This Information Sheet provides guidance to enable the correct identification and assessment of the hazards associated with the use of a single chemical and / or chemicals used in combination.

General Information

Everywhere we look chemicals are used, for example, clothes, food, health care, and before this in the research needed to create and / or to ensure the chemical's safe inclusion in such products.

Many chemicals are relatively harmless and can be used without significant risk. However, some are inherently dangerous and whilst some of the nastier chemicals may produce an odour to warn of danger, the majority do not.

To help identify ***'what is hot and what is not'***, Legislation requires chemical producers to label their products and provide information on the hazards associated with the chemical. Information can be found on product labels and in Material Safety Data Sheets (MSDS), eg Sigma-Aldrich / Alfa Aesar.

Before using any chemical, always look at the product label for the following warning symbols. *But remember the Classification, Labelling and Packing (CLP) Regulations come into full effect on 1st June 2015. Hazard Symbols changed and Safety and Risk Phrases were replaced with Hazard and Precautionary Statements*.

Warning Symbols (new CLP symbols in red) - *See Info Sheet 8 for further information*

Old Definition	Old Symbol	New CLP Symbol	New CLP Number / Definition
TOXIC / VERY TOXIC / HARMFUL: Substances that can cause death or serious illness if even a small amount enters the body (by ingestion, inhalation, skin contact)			GHS-06: ○ Acute toxicity (Cat 1 - 3)
HARMFUL: Substances that can cause illness by ingestion, inhalation or skin contact **IRRITANT:** Substances which can cause inflammation of the skin, mucous membrane or irritation of the respiratory tract			GHS-07 (New): ○ Acute toxicity (Cat 4) ○ Skin and eye irritation ○ Skin sensitisation specific target organ toxicity ○ Respiratory tract irritation ○ Narcotic effects

Old Definition	Old Symbol	New CLP Symbol	New CLP Number / Definition
NO PREVIOUS CATEGORY: Closest match Irritant / Toxic	 		GHS-08 (New): ○ Respiratory sensitisation ○ Germ cell mutagenicity ○ Carcinogenicity ○ Reproductive toxicity specific target organ toxicity ○ Aspiration hazard
CORROSIVE: Substances that can destroy living tissue. Cause damage quickly and can react violently with water or certain metals eg concentrated acids			GHS-05: ○ Corrosive to metals ○ Skin corrosion ○ Severe eye damage
EXPLOSIVE: Substances that can explode when exposed to heat, flame or other sources of ignition. Very sensitive to shock or friction. Usually more dangerous when dry			GHS-01: ○ Explosives ○ Self-reactive substances and mixtures types A, B ○ Organic peroxides, types A,B
OXIDISING: Substances that produce a lot of oxygen and possibly heat in contact with other substances, particularly flammable substances			GHS-03: ○ Oxidising gases, liquids and solids
HIGHLY / EXTREMELY FLAMMABLE: Substances that can ignite spontaneously in air or react with water or damp air to produce dangerous quantities of flammable gas. They can also ignite in the presence of sources of ignition including static or heat			GHS-02: ○ Flammable gases, aerosols, liquids or solids ○ Self-reactive substances and mixtures ○ Pyrophoric liquids and solids Self-heating substances and mixtures ○ Substances and mixtures, which in contact with water emit flammable gases ○ Organic peroxides

Old Definition	Old Symbol	New CLP Symbol	New CLP Number / Definition
DANGEROUS FOR THE ENVIRONMENT: Chemicals that may present an immediate or delayed danger to one or more components of the environment			GHS-09: ○ Hazardous to the aquatic environment
			GHS-04 (New): ○ Compressed gases, liquids and solids ○ Liquefied gases ○ Refrigerated liquefied gases ○ Dissolved gases
CRYOGENS: Substances that boil at extremely low temperatures which are used to keep things cold. Commonly used cryogens include liquid nitrogen. Contact with cryogens can cause severe damage to tissues. Also risk of asphyxiation		The same	

Product labels are only the starting point. **ALWAYS** look beyond them for the following reasons:

1. **Old Chemicals:** Although the University has done a lot of work to get rid of redundant stocks, old chemicals may still appear. These may not have any labels or labels that are out of date or which can no longer be read.
2. **All Relevant Information:** Although labels give you a good idea about the chemical hazards they won't tell you:
   a. If the chemical has particular hazardous properties that require special precautions to be taken eg carcinogens, teratogens, mutagens.
   b. How the chemical will react when mixed with another chemical.
   c. How the chemical will react if exposed to air, moisture, heat.
   d. About specific needs eg PPE which could differ dependent on how you are using / processing the chemical.

Chemical Reactions

What is a chemical reaction?

Chemical Reaction: ***A process in which a substance decomposes, combines with other substances or interchanges with other substances.***

Before working with chemicals, assess if a reaction could occur when you mix any chemicals together. Common types of reaction that pose a health and safety risk include:

- **Exothermic:** Reactions that give out heat energy.
- **Synergistic:** The combined effect is greater than if each chemical was administered alone. For example, 2 + 2 = 20.
- **Potentiation:** The first harmless chemical enhances the effect of the second, eg 0 + 2 = 10.

Of these reactions, exothermic causes the most concern as it can lead to **Runaway Reactions**:

Runaway Reaction: ***When the heat produced exceeds the heat removed. The surplus heat raises the temperature of the reaction mass, causing the reaction rate to speed up to a point where the chemical reaction can no longer be controlled.***

An approximate rule of thumb - heat generation doubles with every 10°C rise in temperature.

In general most chemicals can be used safely. However there are some which appear to be perfectly safe but which if not handled correctly. For example if heated above its flash point or mixed with another chemical, will react, creating harmful by-products such as fire, explosion and toxic gases. All of which can harm people, the environment and cause damage to property or other assets.

Such uncontrolled reactions can cause:

- Boiling over of the reaction mass.
- Explosions.
- Fire.
- Toxic gases / vapours / fumes.

Fire caused by a runaway reaction

Winchester jar exploded due to severe over pressure caused by rapid gas generation

BEFORE handling any chemicals:

- **RESEARCH** to understand the task, hazards associated with the chemical(s) and the necessary controls. Especially if using a mixture.
- **NEVER** rush.
- **MAKE SURE** you have everything you need to hand.
- **CHECK** equipment is clean. Contaminants can act as catalysts, causing unexpected reactions.
- **IF IN DOUBT** ask your Academic Supervisor or Lab Technician.

Finding out about Chemical Hazards

Always carry out thorough research pre-experiment in order to assess the hazards associated with a chemical(s). The following are useful sources of information:

- Product labels as discussed.
- Material Safety Data Sheets (MSDS) which are usually provided by the chemical supplier / manufacturer.
- Useful MSDS sources for chemical hazard data are Sigma-Aldrich or Alfa Aesar.

MSDSs were required by the old Chemical Hazard Information & Packing Supply (CHIP) Regs that required suppliers to classify substances and give users information based on a specified classification scheme. They now fall under the scope of the Registration, Evaluation, Authorisation & Restriction of Chemicals (REACH) Regs.

NOTE: *1st June 2015 CHIP was replaced by the Classification, Labelling & Packaging of Substances and Mixtures (CLP) Regs. Symbols changed and Risk and Safety Phrases were replaced with Hazard and Precautionary Statements.*

MATERIALS SAFETY DATA SHEET (MSDS)

Ethanol (C_2H_5OH)

MSDS Number	NCP/P/1
Version number	Version 2.0
Date issued	3rd May 2012
Next Review date	May 2014
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COMPANY DETAILS

Name :	NCP Alcohols	**Emergency telephone No.**:	+27 (31) 579 2004
Address :	121 Sea Cow lake Road, Durban, 4001, South Africa	**Telephone** :	+27 (31) 560 1111
		Fax :	+27 (31) 579 2776

1. Product and Company Identification

(Page 1 may be used as an emergency safety data sheet)

Trade name	: Ethanol (Industrial, Absolute or Anhydrous, Rum, Light Spirits, Extra Neutral Potable, Neutral Potable, Rectified Extra Neutral and High Purity Extra Neutral Potable Alcohol)	Chemical abstract No.	: 64-17-5
		Molecular Mass	: 46,08
Chemical family	: Aliphatic Alcohol	NIOSH No.	: KQ 6300000
Chemical name	: Ethanol	Hazchem code	: 2(S) E; 3(S) E
Synonyms	: Ethyl Alcohol, See Trade name	UN No.	: 1170

2. Composition:

Hazardous components	: Ethyl Alcohol (75.0 – 99.9%v/v)
EEC classification	: 200 – 578 – 6 [30]
R Phrases	: R11 (Highly Flammable)

3. Hazards Identification:

Main Hazard	: Harmful if swallowed or inhaled. Possible aspiration hazard if swallowed (can enter lungs and cause damage). May be irritating to the skin, eyes and respiratory tract. Over exposure may cause CNS depression. Possible reproductive hazard.
Flammability	: Flash Point 12°C. Extremely flammable liquid (R11). Ignition temperature 425°C.
Chemical Hazard	: Ethanol is a flammable liquid whose vapours can form ignitable and explosive mixtures with air at normal room temperatures. Thus, an aqueous mixture containing 30% ethanol can produce a flammable mixture of vapour and air at 29°C, and even one containing only 5% alcohol can produce a flammable mixture at 62°C.[1] Ethanol reacts vigorously with a wide range of oxidizing materials and other chemicals[2] .e.g. Disulphuryl Difluoride, Silver Nitrate, Bromine Pentafluoride, Potassium Perchlorate, Nitrosyl Perchlorate, Chromyl Chloride, Chloryl Perchloride, Uranyl Perchlorite, Chromium Trioxide, Fluorine Nitrate, Dioxygen Difluoride, Uranium Hexafluoride, Iodine Heptafluoride, Tetrachlorosilane, Permanganic acid, Nitric acid [the nitric acid fizz reaction used formally for cleaning laboratory glassware should not be used[3,5]], Hydrogen Peroxide, Peroxodisulphuric acid, Potassium Dioxide, Sodium Peroxide, Potassium Permanganate, Ruthenium (VIII) Oxide, Platinum, Potassium[6], Potassium *tert* – Butoxide, Silver Oxide and Sodium[7].

MSDS Headings include:

- **Hazard Identification:** Routes of entry into the body.
- **Handling and Storage:** Incompatible materials, special storage needs.
- **First Aid Measures:** What to do and what not to do if someone is exposed to the chemical.
- **Fire Fighting:** Extinguishers to use in a fire, requirements for breathing apparatus etc.

COSHH Assessment

As part of any research into the chemicals to be used also consider:

- **Any activity that may affect the chemicals behaviour eg heating or stirring.**
- **Compatibility when mixing chemicals eg will an exothermic reaction or one that produces large amounts of gas occur.**
- **The concentration and amount of chemical used.**
- **Its form eg liquid, powder, solid.**
- **Routes of entry into the body eg inhalation.**
- **The Lab environment. Is it hot, is it well-ventilated.**
- **Vulnerable persons eg expectant mothers, asthmatics.**

Temperatures and Fire

At certain temperatures some chemicals ignite leading to fire and / or explosion. This must be considered when preparing a COSHH Assessment. Information is usually included on the MSDS - lookout for the following terms:

- **Flash Point:** The lowest temperature at which sufficient vapour is produced to form an ignitable mixture.
- **Fire Point:** The lowest temperature at which, the heat produced will enable combustion to continue after a substance is ignited.
- **Auto Ignition:** The lowest temperature at which a substance will ignite spontaneously and will burn without an ignition source.

Ignition points vary greatly and do not just include high temperatures. The term 'Flammable' often causes confusion as it is not always used. The four categories are:

1. **Flammable:** Flash point between 22^{o}C and 55^{o}C. The liquid usually needs to be heated to give off an ignitable vapour eg. diesel, paraffin, methyl alcohol, isopropanol, xylene.
2. **Highly & Extremely Flammable:** Flash point of less than 21^{o}C and readily ignites within normal temperature ranges, giving off an ignitable vapour in normal circumstances eg. acetone, methanol, methyl ethyl ether.
3. **Combustible Liquids:** All liquids with a flash point above 55^{o}C eg. phenol, pine or linseed oil.
4. **Inflammable:** Has the same meaning as *Flammable*.

Chemical Compatibility

The improper storage or mixing of chemicals can also cause serious accidents due to violent reactions between incompatible chemicals.

Information Sheet 4 - Chemical Compatibility provides further information on common laboratory chemicals found at the University and the mixing and storing of chemicals together.

But **REMEMBER** this list only includes common chemicals found at the University. **ALWAYS** refer to the COSHH Assessment and supporting MSDS information before storing or mixing chemicals. And if in doubt **ASK FOR HELP.**