon disulfide Cyclohexane Dichloromethane Diethyl pyrocarbonate Dimethylformamide Dimethyl sulfate Dimethylsulfoxide (DMSO) Dioxane Ethyl ether Ethyl acetate Formaldehyde, 37% Formamide Hexane Hydrazine Isoamyl alcohol β-Mercaptoethanol Methyl ethyl ketone Methylene chloride Paraformaldehyde solid Phenol Piperidine Propanol Sodium dodecyl sulfate (SDS) Tetrahydrofuran Toluene Xylenes
<p>Group C – Compatible Inorganic Bases</p> <ul style="list-style-type: none"> Ammonium hydroxide Potassium hydroxide Sodium hydroxide solutions 	<p>Group E – Compatible Oxidizers including Peroxides</p> <ul style="list-style-type: none"> Ammonium nitrate Ammonium perchlorate Ammonium persulfate Benzoyl peroxide, wet tert-Butyl hydroperoxide Calcium hypochlorite Chlorosulfonic acid Chromic acid Fuming nitric acid Hydrogen peroxide, 30% Isoamyl nitrite Potassium chlorate Potassium dichromate Potassium permanganate Silver nitrite Sodium chlorate Sodium chlorite Sodium hypochlorite solution (bleach) 	<p>Group F – Compatible Inorganic Acids not including Oxidizers or Combustibles</p> <ul style="list-style-type: none"> Hydrochloric acid Nitric acid Phosphoric acid Sulfuric acid 	<p>Group G – Not Intrinsically Reactive or Flammable or Combustible (liquids)</p> <ul style="list-style-type: none"> Chloroform Isoflurane <p>Non-reactive chlorinated solvents may be stored with flammables.</p>

<p>Group X – Incompatible with ALL other storage groups</p> <ul style="list-style-type: none"> • Sodium azide • Picric acid 10-40% water 	<p>Group B – Compatible Pyrophoric and Water Reactive Materials</p> <ul style="list-style-type: none"> • Acetyl chloride • Lithium aluminum hydride, other metal hydrides • Phosphorus pentachloride • Silanes such as Silane gas, Dimethyldichlorosilane • Sodium • Sodium hydride • Toluene 2,6-diisocyanate 	<p>Examples Compressed Gases and their respective CT Compatible Storage Group</p> <ul style="list-style-type: none"> • Ammonia (C) • Arsine (X) • Carbon monoxide (L) • Chlorine (E) • <i>Cyanogen chloride (J - poison)</i> • Fluorine (E) • Formaldehyde gas (L) • Hydrogen (L) • Hydrogen chloride (F) • Hydrogen cyanide (C) • Hydrogen sulfide (L) • Nitric oxide (E) • Ozone (E) • Phosphine (B) • Silane (B) • Stibine (B) • Sulfur tetrafluoride (B) • <i>Tellurium hexafluoride (J - poison)</i> 	<p>Examples of Group K – Compatible Explosive or other highly Unstable Materials</p> <ul style="list-style-type: none"> • Ammonium picrate, dry • Benzoyl peroxide, 97% • Dinitrophenol • Mercury fulminate • Nitroglycerin • Picric acid, dry • Trinitrotoluene (TNT)
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Another more detailed chemical mixing compatibility chart is also available. It is based on a source from the Environmental Protection Agency. At the link, you will open an Excel file that appears similar to the image below. Because this chart has numerous categories, it can be referenced to help form a better decision about the storage category of a particular chemical when more information is needed.

Chemical Mixing Compatibility Chart

Reactivity Group No.	Reactivity Group Name	Chemical Mixing Compatibility Chart [to assist with safe chemical segregation]																																										
1	Acids, Mineral, Non-Oxidizing	1																																										
2	Acids, Mineral, Oxidizing		2																																									
3	Acids, Organic			3																																								
4	Alcohols and Glycols				4																																							
5	Aldehydes					5																																						
6	Amides						6																																					
7	Amines, Aliphatic and Aromatic							7																																				
8	Azo Compounds, Diazo Compounds and Hydrazines								8																																			
9	Carbamates									9																																		
10	Caustics										10																																	
11	Cyanides											11																																
12	Dithiocarbamates												12																															
13	Esters													13																														
14	Ethers														14																													
15	Fluorides, Inorganic															15																												
16	Hydrocarbons, Aromatic																16																											
17	Halogenated Organics																	17																										
18	Isocyanates																		18																									
19	Ketones																			19																								
20	Mercaptans and Other Organic Sulfides																				20																							
21	Metals, Alkali and Alkaline Earth, Elemental																					21																						
22	Metals, Other Elemental Alloys as Powders, Vapors, or Sponges																						22																					
23	Metals, Other Elemental Alloys as Sheets, Rods, Moldings, Etc.																							23																				
24	Metals and Metal Compounds, Toxic																								24																			
25	Nitrides																									25																		
26	Nitriles																										26																	
27	Nitro Compounds, Organic																											27																
28	Hydrocarbons, Aliphatic, Unsaturated																												28															
29	Hydrocarbons, Aliphatic, Saturated																													29														
30	Peroxides and Hydroperoxides, Organic																														30													
31	Phenols and Cresols																																											
32	Organophosphates, Phosphothioates, Phosphodithioates																																											
33	Sulfides, Inorganic																																											
34	Epoxides																																											
35	Combustible and Flammable Materials, Miscellaneous																																											
36	Explosives																																											
37	Polymerizable Compounds																																											
38	Oxidizing Agents, Strong																																											
39	Reducing Agents, Strong																																											
40	Water and Mixtures Containing Water																																											
41	Water Reactive Substances	<---<---<---<---Extremely Reactive! --- Do Not Mix With Any Chemical! --- Extremely Reactive--->--->--->--->																																										

Chemical Mixing Compatibility Chart [to assist with safe chemical segregation]

Modified From:
Source: EPA-600/2-80-076 / April 1980
A Method for Determining the Compatibility of Chemical Mixtures
and from University of Arizona

Reactivity Code	Consequence
H	Heat Generation
F	Fire
G	Innocuous and Non-Flammable Gas Generation
GT	Toxic Gas Generation
GF	Flammable Gas Generation
E	Explosion
P	Violent Polymerization
S	Solubilization of Toxic Substance
U	May be Hazardous But Unknown

Example
H, F, GT
Heat Generation, Fire, and Toxic Gas Generation

EHS Contacts for Chemical Storage Safety Questions

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