LABORATORY SAFETY, STORAGE & SEGREGATION

A culture of safety consciousness, accountability, organization and education is necessary in laboratories. Safety and training programmes should be implemented to monitor the handling of chemicals from ordering to disposal and to train laboratory personnel in safe practices. A crucial component of chemical education for all personnel is to nurture basic attitudes and habits of prudent behaviour so that safety is a valued and inseparable part of all laboratory activities.

Beyond regulation, personnel hold themselves responsible for the safety of the building occupants and the general public. Emergency preparedness, emergency response and consideration of physical hazards as well as chemical hazards is an integral part of laboratory safety. To be most effective, safety and health must be balanced with, and incorporated into, laboratory processes. A strong safety and health culture is the result of positive workplace attitudes.

In order to perform their work in a prudent manner, laboratory personnel should consider the health, physical and environmental hazards of the chemicals they plan to use in an experiment. However the ability to accurately identify and assess laboratory hazards must be taught and encouraged through training and ongoing organizational support. Training should be at the core of every good health and safety programme for management to lead personnel to assess worksite hazards and hazards to be eliminated or controlled; everyone involved must be trained.

STANDARD PRECAUTIONS FOR LABORATORY GLOVE REMOVAL

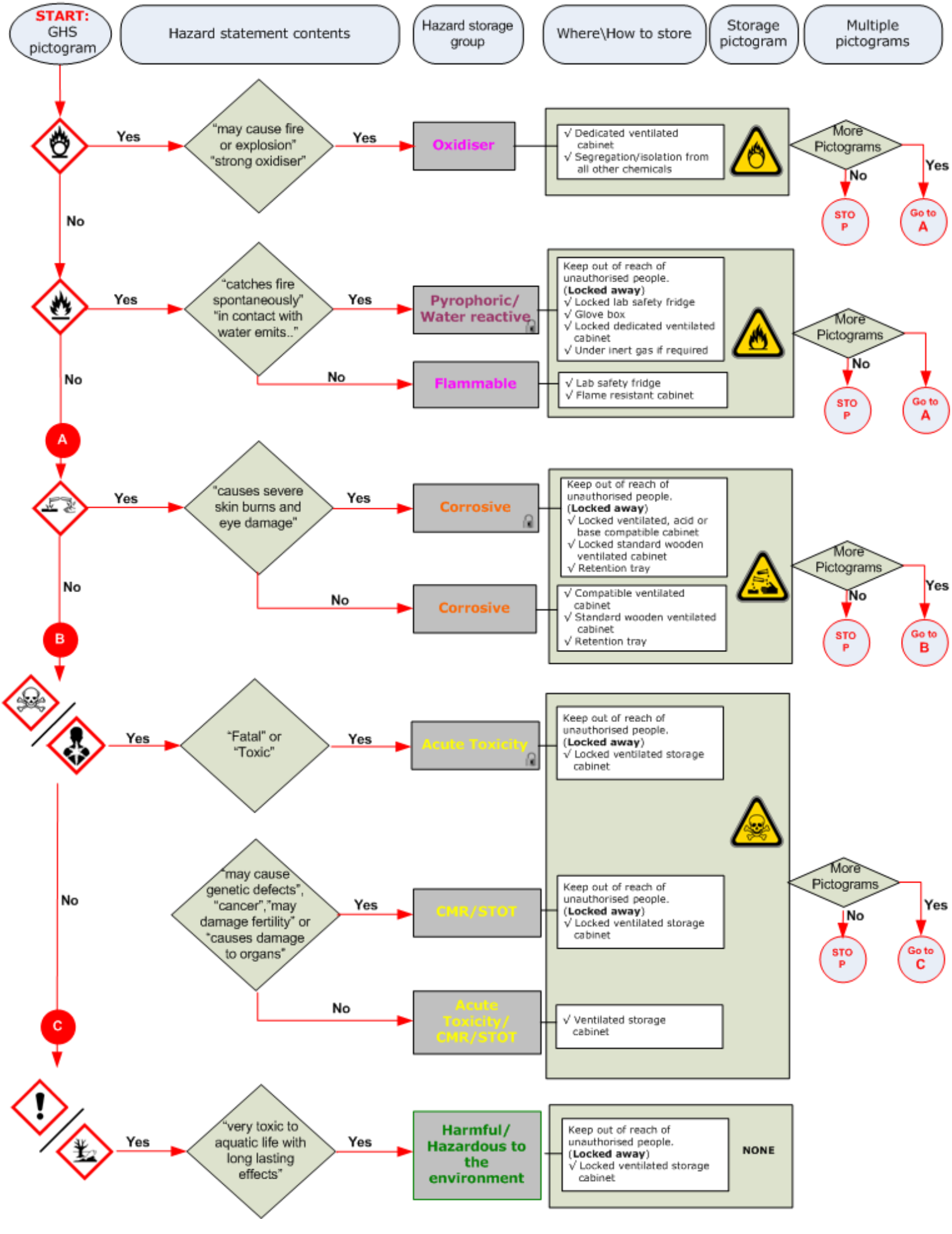
Remove gloves before leaving the laboratory and entering common use spaces such as elevators or corridors outside your laboratory. Use an appropriate secondary container when transporting materials through common use areas. Remove gloves before using the telephone or touching other common use surfaces in you laboratory. Always wash your hands with soap and water after removing gloves and before leaving the laboratory.

Flowchart for general Lab Storage of chemicals using GHS pictograms and flowchart arrows

From START, move downward until you reach the GHS pictogram you have on the label and then follow the flowchart instructions

* Separate solid from liquid * Do not sort and store chemicals alphabetically unless they have first been separated into hazard groups * Always close the caps * Store liquid chemicals below eye level * Keep bottles in the upright position * Do not store chemicals on benches or inside fume hoods * Do not stockpile chemicals * Return chemicals to their storage location when not in use * Post a chemical compatibility chart in the lab and next to chemical storage rooms for reference * Use retention tray for liquids * **Do not hesitate to contact ACE if you need any help.**

* CMR = Carcinogenic, mutagenic, repro-toxic * STOT = Specific target organ toxicity



CHEMICAL SEGREGATION

Class of Chemicals	Common chemical Examples	Additional Concerns and storage Recommendations	Common Incompatible Chemical Types	Possible Reaction if Mixed/Health Concerns
Corrosive Acids – Organic 	Acetic Acid Acetic Acid glacial Butyric Acid Formic Acid Picric Acid Propionic Acid Trifluoroacetic Acid	Store in ventilated corrosives cabinet on protective shelving using secondary containment, keep away from water sources. *Do not store under the sink. *Do not store acids on metal shelving	Bases Cyanides Flammable Liquids Flammable Solids Inorganic Acids Oxidizers Poisons/Toxins Sulphides	Gas Generation Heat Violent Reaction *DO NOT POUR WATER INTO ACID
Corrosive Acids – Inorganic 	Chromic Acid Hydrochloric Acid Hydrofluoric Acid Nitric Acid Orthophosphoric Acid Perchloric Acid	Store concentrated Nitric Acid (≥68%) and Sulphuric acid (≥ 93%) in a secondary container. Store in a corrosive cabinet labelled "Acid" or on shelving using a secondary containment *Do not store under the sink *Do not store acids on metal shelving * Hydrofluoric acid should be stored in an area accessible only by authorized personnel; do not store in glass; use plastic containers and secondary containment	Bases Cyanides Flammable Liquids Flammable Solids Organic Acids Oxidizers Poisons/Toxins Sulphides	Gas Generation Heat Violent Reaction *DO NOT POUR WATER INTO ACID *Hydrofluoric Acid can result in severe burns to skin and lungs *Perchloric Acid vapour can form explosive compounds within fume ducts
Corrosive Bases-Organic/ Caustic 	Diamine Hydroxylamine Tetramethyethylamine Triethylamine	Store in a separate cabinet, preferably with ventilation, corrosive cabinet or storage area with a spill tray, away from potential water sources (Do not store under the sink)	Acids Flammable Liquids Flammable Solids Organic Bases Oxidizers Poisons/Toxins	Gas Generation Heat Violent Reaction

Corrosive Bases-Inorganic/ Caustic 	Ammonium Hydroxide Calcium Hydroxide Potassium Hydroxide Sodium Hydroxide	Store in a separate cabinet, preferably with ventilation, corrosive cabinet or storage area with a spill tray, away from potential water sources (Do not store under the sink); Store solutions of inorganic hydroxides in labelled polyethylene containers	Acids Flammable Liquids Flammable Solids Organic Bases Oxidizers Poisons/Toxins	Gas Generation Heat Violent Reaction
Flammable Solids 	Carbon Charcoal Magnesium Paraformaldehyde Phosphorus	Keep in a dry, cool area away from corrosives and oxidizers	Acids Bases Oxidizers Poisons/Toxins	Fire Hazard Violent Reaction
Flammable Liquids 	Acetic Acid glacial Acetone Acetonitrile Benzene Diethyl Ether Ethanol Ethyl Acetate Methanol Tetrahydrofuran Toluene	Flammable storage cabinet or refrigerator rated for flammable/hazardous storage/explosion proof *Peroxide-forming chemicals must be dated upon delivery and opening (two dates)	Acids Bases Oxidizers Poisons/Toxins Reactives	Fire Hazard Heat Violent Reaction
Poisons/Toxins 	Acrylamide Carbon Tetrachloride Cadmium Chloroform Cyanides Ethyl Bromide Formamide Formic Acid Hydrofluoric Acid 2-Mercaptoethanol Mercury Osmium Oxalic Acid Phenol Sodium Azide	Store in dark, dry, ventilated, cool area in an unbreakable chemically resistant secondary container (polyethylene) *Store volatile toxins with evaporation rate above 1.0- (ether =1.0) in flammable cabinet; *Store non-volatile liquid poisons in a refrigerator or cabinet; amounts less than 1 liter can be stored in a cabinet above bench level. Only if the cabinet has sliding doors (not swinging)	Acids Bases Corrosives Flammable Liquids Hydrofluoric acid should be stored in an area accessible only by authorized personnel; do not store in glass; use plastic containers and secondary containment Oxidizers Poisons/Toxins Reactives	Combustion Explosion hazard Fire Hazard Generation of Toxic and Flammable Gas Heat Violent Reaction Chloroform explosively reacts with chemically-reactive metals (e.g. Aluminium or Magnesium powder, Sodium and Lithium) Strong Caustics (eg. Alkalis) and decomposes in sunlight Strong Oxidizers

Explosives 	Ammonium Nitrate Benzoyl Peroxide Diazoisobutylnitrile Nitro urea Picric Acid Tri-nitroaniline Tri-nitrobenzene Tri-nitrobenzoic Acid Tri-nitrophenol Urea nitrate	Store in a secure location away from other chemicals; store in an area away from friction or shock	Always consult the Safety Data Sheet (SDS)	Heat Shock Violent Reaction
Oxidizers 	Ammonium Persulphate Benzoyl Peroxide Bromates Chlorates Ethyl Acetate Ferric Chloride Iodine Nitrates Perchlorates Permanganates Peroxides Potassium Dichromate Sodium Hypochlorite Superperoxides	Store in secondary containment separately from combustibles and flammable materials	Combustibles Flammables Organic Materials Reducing Agents	Fire Hazard Gas Generation Toxic Gas
Peroxide Formers 	Acetaldehyde Acetyls & Ketals, especially Cylic Ethers and those with primary and/or secondary Alkyl groups Acrylonitrile Benzaldehyde Butylated Hydroxytoluene Diethyl Ether 1,4-Dioxan Isopropyl Alcohol Isopropyl Ether Tetrahydrofuran Vinyl Vinylidene	Store in airtight bottles, away from light and heat in a dark, cool dry area; avoid using containers with loose-fitting lids and ground glass stoppers; crystallization, discolouration, and formation or deposition of layers are signs a peroxide former may have become shock sensitive; do not use or move such containers but contact necessary authorities; all bottles of peroxide forming chemicals must have the received date marked on the container; when the bottle is first opened, the container must be marked with the date opened	Always consult the Safety Data Sheet (SDS)	Combustion (Exothermic Reaction) Explosion Hazard Shock Sensitive Violent Reaction

Water Reactive	Alkali Metal Hydrides Borohydride Lithium Metal Potassium Metal Sodium Metal	Store in a dry, cool area away from potential spray from fire sprinklers and other water sources (DO NOT store under the sink) Label this area for water-reactive storage	Aqueous solutions Oxidizers Always consult the Safety Data Sheet (SDS)	Heat Violent Reaction
Strong reducing Agents	Acetyl Chloride Ferrous Sulphide Maleic Anhydride Thionyl Chloride	Store in a cool, dry, well-ventilated location. Segregate from all other chemicals Water reactive	Always consult the Safety Data Sheet (SDS)	Always consult the Safety Data Sheet (SDS)
Carcinogens 	Benzene Benzidine Beta-Naphthylamine Carbon tetrachloride Dichloromethane	Label all containers as "Cancer Suspect Agents" or the equivalent. Store according to the hazardous nature of the chemical, using appropriate security when necessary	Always consult the Safety Data Sheet (SDS)	Always consult the Safety Data Sheet (SDS)
Teratogens 	Aniline Benzene Lead Compounds Mercury Compounds	Label all containers as "Suspect reproductive Hazard" or "Reproductive Effecter" Store according to the hazardous nature of the chemical using appropriate security where necessary	Always consult the Safety Data Sheet (SDS) Aniline incompatible with Nitric Acid and Hydrogen Peroxide	Always consult the Safety Data Sheet (SDS)
General Stock Chemicals	Agar Most non-reactive salts Salt buffer Sodium Chloride Sodium Hydrogen Carbonate	Store on shelves, or laboratory benches or shelving, preferably behind glass doors and below eye level with like chemicals	Always consult the Safety Data Sheet (SDS)	Always consult the Safety Data Sheet (SDS)

CHEMICAL COMPATABILITY CHART

RED = Incompatible **Green = Compatible**

	Group Number/ Chemical Type	1 Inorganic Acids	2 Organic Acids	3 Caustics	4 Amines & Alkanolamines	5 Halogenated Compounds	6 Alcohols & Glycols	7 Aldehydes	8 Ketones	9 Saturated Hydrocarbons	10 Aromatic Hydrocarbons	11 Olefins	12 Petroleum Oils	13 Esters	14 Monomers, Polymerizable Esters	15 Phenols	16 Alkylene Oxides	17 Cyanohydrins	18 Nitriles	19 Ammonia	20 Halogens	21 Ethers	22 Phosphorus
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22	Phosphorus																						

GROUP#	NAME	EXAMPLES
1	Inorganic Acids	Hydrochloric acid, Hydrofluoric acid, Nitric acid, Orthophosphoric acid, Sulphuric acid
2	Organic Acids	Acetic acid, Butyric acid, Formic acid, Propionic acid
3	Caustics	Ammonium hydroxide solution, Sodium hydroxide
4	Amines and Alkanolamines	Aniline, Aminoethanolamine, Diethanolamine, Diethylamine, Dimethylamine, Ethylenediamine, Monoethanolamine, Pyridine, Triethylenetetramine
5	Halogenated Compounds	Allyl chloride, Carbon tetrachloride, Chlorobenzene, Chloroform, Dichloromethane, Monochlorodifluoromethane, 1,2,4-Trichlorobenzene, 1,1,1-Trichloroethane, Trichloroethylene, Trichlorofluoromethane
6	Alcohols and Glycols	Iso-Amyl alcohol, 1,4-Butanediol, Butyl alcohols, Diethylene glycol, Ethanediol, Ethanol, Ethyl butanol, Furfuryl alcohol, Methanol, Propan-1,2-Diol
7	Aldehydes	Acetone, Acetophenone, Crotonaldehyde, Formaldehyde, Furfural, Paraformaldehyde, Propionaldehyde
8	Ketones	Butane, Butanone, Cyclohexane, 2,6-Dimethylheptan-4-one
9	Saturated Hydrocarbons	Benzene, Ethane, Heptane, Paraffin's, Paraffin wax, Pentane, Petroleum Ether
10	Aromatic Hydrocarbons	Cumene, Ethyl benzene, Naphthalene, Toluene, Xylene
11	Olefins	Butylene, 1-Decene, 1-Dodecene, Ethylene, Turpentine
12	Petroleum Oils	Gasoline, Mineral oil
13	Esters	Amyl acetate, Butyl acetate, Castor oil, Dimethyl sulphate, Ethyl acetate
14	Monomers	Acrylates, Acrylic acid, Acrylonitrile, Butadiene, Polymerizable esters
15	Phenols	Carbolic acid, Cresols, Phenol
16	Alkylene Oxides	Ethylene oxide, Propylene oxide
17	Cyanohydrins	Acetone cyanohydrin, Ethylene cyanohydrin
18	Nitriles	Acetonitrile, Adiponitrile
19	Ammonia	Ammonium hydroxide, Ammonia gas
20	Halogens	Chlorine, Fluorine
21	Ethers	Diethyl ether, Tetrahydrofuran
22	Phosphorus	Phosphorus, Elemental

Incompatibile Groups:

Acidic and Alkaline; Acidic and Cyanide; Acidic and Flammable; Acidic and Reactive Cyanides; Acidic and Spontaneously Combustible; Acids & Nitrates; Ammoniated Compounds and Hypochlorites; Organics and Oxidizers; Organic Nitrates/Perchlorates and other Oxidizers or Metals; Azides and Metals, Metal Salts, Acids, Strong Oxidizers, Halogens. Perchloric Acid and Metals, Metal Salts, Charcoal, Ethers, Organics, Combustibles, Acids.