1 Introduction

This document offers a short and concise overview of incompatible chemicals. Understanding the following content is a crucial prerequisite in understanding basic safety fundamentals such as 1) hazard awareness, 2) engineering controls, 3) work practices, 4) PPE and 5) emergency response for handling and storing incompatible chemicals.

2 Scope

The guideline applies to lab personnel, and it has been developed to assist them in the preparation of lab specific SOPs.

3 Procedure

3.1 Incompatible chemicals

Substances in the left-hand column should be stored and handled so they cannot contact corresponding substances in the right-hand column. The following list contains some of the chemicals commonly found in laboratories, but it should not be considered exhaustive. Information for the specific chemical you are using can usually be found in the "REACTIVITY" or "INCOMPATIBILITIES" section of the Material Safety Data Sheet.

Alkaline and alkaline earth metals, such as Sodium, Potassium, Cesium, Lithium, Magnesium, Calcium		Carbon dioxide, Carbon tetrachloride and other chlorinated hydrocarbons, any free acid or halogen. Do not use water, foam or dry chemical on fires involving these metals.
Acetic acid		Chromic acid, Nitric acid, hydroxyl compounds, Ethylene glycol, Perchloric acid, peroxides, permanganates
Acetic anhydride		Chromic acid, Nitric acid, hydroxyl-containing compounds, Ethylene glycol, Perchloric acid, peroxides and permanganates

Acetone		Concentrated Nitric and Sulfuric acid mixtures
Acetylene		Copper, Silver, Mercury and halogens, Fluorine, Chlorine, Bromine
Alkali & alkaline earth metals (such as powdered Aluminum or Magnesium, Calcium, Lithium, Sodium, Potassium)		Water, Carbon tetrachloride or other chlorinated hydrocarbons, Carbon dioxide, and halogens
Aluminum alkyls		Halogenated hydrocarbons, water
Ammonia (anhydrous)		Silver, Mercury, Chlorine, Calcium hypochlorite, Iodine, Bromine, Hydrogen fluoride, Chlorine dioxide, Hydrofluoric acid (anhydrous)
Ammonium nitrate		Acids, metal powders, flammable liquids, chlorates, nitrites, Sulfur, finely divided organics or combustibles
Aniline		Nitric acid, Hydrogen peroxide
Arsenical materials		Any reducing agent
Azides		Acids
Benzoyl peroxide		Chloroform, organic materials

Bromine		Ammonia, Acetylene, Butadiene, Butane and other petroleum gases, Sodium carbide, Turpentine, Benzene and finely divided metals, Methane, Propane, Hydrogen
Calcium carbide		Water (see also Acetylene)
Calcium hypochlorite		Methyl carbitol, Phenol, Glycerol, Nitromethane, Iron oxide, Ammonia, activated carbon
Calcium oxide		Water
Carbon, activated		Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride		Sodium
Chlorates		Ammonium salts, acids, metal powders, Sulfur, finely divided organics or combustibles
Chlorine		Ammonia, Acetylene, Butadiene, Butane, Propane, and other petroleum gases, Hydrogen, Sodium carbide, Turpentine, Benzene and finely divided metals, Methane
Chlorine dioxide		Ammonia, Methane, Phosphine and Hydrogen sulfide
Chlorosulfonic acid		Organic materials, water, powdered metals

Chromic acid & Chromium trioxide		Acetic acid, Naphthalene, Camphor, Glycerin, Turpentine, alcohol and other flammable liquids, paper or cellulose
Copper		Acetylene, Hydrogen peroxide, Ethylene oxide
Cumene hydroperoxide		Acids, organic or mineral
Cyanides		Acids
Ethylene oxide		Acids, bases, Copper, Magnesium perchlorate
Flammable liquids		Ammonium nitrate, Chromic acid, Hydrogen peroxide, Nitric acid, Sodium peroxide, halogens
Fluorine		Almost all oxidizable substances
Hydrocarbons (such as Bromine, Butane)		Fluorine, Chlorine, Chromic acid, Sodium peroxide
Hydrocyanic acid		Nitric acid, alkalis
Hydrofluoric acid (anhydrous)		Ammonia (aqueous or anhydrous)
Hydrogen peroxide		Copper, Chromium, Iron, most metals or their salts, any flammable liquid, combustible

		materials, Aniline, Nitromethane, alcohols, Acetone, organic materials, Aniline
Hydrides		Water, air, Carbon dioxide, chlorinated hydrocarbons
Hydrofluoric acid, anhydrous (Hydrogen fluoride)		Ammonia (anhydrous or aqueous), organic peroxides
Hydrogen sulfide		Fuming Nitric acid, oxidizing gases
Hydrocarbons (Benzene, Butane, Propane, Gasoline, Turpentine, etc.)		Fluorine, Chlorine, Bromine, Chromic acid, Sodium peroxide, fuming Nitric acid
Hydroxylamine		Barium oxide, Lead dioxide, Phosphorus pentachloride and trichloride, Zinc, Potassium dichromate
Hypochlorites		Acids, activated Carbon
Iodine		Acetylene, Ammonia (anhydrous or aqueous), Hydrogen
Maleic anhydride		Sodium hydroxide, Pyridine and other tertiary amines
Mercury		Acetylene, Fulminic acid, Ammonia, Oxalic acid
Nitrates		Acids, metal powders, flammable liquids, chlorates, sulfur, finely divided organics or combustibles, Sulfuric acid

Nitric acid (concentrated)		Acetic acid, Aniline, Chromic acid, Hydrocyanic acid, Hydrogen sulfide, flammable liquids, flammable gases, nitratable substances, organic peroxides, chlorates, Copper, brass, any heavy metals
Nitroparaffins		Inorganic bases, amines
Oxygen		Oil, grease, Hydrogen, flammable liquids, solids, or gases
Oxalic acid		Silver, mercury, organic peroxides
Perchlorates		Acids
Perchloric acid		Acetic anhydride, Bismuth and its alloys, alcohol, paper, wood, grease, oil, organic amines or antioxidants
Peroxides, organic		Acids (organic or mineral); avoid friction, store cold
Phosphorus (white)		Air, Oxygen, alkalis, reducing agents
Phosphorus pentoxide		Propargyl alcohol
Potassium		Carbon tetrachloride, Carbon dioxide, water

Potassium chlorate		Acids, Sulfuric acid (see also chlorates)
Potassium perchlorate		Sulfuric & other acids (see also Perchloric acid, & chlorates)
Potassium permanganate		Glycerin, Ethylene glycol, Benzaldehyde, any free acid, Sulfuric acid
Selenides		Reducing agents
Silver		Acetylene, Oxalic acid, Tartaric acid, Fulminic acid, ammonium compounds
Sodium		Carbon tetrachloride, Carbon dioxide, water. See alkaline metals (above)
Sodium amide		Air, water
Sodium nitrate		Ammonium nitrate and other ammonium salts
Sodium oxide		Water, any free acid
Sodium peroxide		Any oxidizable substance, such as Ethanol, Methanol, glacial Acetic acid, Acetic anhydride, Benzaldehyde, Carbon disulfide, Glycerine, Ethylene glycol, Ethyl acetate, Methyl acetate and Furfural

Sulfides		Acids
Sulfuric acid		Chlorates, perchlorates, permanganates, organic peroxides. Potassium chlorate, Potassium perchlorate, Potassium permanganate (similar compounds of light metals, such as Sodium, Lithium)
Tellurides		Reducing agents
UDMH (1,1-Dimethylhydrazine)		Oxidizing agents such as Hydrogen peroxide and fuming Nitric acid
Zirconium		Prohibit water, Carbon tetrachloride, foam and dry chemical on zirconium fires

3.2 Chemical Segregation Scheme

All Hazard Classes must be segregated from other Hazard Classes

- Class – must segregate from other Classes within Hazard Class
    - Group – recommend segregating from other groups within Class

Hazard Class 1 - Explosives (potentially explosive)

Hazard Class 2 - Compressed Gases / Lecture Bottles

- Class 2.1 - Flammable gases
- Class 2.2 - Non-Flammable gases
- Class 2.3 - Poisonous gases
- Oxidizing gases (separate from everything)
- Corrosive – acids
- Corrosive – bases
- Cryogenics
- Pyrophorics

Hazard Class 3 - Flammable liquids

- Combustible liquids (that do not have another hazard)

Hazard Class 4 - Flammable solids

- Class 4.1 - Flammable solids
- Class 4.2 - Spontaneously combustible
- Class 4.3 - Dangerous When Wet

Hazard Class 5 - Oxidizers

- Class 5.1 - Oxidizers
    - Liquids
    - Solids
- Class 5.2 - Organic peroxides

Hazard Class 6 - Poisons

- Class 6.1 - Poisons
    - Liquids
    - Solids
    - Carcinogens
    - Reproductive hazards (Teratogens, Mutagens)
    - Irritants
    - Organic acids, solid
    - Nonhazardous chemicals
- Poison Inhalation Hazards (PIH)
- Cyanides
- Controlled substances
- Class 6.2 - Biohazards – Infectious agents
    - CDC Select agents

Hazard Class 7 - Radioactives

Hazard Class 8 - Corrosives

- Inorganic acids
- Oxidizing acids (Nitric acid and Perchloric acid)
- Hydrofluoric acid
- Organic acids, liquid (can store in flammable cabinet)
- Bases
    - Liquids
    - Solids

Hazard Class 9 – Miscellaneous

- For KAUST segregation purposes, these materials can be stored with Hazard Class 6 - Poisons

4 References

- OSHA 3404-11R (2011) – Laboratory Safety Guidance
- KAUST Laboratory Safety Manual
- HSE-RST-Chem001M – Chemical Safety Program
- Prudent Practices in the Laboratory, National Research Council, 2011

5 Help

Questions about this guideline? Contact: hse@kaust.edu.sa