

BMSC: CHEMICAL SAFETY

Segregation of Stored Chemicals (Page 1 of 1):

It is important to separate stored chemicals based on their chemical properties to avoid serious problems that can occur if certain combinations are accidentally mixed. People should use information from both the list of incompatible chemicals combinations and the list of compatibles to help them decide how to safely store their chemicals. To minimize problems that might occur in the event of a major accident in a lab full of chemicals, reagents are grouped in five or six separate locations to reduce the chance of mixing in case of a disaster. The categories should also be followed when disposing of chemical waste. They are as follows:

Chemical Group	Symbol	Examples	Storage	Caution
Strong acids		Hydrochloric, Sulfuric, Nitric (strong oxidizer), Perchloric (strong oxidizer), Phosphoric, Chloric (v. strong oxidizer).	Store separate from weak acids or flammable solvents. Strong acids that are also oxidizers must not be stored near any compounds that can be oxidized Note: Perchloric acid is very dangerous and should always be held in a secondary container (e.g. a plastic tub).	Does NOT include Weak Acids (acetic, formic, propionic) or Flammables
Strong bases		Sodium hydroxide, Potassium hydroxide, Ammonium hydroxide, Calcium oxide.	Isolate in a cabinet away from Strong acids.	Does NOT include Acids or Flammables
Weak acids		Acetic, Formic, Propionic, Butyric.	Store separate from strong acids and oxidizers. Acetic acid and formic acids are combustible and are stored in reserved location for weak acids.	Note: Acetic and formic are combustible
Flammables and combustibles (including weak acids)		Alcohols (methanol, ethanol, isopropanol), Ethers (petroleum, diethyl, and monomethyl ether), Organic "solvents" (hexane, pentane, acetone, xylene, methylene chloride, diethylamine [organic base, but also flammable]), Methyl ethyl ketone, Ethylene glycol	Store large containers (esp. > 1L) in a Flammable Storage cabinet.	Do NOT store near strong acids Note: Hydrogen peroxide (30% or 70%) - don't store w. Flammables; refrigerate at 4 deg C
Oxidizers		Nitrates / nitrites (sodium nitrate, potassium nitrite), Chlorates and perchlorates, Dichromates (sodium or potassium dichromate), Hydrogen peroxide, Nitric acid, Perchloric acid, Iodine, Bromine, Fluorine (strong oxidizers), Persulfates	Oxidizers must be separated from other chemicals and stored in a separate cabinet. Other: nitric acid: store with strong acids; perchloric acid: store with strong acids and within a secondary container (beaker or tub).	NO Flammable / Combustibles Oxidizers can cause spontaneous ignition if mixed with a combustible material.
General Chemicals		Arsenic, cyanide, carcinogens	Special treatments (e.g., plastic bags/ containers) for things like very toxic substances to help contain the material if dropped.	See "Some Chemicals with Special Hazards".

Additional locations or containers might be set up for: radioisotopes, extremely toxic compounds, compounds that require desiccation or low temperature .

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WHMIS Hazard Symbols (Page 1 of 1):

Class A: Compressed Gasses



Class B: Combustible and Flammable material



Class C: Oxidizing Material



Class D:
Division 1 Poisonous & Infectious material
Immediate serious & toxic effects



Class D:
Division 2 Poisonous & Infectious material
other toxic effects



Class D:
Division 3 Poisonous & Infectious material
biohazardous infectious material



Class E: Corrosive material



Class F: Dangerously reactive material



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Some Chemicals with 'Special' Hazards: (Page 1 of 1):

The hazards listed here do not fully describe all the problems associated with these compounds. There are undoubtedly many more items that deserve special attention in terms of storage or usage. If you work with any of these items or groups, get further information from the MSDS or from reference texts available from the Research Coordinator or from the library in the Main Building. The links to more detailed information were current in December 2000. This list was compiled from the University of Alberta Department of Biological Sciences web site.

Chemical	Possible Use	Hazard
Aluminum chloride	Reagent	Forms HCl on contact with moisture; bottles may develop dangerous pressure buildup
Benzoyl peroxide	Used to decolorize samples before measuring in a liquid scintillation counter	Shock-sensitive solid
2,4-Dinitrophenol (DNP)	pH indicator, respiratory inhibitor	Unstable/shock sensitive/explosion hazard when dry; keep wetted with >30% water
Hydrazine and derivatives: (2,4-dinitrophenyl hydrazine)	Chemical assay	Flammable solid; may be shock sensitive; explosive; keep wet (>30% water)
Hydrofluoric acid	Digest rocks	Causes severe skin burns, penetrates skin and can cause death due to its interaction with calcium. Check links below: http://bfrost.uni.edu/bhs/FactSheets/hf acids.htm http://www.cscheme.labsafety.umaryland.edu/articles/incident%20reports%20incident.htm
Perchlorates (Mg, Na)	Mg perchlorate is used as a drying agent	Shock-sensitive solids
Perchloric acid	Digest organic samples	Very strong oxidizer when heated; old bottles may accumulate shock-sensitive crystals. Do not unscrew cap!
Peroxide forming compounds: diethyl ether (not petroleum ether), di-isopropyl ether, tetrahydrofuran, ethylene glycol monomethyl ether (methyl cellosolve), dioxane	Organic solvents	Peroxides formed on exposure to air; should regularly dispose of old bottles (annually or sooner). May explode on distillation or drying or even the friction from opening the cap. http://bfrost.uni.edu/bhs/FactSheets/peroxids.htm http://www.cscheme.labsafety.umaryland.edu/article/peroxides.htm
Picric acid (trinitrophenol)	Prepare a histological stain	Unstable/shock sensitive/explosion hazard when dry (<30% water); keep wetted with >30% water
Sodium azide	Metabolic inhibitor; preservative	Reacts with lead, copper to form unstable compounds; do not pour solutions down the drain http://bfrost.uni.edu/bhs/FactSheets/sodiums.htm
Sodium dithionite	Remove oxygen from solution	May ignite if water is added to powder

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Incompatible Chemical Mixtures (Page 1 of 5):

The following are examples of chemical incompatibilities. These combinations may produce fire, explosion or poisonous gases so efforts must be made to ensure that such mixtures do not occur. Avoiding these reactions is also the main reason for segregating stored chemicals into different parts of the laboratory or biohazards lab. This list was obtained from the University of Alberta Department of Biological Sciences web site and may not be comprehensive. Consult alternate sources (e.g. MSDS) for further information.

Chemical	Incompatible With
Acetic acid	Acetaldehyde, acetic anhydride and water, ammonium nitrate, 5-Azidotetrazole and acetone, carbonates, chlorine trifluoride, dialyl, chromic acid, ethylene glycol, hydroxide, hydroxyl compounds, methyl carbinal and ozone, nitric acid, organic materials, phosphates, phosphorus isocyanate, perchloric acid, peroxides, permanganates, potassium tert-butoxide, p-xylene, sodium hexahydroxyplatinate (IV) oxides.
Acetylene gas	Beaching powder, bromine, chlorine, cobalt, copper acetylides, fluorine, halogen, mercury, nitric acid, nitric oxide products, oxygen, potassium, silver trifluoromethyl hypofluorite.
Acetone	Air, alkali, bromoform, carbon, chloroform, concentrated nitric and sulfuric acid mixtures, 2-methyl-1,3-butadiene (isoprene) potassium hydroxide, potassium tert-butoxide, sulfur dichloride, triethylthiaziyl perchlorate.
Alkali and alkaline earth metals: (e.g. powdered aluminum or magnesium, calcium, lithium, sodium, potassium)	Air, alcohols, atmospheric gases, bromobenzene, carbon, carbon dioxide carbon disulfide, carbon tetrachloride or other chlorinated hydrocarbons, chloroform, diethyl ether, dimethyl sulfoxide, ethanol, halocarbons, halogens, hydrazine, hydrogen iodide, mercury, metal chlorides, metal halides, metal oxides, metal oxosalts, methanol, nitric acid, nitric acid/nitrite, N-dimethylformamide, non-metal halides, non-metal oxides, oxalyl dihalides, oxidants, oxygenated compounds, potassium carbonate, sodium carbonate, sulfides, sulfur, sulfuric acid.
Ammonia gas (anhydrous)	Bromine, calcium chlorine hypochlorite, hydrofluoric acid (anhydrous), iodine, mercury metal, nitromethane.
Ammonium nitrate (an oxidizer)	Acetic anhydride, acids, alkali metals, aluminium, ammonia, ammonium chloride, ammonium phosphate ammonium sulfate, barium nitrate, calcium, charcoal, chlorates, chloride salts, copper iron (II) sulfide, fertilizer materials, finely divided organic combustible materials, flammable liquids, formamide, hexamethylenetetramine acetate, metal oxides, metals, metal salts nitrate, nitric acid, nitrites, non-metals, organic fuels, potassium, potassium nitrite, potassium permanganate, potassium sulfate, powdered metals, sawdust, sugar, sulfide ores, sulfur, urea, water, zinc.
Aniline	Benzene diazonium-2-carboxylate, boron trichloride, dibenzoyl peroxide, hydrogen peroxide, nitric acid, nitromethane, oxidants.
Arsenical materials	Any reducing agent (generates poisonous arsine gas), arsenic sulfides, arsenic trichloride, arsenic trifluoride, arsenic trioxide, arsenic trisulfide, arsine.
Azides	Acids (forms hydrogen azide-extremely explosive).
Bromine (an oxidizer)	Acetone, acrylonitrile, ammonia, diethyl ether, N-N-dimethylformamide, ethanol, phosphorus, metal acetylides, carbides, metal azides, methanol, metals, non-metal hydrides, rubber, trialkylboranes, See chlorine.
Calcium oxide	Water.

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Chemical	Incompatible With
Carbon (activated charcoal)	Calcium hypochlorite, all oxidizing agents.
Carbon tetrachloride	Aluminum chloride, benzoyl peroxide, boranes, cleaning of barium lamps under carbon tetrachloride, chlorine trifluoride, decaborane, 1,11-diamino-3,6,9-triazundecane, ethylene, fluorine, metals, N,N-dimethylformamide, potassium tert-butoxide, sodium, triethylaluminum.
Chlorates (e.g. Na, K; strong oxidizers)	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials.
Chromic acid and chromium metal	Acetic acid, acetic anhydride, alcohol, boron, camphor, ethanol, flammable liquids in general, glycerol, hydroxylamine, naphthalene, organic residues, oxidizable substances, sulfuric acid, trinitrotoluene.
Chlorine gas	Acetylene, activated carbon, ammonia, antimony trichloride and tetramethylsilane, benzene, bromide, bromine pentafluoride, boron, butadiene, butane, carbides, carbon disulfide cobalt(III) chloride and methanol, 1-chloro-2-propyne, dibutyl phthalate, dichloro(methyl)arsine, diethyl ether, diethylzinc, distyli oxide, finely divided metals, fluorine, glycerol, hydrocarbons, hydrogen, iron(III) chloride and monomers, Lewis acids, magnesium, metal acetylides, metal hydrides, methanol, methane, nitrogen compounds), phenyl, phosphorus compounds, phosphorus, propane (or other petroleum gases), silicon, silicon oils, sodium carbide, sodium hydroxide, steel, sulfides, synthetic rubber, tert-butyl alcohol, turpentine, water.
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide.
Copper metal	Acetylene, hydrogen peroxide.
Cumene hydroperoxide	Acids (organic or inorganic).
Cyanides	Acids (generates poisonous hydrogen cyanide gas), oxidants, sodium nitrite.
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens.
Fluorine gas (very strong oxidizer)	All other chemicals.
Hydrocarbons (e.g. butane, propane, benzene)	Air, arsenic pentafluoride, bromine, chlorine, chromic acid, diborane, fluorine, hexafluoride, interhalogens, oxidants, potassium methoxide, sodium peroxide, uranium.
Hydrocyanic acid	Alkali, nitric acid.
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous), potassium permanganate, sodium.

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Chemical	Incompatible With
Hydrogen peroxide (an oxidizer)	Acetic acid, acetic anhydride, acetone, alcohols ,aniline, carboxylic acids, cellulose materials, chromium , combustible materials, copper, iron, keytones, metals, most metals or their salts, nitrogen containing bases, nitromethane, organic materials,organic compounds, phosphorus pentoxide, soluble fuels(acetone,ethanol,glycerol), tin (II) chloride,
Hydrogen sulfide	4-bromobenzene diazonium chloride,copper/oxygen 1:2, fuming nitric acid, metal oxides, metals, oxidants, oxidizing gases, oxygen, silver fulminate, soda-lime.
Hypochlorites Iodine (an oxidizer)	Acids, activated carbon.
Mercury metal	Acetylene, ammonia (aqueous or anhydrous), carbides, ethanol formamide, halogen,s, hydrogen acetaldehyde, interhalogens, metal acetylides, metals, metals and water, non-metals, phosphorus, potassium, silver azide, sodium phosphinate, tetramminecopper (II) sulfate.
Nitrates (e.g. Na, K; oxidizers)	Acetylene, ammonia,bromine, fulminic acid, metals, peroxyformic acid.
Nitric acid (concentrated; an oxidizer)	Acids, air, chloroform, diethyl ether, ethanol, halocarbons, halogens, hydrazine, mercury, metal halides, metal oxides, N,N-dimethylformamide, non-metal halides, non-metal oxides, non-metals, oxygenated compounds, sulfides, Sulfuric acid (generates nitrogen dioxide), water.

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Chemical	Incompatible With
Nitrites (e.g. Na, K; oxidizers)	Acids (generates nitrous fumes) acids, air, chloroform, diethyl ether, ethanol, halocarbons, halogens, hydrazine, mercury, metal halides, metal oxides, N,N-dimethylformamide, non-metal halides, non-metal oxides, non-metals, oxygenated compounds, sulfides, water.
Nitroparaffins	Inorganic bases, amines.
Oxalic acid	Mercury, silver, sodium chlorite and water.
Oxygen gas (oxidizer)	Oils, grease, hydrogen, flammable liquids, solids or gases.
Perchloric acid (strong acid & very strong oxidizer when heated)	Acetic acid, acetic anhydride, alcohol, aniline, bismuth and its alloys, antimony, carbon, carbon tetrachloride, cellulose and derivatives, dehydrating agents, deoxyribonucleic acid, diethyl ether, formaldehyde, glycols and their ethers, grease, iodides, ketones, 2-methylcyclohexanone, methanol, , nitric acid, nitrogenous epoxides, oleic acid, oils, organic materials, pyridine, phosphine, paper, sodium phosphinate, sulfoxides, sulfuric acid , thallium triacetate trichloroethylene, triglycerides, wood.
Peroxides, organic	Acids (organic or mineral), aniline, 2-bromo-4-methylpyridine, avoid friction, carbon tetrachloride, dimethyl sulfide, ethylene, lithium aluminum hydride, methyl methacrylate, metals and metal oxides, N,N-dimethylaniline, sodium nitrate, store cold may explode when distilled(tert-butyl hydroperoxide).
Phosphorus (white)	Air, alkalies, chlorosulfuric acid, halogens and interhalogens, hydroiodic acid, hydrogen peroxide, magnesium perchiorate, metal halogenates, metal halides, metal oxides, metals, nitrates, nitric acid, non-metal halides, non-metal oxides, oxygen, performic acid, potassium nitrite, potassium permanganate, reducing agents, selenium, sulfur, sulfuric acid.
Potassium metal	Air, alcohols, carbon, carbon dioxide, carbon disulfide, carbon dioxide, carbon monoxide, carbon tetrachloride, halocarbon, halogens, hydrazine, hydrogen iodine, mercury, metal halides, metal oxides, metals, nitrates, nitric acid, non-metal halides, non-metal oxides, oxalyl dihalides, oxidants, sulfuric acid, water.
Potassium chlorate (strong oxidizer)	Ammonia, ammonium sulfate, fabric, hydrocarbons, hydrogen iodide, manganese dioxide, metal sulfides, metal thiocyanates, nitric acid, non-metals, organic matter, potassium hydroxide, sodium amide, sulfuric acid, sulfuric acid and other acids (explodes!).
Potassium perchlorate (oxidizer)	Sulfuric acid and other acids.

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Chemical	Incompatible With
Potassium permanganate (oxidizer)	Acetic acid, acetic anhydride, acetone, alcohols, ammonia, ammonium nitrate, antimony, arsenic, benzaldehyde, dichloromethylsilane, ethylene, formaldehyde, glycerol, glycol, hydrochloric acid, hydrogen peroxide, hydroxylamine, nitric acid, non-metals, sulfuric acid, tert-butylamine, water, wood.
Selenides	Metal chloride, metals, nitrogen trichloride, oxidants, oxygen, organic matter, phosphorus, reducing agents (generates hydrogen selenide gas).
Silver metal	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid.
Sodium metal	Acids, air, carbon tetrachloride, carbon dioxide, chloroform, diethyl ether, ethanol, halocarbons, halogens or interhalogens, hydrazine, mercury, metal halides, metal oxides, methanol, N,N-dimethylformamide, metal oxides, non-metal halides, non-metal oxides, non-metals, oxygenated compounds, sulfides, water.
Sodium nitrite (oxidizer)	Amidosulfates, aminoguanidine, ammonium nitrate and other ammonium salts, metal cyanides, phenol, phthalic acid, phthalic anhydride, sodium amide, sodium thiocyanate, sodium thiosulfate, urea, wood.
Sodium peroxide (oxidizer)	Acetic anhydride, acetic acid, ammonium peroxydisulfate, benzaldehyde, calcium acetylidyde, carbon disulfide, carbon dioxide, ethylene glycol, ethyl acetate, ethyl or methyl alcohol, fibrous materials, furfural, glacial acetic acid, glycerin, hydrogen sulfide, hydroxy compounds, metals, methyl acetate, non-metal halides, non-metals, organic liquids and water.
Sulfides	Acids (generate poisonous hydrogen sulfide gas).
Sulfuric acid	Acetaldehyde, acetone, acetonitrile, acrylonitrile, alkyl nitrates, benzyl alcohol, carbides, 1-chloro-2,3-epoxypropane, 2-cyano-2-propanol, cyclopentadiene, cyclopentanone, 1,3-diazidobenzene, metal acetylides, metal chlorates, metal perchlorates, nitric acid and organic matter, nitric acid and toluene, nitroaryl bases and derivatives, nitromethane, nitromethylamine, permanganates, phosphorus trioxide, potassium, p-toluene, potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium), sodium, sodium borohydride, water.
Tellurides	Reducing agents (generates poisonous hydrogen telluride gas).
Matter	Antimatter (this wasn't mine but it's good!).