1.0 OBJECTIVE

This document provides guidelines for handling hazardous chemicals in Physics Department.

2.0 SCOPE

This guideline applies to all laboratories and workshop in Department of Physics.

3.0 RESPONSIBILITIES

3.1 The principle Investigators (PI), Laboratory Technologist, Laboratory Managers, Scientific officers, research staff and students shall be responsible for proper handling of hazardous chemicals substances in accordance with the applicable MSDS/local legislation and other requirement.

3.2 All users handling chemicals and chemical waste must attend faculty safety induction and related trainings by OSHE.

4.0 DEFINITION

Hazardous Chemicals can cause harm when they enter the body in sufficient amounts via inhalation, ingestion, injection or skin absorption.

5.0 PROCEDURES

CONTROL MEASURES (Adapted from NUS Laboratory Chemical Safety Manual Chapter 7)

Hazardous substances can cause harm when they enter the body in sufficient amounts via inhalation, ingestion, injection or skin absorption. Therefore, suitable control measures must be implemented to minimize exposure so as to safeguard the safety and health of workers. The nature of the hazardous chemical and the routes by which it enters the body determine the type of controls that are needed. These control measures can take the form of engineering measures, safe work practices, administrative measures and personal protective equipment (PPE).
5.1 Engineering Control

5.1.1 Elimination/ Substitution

The most effective way of keeping hazards at bay is by eliminating the use of the chemicals totally or by substituting the toxic chemical to a less toxic chemical, which will not comprise the result of work to be carried out. However, it may not be advisable to substitute a toxic but non-flammable solvent with a less toxic but flammable compound and vice versa.

General principles for substitution of chemicals:

a. Volatile solvents with low boiling points and high vapour pressures should be substituted with solvents having high boiling points and low vapour pressures.
b. Toxic substances with low permissible exposure levels should be substituted with less toxic substances having higher permissible exposure levels, taking into account the effect and target organ that will be affected.
c. Liquids with low flash points should as far as possible be substituted with liquids having higher flash points or no flash point to minimise or prevent fire risk.
d. Materials in fine powder should be substituted with substances in granular, pellet or other bulk solid forms to reduce or prevent inhalation hazards.
e. Chemicals in liquid form should be substituted with chemicals in paste, gelatinous or other viscous liquid to reduce exposure hazards.

5.1.2 Isolation/ Segregation

Hazardous or potentially hazardous operations should be isolated or segregated to minimise the number of people that will be exposed to the chemicals. Such process can be achieved by carrying out the work in an isolated area away from the rest of the lab process or in a separate room away from the main work area.

5.1.3 Local Exhaust Ventilation

Properly exhausted fume hoods, other local exhaust ventilation must be used when there is a likelihood of excessive exposure to air contaminants generated by laboratory activity. Used in conjunction with good work practices, properly designed and operated exhaust ventilation is effective in minimizing air contaminant exposure.

5.2 Administrative Control

Administrative controls are work procedures such as safety policies, rules, supervision, Standard Operating Procedures (SOP), placement of proper signs and
labels at the appropriate places in the laboratory and training in order to reduce the duration, frequency, and severity of exposure (via inhalation and physical contact) to hazardous chemicals.

5.2.1 Signs and Labels

Signs, labels, and other postings are also classified as administrative controls. Their presence in the laboratory provides workers and visitors with critical information concerning hazards present in that laboratory.

The Globally Harmonised System (GHS) is developed to have a globally harmonised system to classify and label chemicals according to their hazard and create a labelling system base on pictogram universally understandable. The list of pictogram used to represent the different group of chemical hazard can be found in the table below.

**Workplace GHS Pictogram**
5.2.2 Training

Training is yet another example of an administrative control. Principal Investigators or Laboratory Technologist are responsible for training the rest of the lab staff or research students the proper operations of all equipment, performance of laboratory procedures and recognizing and dealing with other hazards in the workplace. For the different category of safety training offered by NUS, please refer to section 3.2.1 of this manual.

5.3 Personal Protective Equipment (PPE)

The use of personal protective equipment (PPE) is necessary when feasible engineering and administrative controls are unavailable or if there is a need to supplement those controls. It should never be considered as a first priority in minimising chemical exposure. Selection of PPE should be based on the type of chemicals used and the MSDS could also provide information on the types of PPE required.

The following types of PPE are used to minimize inhalation and physical contact exposures:

Eye and face protection: Safety glasses, chemical splash goggles and face shields. (Note: Wearing of eye-protection goggle is mandatory in labs with chemicals unless it has a letter of exemption).

Protective clothing: Lab coats, aprons, arm covers, and closed-toe shoes. Respiratory protection: Respirators for short-term use or during emergencies may be necessary to supplement existing engineering or administrative controls.

For staff who will be using the respirator in the course of their work, are required to go for the respirator fit test at the UHWC Clinic. The details can be found on OSHE Occupational Health webpage:
It should be noted that PPE will always be the last option to provide protection as it does not eliminate or reduce the hazard. In laboratories, the most appropriate PPE other than goggles, lab coat and closed-toes shoes, will be gloves. Gloves should always be worn by the user when handling hazardous chemicals such as acids, alkalis and any other toxic chemicals that could pose a considerable amount of adverse effect. The type of material for glove, suitable for use when dealing with the various chemical is listed in the glove chart below and the detailed glove type and chemical use can be found on Appendix II. The SOP (OSHE/SOP/GL/08) on “The guidance on selection of PPE can be found in OSHE’s Website: -
https://wws.nus.edu.sg/osh/nus_manuals/guidelines/U_GL_01_PPE.pdf

<table>
<thead>
<tr>
<th>Type</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Use Against</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Rubber</td>
<td>Low cost, Good physical properties, dexterity</td>
<td>Poor for handling of oils, greases, organises</td>
<td>Bases, alcohols, dilute water solutions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May be of poor quality</td>
<td>Provide only fair protection for aldehydes, ketones</td>
</tr>
<tr>
<td>Natural Rubber Blends</td>
<td>Low cost, dexterity, better chemical resistance compared to</td>
<td>Physical properties inferior to that of natural rubber</td>
<td>Same as natural rubber</td>
</tr>
</tbody>
</table>
### 6.0 RECORDS

a. Incident reporting forms

b. Investigation reports

### 7.0 REFERENCE
7.1 NUS Laboratory Chemical Safety Manual

7.2 EPA chemical compatibility chart

7.3 SOP for Transporting of Chemicals, Gas Cylinders and Cryogenic Liquid in Physics Department. (Please refer to Physics Safety Website-Safety Resource).