Safety Manual

6th Edition

(July 2015)

Department of Chemistry

Faculty of Science

Chulalongkorn University

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Safety Policy of the Department of Chemistry

Students and staff of the Department of Chemistry must understand and acknowledge the importance of chemical safety and contribute to a safe laboratory at all times.

Strategic plan	Output	Indicator
1. Provide practical guidelines for chemical safety management including storage, handling, waste disposal, risk assessment and emergency response as a safety manual available on the web site: http://www.chemistry.sc.chula.ac.th/safety/safetymanual.pdf. It is mandatory that all laboratories in the department must keep a hard copy of the safety manual as a reference. The safety manual will be revised every 2-3 years.	The department has clear and practical guidelines for chemical safety management.	Safety manual is comprehensive, up-to-date, and accessible.
2. Organize an annual chemical safety and fire extinguisher training for students and researcher at the beginning of the semester. Only those who pass a safety evaluation test will be permitted to perform research in laboratories. A safety evaluation test will be scheduled annually to encourage a safe environment.	Students and staff have basic knowledge and awareness on the importance of chemical safety.	Students and staffs who study the safety manual and attend safety training pass an annual evaluation test.
3. Monitor and evaluate safety conditions of all research and teaching laboratories by the safety committee and graduate students. The evaluation results will be informed to the person in charge of each laboratory every semester.	All laboratories maintain a safe working environment at all times.	Qualified laboratories report evaluation results and accident report forms to the safety committee.

The Department of Chemistry's Safety Committee
(Name list is available in Appendix 7)

1. Code of Practice for General Safety

1. Wear safety glasses and laboratory coat when working in the laboratory.
2. Protective footwear, covering the toes, the upper surface of the foot and the heel, must be worn when working in the laboratory. Sandals or high-heels over 2 inches are prohibited.
3. Long hair must be tied at the back. Hats, caps, scarves and the like must be removed.
4. Smoking is strictly prohibited in the building.
5. All food and drink must not be stored or consumed in the laboratory, including any activities that might bring about an accidental intake of chemical substances.
6. Unauthorized persons are not allowed in the laboratory without consent from the laboratory supervispor. Those who are allowed must strictly comply with Laboratory's code of practice and should be under supervision of the person in charge at all times.
7. For safety and security reasons, undergraduate students and visiting students are not allowed in the laboratory outside office hours unless given prior consent from the laboratory supervispor and must be under supervision of either the laboratory supervispor or an assigned instructor.
8. Working alone in the laboratory is not permitted for laboratory operators of all levels.
9. When working in the laboratory, all entrances should never be locked.
10. Ensure that the gas isolating valves, water taps, electricity switches are properly turned off after use. Re-check before leaving the laboratory.
11. Any experiment run or left unattended overnight must be clearly marked with emergency procedures and contact details of the responsible laboratory operator. A high-risk experiment to be run overnight must obtain an official permission from the advising professor.
12. It is mandatory that all laboratory operators are aware of safety practice, hazardous chemical protection, possible risks involved, first-aid training, and proper handling of hazardous substances in case of fire and spillage as well as waste disposal management. Researchers of all levels must attend the annual safety training and pass an evaluation test before performing any research. Undergraduate students working in teaching laboratories must pass Chulalongkorn University's online "Chemical Safety Training & Testing" and must work under supervision of a qualified instructor.
13. Never handle any hazardous or toxic chemicals without acquiring proper information on its properties and sufficient precautions from *MSDS* or other reliable sources. If in any doubt, seek guidance from the academic supervisor or Safety Committee members.
14. No experiment can be undertaken without a thorough Risk Assessment.
15. All accidents must be reported in writing to laboratory supervisors and Chairman of the Safety Committee to help prevent similar incidents in the future.
16. All chemical waste disposal must follow the practice in this safety manual.
17. All electrical equipment must be regularly inspected. Switch off and unplug when not in use. Only use an extension cord with 10-Amp fuse wire. Do not overload electrical outlets.
18. Maintain good housekeeping and hygiene in the laboratory at all times. The Safety Committee may randomly inspect all laboratories without prior notice.
19. Take off gloves, laboratory coat and wash your hand thoroughly before leaving the laboratory.
20. For emergency help, contact laboratory supervisors, floor & building supervisors, the Safety Committee members or the security desk of Mahamakut Building (Tel. 0-2218-7500), in a respective order as indicated in this safety manual.

2. General Information

2.1 Building Access

Office Hours of Mahamakut Building (MHMK Bldg.)

Monday - Saturday	06.00–21.00 hrs.
Sunday and public holidays	Closed

Prior consent signed by the advisor and Head of Department is required for any work outside office hours. (The form is available at Administrative Office, Department of Chemistry)

2.2 Chemical Safety Resources

Material Safety Data Sheets (MSDS) could be searched from:

A. Chemicals Manufacturers:

http://www.sigmaaldrich.com

http://www.merck.co.th

B. Other Websites:

http://www.msds.com

http://msds.pcd.go.th

http://www.chemtrack.org

2.3 Useful Telephone Numbers

Numbers	
Head - Department of Chemistry: Assoc.Prof. Dr.Vudichai Parasuk	0-2218-7599
Chairman, the Safety Committee: Prof. Dr. Tirayut Vilaivan	0-2218-7627, 083-986-8772
Secretary, the Safety Committee: Dr. Puttaruksa Varanusupakul	0-2218-7612, 089-188-7043
Building Supervisor (Chem): Asst. Prof. Dr. Soamwadee Chaianansutcharit	0-2218-7602
Building Supervisor (Faculty of Science): Mr. Thongchai Chaoprom	0-2218-5240, 081-772-2611
Security Desk - Mahamakut Building (MHMK)	0-2218-7500
Security Desk - Faculty of Science	0-2218-5022
Security Desk - CU Safety and Traffic Control Center	0-2218-0000
CU Health Service Center	0-2218-0568
Phathumwan Police Station	0-2215-2991-3, 214-1042

Facility: Mahamakut Bldg. (MHMK) Faculty of Science, Chulalongkorn University, Phayathai Rd.

Remark: Emergency report should follow the procedure in Section 6: Accident and Emergency Report

3. Code of Practice for Fire Accident

3.1 Types of Fires

	**Class A** Fires involve ordinary materials such as paper, wood, cloth, rubber and plastics. Most appropriate extinguishing method: water.
	**Class B** Fires entail flammable or combustible liquids such as oil, gasoline, greases, etc. Most appropriate extinguishing method: Foam, dry chemical powder.
	**Class C** Fires involve energized electrical equipment such as appliances, power tools Most appropriate extinguishing method: CO_2, Halon.
	**Class D** Fires encompass combustible metals. Most appropriate extinguishing method: air removal or specialized extinguishing substance depending on the type of metals.

3.2 Types of Fire Extinguishers

3.2.1 Dry Chemical Powder

Dry chemical powder could be classified into two types: ABC and BC

1) **ABC Dry Chemical Powder:** an all-purposed fire extinguisher for common fire situations. It is useful for either class A, B or C. Specifically speaking, ABC could extinguish fires from ordinary materials such as paper, wood and plastic; flammable gas, liquid, oil, grease, kerosene; and electrical apparatus (which might get damaged by the fire extinguishing). In Department of Chemistry's laboratories, this type of extinguisher is found as a red tank, as shown in Figure 1.

Figure 1 ABC Dry Chemical Powder Extinguisher used at the Department of Chemistry

2) **BC Dry Chemical Powder**: an extinguisher exclusively for class B and C, or fires from flammable gas, liquid, oil, grease, kerosene; and electrical apparatus. It is not for class A fires.

3.2.2 Water-based Extinguisher

Suitable for class A (paper, wood, etc.) fires only, not for class B, C and D. This type of fire extinguisher is not available at the Department of Chemistry, but the fire hose reel is installed in the building's ground floor. See Figure 2 for detail.

Figure 2 Fire hose reel at Mahamakut Building

3.2.3 Foam-based Extinguisher

The foam fire extinguisher or AFFF (Aqueous Film Forming Foam) fire extinguisher is suitable for class A and B fires, not for class C as the water content is electricity conductive.

3.2.4 Volatile Liquid-based Extinguisher

The volatile liquid-based extinguisher (contains Halon or similar active ingredients) is suitable for class A, B and C fires (See Figure 3). It leaves no residue and is non-conductive, which is ideal for delicate or expensive apparatus such as electronic devices.

Figure 3 Volatile liquid-based extinguisher used at the Department of Chemistry

3.2.5 Carbon Dioxide Extinguisher

Charged with non-flammable carbon dioxide gas under high pressure, suitable for class B and C fires, but not class A. It is not recommended to use in any electrical short-circuit circumstances. This type of fire extinguisher normally has a black discharge nozzle (horn) to protect the coolness of evaporating carbon dioxide. (See Figure 4.)

Figure 4 Carbon Dioxide Extinguisher used at the Department of Chemistry

3.3 On Discovering a Fire

1) Stay calm and quickly assess all risks involved.
2) If you are confident that you could safely fight the fire, immediately do so. (See 3.4 - 3.5)
3) Use a proper choice of fire extinguisher available for the fire type.
4) Should the initial fire fighting attempt fails, immediately inform the laboratory supervisor and activate the closest fire alarm pull station (Figure 5) by pulling the trigger (locations of fire alarm pull stations are indicated in each floor plan) and follow the evacuation instruction (Section 3.7).

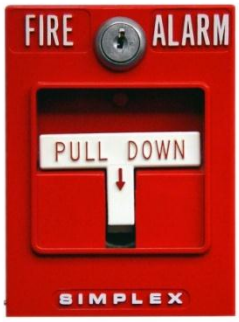


Figure 5 Fire Alarm Pull Stations of Mahamakut Building

3.4 Extinguishing a Fire

1) Identify the source of fire.
2) Turn off the main electrical switch or cutout and gas isolator valves. Also remove flammable items from the area.
3) Extinguish or contain the fire using proper extinguishing agents.
4) If your clothes or body catches fire, lay flat on the floor and roll about. Other people should help covering the body with wet cloth or fire blanket. **DO NOT RUN!**
5) If you are not confident that you could safely fight a fire, **DO NOT** attempt to!

3.5 Using a Fire Extinguisher

1) Acknowledge the fire extinguisher locations at each floor plan. All laboratory operators should recognize all the types of fire extinguishing agents and their closest locations.
2) Stand about 2-4 meters from the fire and follow the instruction in Figure 6.

Remove the nozzle, or horn, from the holder.

Pull the safety pin and tamper seal on the fire extinguisher.

Depress the handle to the bottom and hold tight.

Stay 2-4 meters upwind. Direct the nozzle at the base of the flames.
Sweep left and right.

Figure 6 Using the Fire Extinguisher

3.6 On Hearing a Fire Alarm

Instantly follow the evacuation instruction No. 3.7 without hesitation. Do not wait to see whether it is real or just a drill.

Figure 7 Fire Exit and Evacuation Route Signs of Mahamakut Building

3.7 Evacuation Procedures

1) On hearing the alarm, turn off the main electrical switch, or cutout, as well as gas isolator valves (if present).
2) Quickly evacuate the building through the nearest safe, exit route with Fire Exit Sign (Figure 3). Do not collect any personal belongings. Do not use the main stairs of the building and never use an elevator.
3) In fire evacuation, stay low and cover your face with a soaked towel to prevent smoke smother.
4) Immediately evacuate down the building and gather outside at the assembly point designated for the building.
5) Do not re-enter the building unless authorized by the building supervisor.
6) The fire witness should stay at the assembly point to report the incident to the authorized staff.

Department of Chemistry's assembly point is No.7/1 Anyamanee Bldg. Parking Lot (Behind Mahamakut Bldg.)

Figure 8 Assembly Point No.7/1 Anyamanee Bldg. Parking Lot

3.8 General Practice to Prevent a Fire Accident

Figure 9 Various Sources of Ignition

1) Do not place combustible materials close to any ignition sources (Figure 9).
2) Access to exit passages, corridors, staircases, especially emergency ones, must be clear and free of unnecessary items. If necessary, mark the area with a clear red line and place the items on the inner half (facing the wall).
3) A full fire drill should be held regularly.
4) At least one person with basic fire fighting training background must be designated to each laboratory. (The Department arranges an annual training course on basic fire fighting.)
5) Do not store excessive amount of flammable chemicals, solvents, and gases.
6) Appropriate amount of fire extinguishers must be provided and conspicuously located in the laboratory area that is accessible.
7) All laboratory operators should know all the types of fire extinguishing agents available and their closest locations.
8) Regularly check all fire extinguishers to be in a ready-to-use condition.

9) Unattended reactions that require heating must have a thorough Risk Assessment. The detailed description of the reactions with emergency procedures must be clearly marked.
10) Use only silicone oil for oil bath, or use sand bath. Never use vegetable or mineral oil.
11) Carry out periodic inspections to ensure that electrical appliances are in good conditions. Do not attempt to use equipment that is malfunctioned, broken or in unsafe condition, especially plugs and any equipment with motor.
12) Before leaving the laboratory, always check that all power switches of unused appliances are off and unplugged.
13) If it is necessary to use an extension cord, use a power strip equipped with a 10-Amp fuse wire. Do not use a cable reel.
14) Do not overload electrical outlets (no more than 1000 watt/socket).
15) For damaged electrical appliances, contact the Maintenance and Services Unit of the Chemistry Department (Tel. 02-218-7529) or suppliers/product representatives. Never attempt to adapt or repair them by yourself.
16) Station any heat generated equipment, such as an oven, in a well-ventilated area and on a stand with the height of at least 3 centimeters above the floor.
17) Never leave any combustible materials, such as cloths, plastic, etc., in an oven without close supervision.
18) Never use equipment that may generate flame in the building without a prior permission from the building supervisor.
19) Never place a hot plate near flammable substances or ignition sources. Keep any electrical wire off the hot plate while in use.
20) To heat up flammable substances or any chemicals that have boiling points below 100 $^{\circ}$C, use hot water bath or oil bath. Never use a hot plate directly.
21) Complete risk assessment forms and review all practices with the laboratory supervisor before commencing any experiments that requires a large quantity of flammable reagents/solvents, air-or-water-sensitive substances or relates to any extreme or vigorous exothermic reaction.
22) Be especially careful with disposal of flammable substances. If unsure of its properties, do not pour into water or pour water onto. Always consult the laboratory supervisor.
23) Do not throw away into trash bin any metal powder or other pyrophoric substances. They may catch fire when exposed to air and humidity.
24) Do not flush down the drain any flammable substances, especially when it is water-insoluble and/or present in a large quantity.

4. Code of Practice for Spillage/Leakage

4.1 General Procedures for Spillage/Leakage

1) Remove other people from the affected area.
2) Immediately notify the laboratory supervisor.
3) In case of spillage onto the person, follow the instruction in Section 5. Personal Injuries.
4) Identify the substances leaked or spilled and consult *MSDS* to obtain specific information on spillage procedure and hazard involved.
5) Evaluate all hazard possibilities from leakage/spillage and their cleaning process and prepare for any emergency.
6) Spills must be cleaned up immediately. For highly dangerous substances or if the situation is uncontrollable, evacuate the affected area and immediately notify the laboratory supervisor.
7) A person responsible for cleaning should wear suitable protective equipment, depending on the hazard levels of spilled substances. As a minimum, wear thick rubber gloves and respiratory protection. When dealing with substances emitting toxic vapors, a face mask that cover eyes, nose and mouth must be used.
8) If the cleaning procedures involve water, be careful not to contaminate nearby water resources. However, this depends on the substances, for example, neutralized or diluted acids and bases could be flushed down the drain.
9) When the incident is taken care of, submit the Accident Report Form to Chairman of the Safety Committee, following the instruction in Section 6. Accident and Emergency Report.
10) Each laboratory should have a spill kit to respond to basic chemical spills. The kit should include inert absorbents, neutralizers for acids and bases, thick gloves, shovel and disposal bags to contain the cleanup materials.

4.2 Liquid Spillage

1) Use proper inert absorbents such as chemical-absorbent spill pillows or vermiculite or non-deodorant cat litter (bentonite). Treat cleanup materials as hazardous and dispose them in proper containers. Never use water if the consequences are not fully evaluated.
2) For acid spills, neutralize with sodium hydrogencarbonate ($NaHCO_3$) or Sodium carbonate (Na_2CO_3). For base spills, neutralize with citric acid. Use pH paper/strip to make sure that the solutions is neutralized before disposal.
3) For widespread spills of flammable organic liquids, turn off the electric generator/output or oven nearby to prevent fire accident.
4) Mercury spill needs an immediate attention as its vapor is highly toxic. There are many Mercury cleaning methods. For example, use amalgamation powder to turn mercury into a solid non-vaporizing form, which is easier to collect and dispose. Use powdered sulfur to coat mercury. Or collect the liquid mercury with mercury vacuum cleaner, but never use household vacuum for this purpose because that would instead spread the mercury vapor. Always separate mercury waste from normal waste disposal.

   Remark: As a broken mercury thermometer is the usual cause of mercury spill in the laboratory, it is advisable to use alcohol thermometer and keep mercury ones only for necessity.

4.3 Solid Spillage

1) Hazardous substances, such as reactive or explosive ones, should be strictly handled in accordance with *MSDS* instructions.
2) Non-hazardous substances such as non-toxic metal salts could be collected and disposed off as solid wastes.

4.4 Gas Leakage

1) Turn off the main regulator of the gas supply and immediately notify the laboratory supervisor.
2) For toxic gas leakage, activate the alarm system and evacuate people to a safe distance.
3) If the regulator cannot be controlled, remove the gas cylinder to a ventilated area and let the gas release. For toxic gases, follow the instruction in Table 1.
4) Immediately contact the gas cylinder manufacturer/supplier.
5) If the leakage is near the valve or the regulator, apply the 'contain and divert vapor' technique (Figure 5) and use suitable absorbent or burn away. For water-soluble gases, divert it to a water bucket or spray with water (be careful of potential hazards from the reaction between the gas and water).

Table 1 Techniques for neutralizing/reducing the dangers from small releases of selected toxic gases

Gas	Hazard Reduction Technique
Ammonia, anhydrous	Dissolve in water, using a ratio of 100 litres of water for each litre of released ammonia.
Arsine	Discharge the escaping gas into a solution of potassium permanganate or another strong oxidizer.
Boron trichloride	Discharge the escaping gas into a 15% sodium hydroxide (caustic soda) solution.
Carbon monoxide	Flare off the escaping gas.
Chlorine	Discharge the escaping gas into 15% sodium hydroxide (caustic potash) solution or other strong alkali solution.
Fluorine	Discharge the escaping gas into a 5% to 15% potassium hydroxide (caustic potash) solution.
Fluorocarbons	Reclaim and reuse.
Hydrogen	Vent into the atmosphere.
Hydrogen fluoride	Discharge the escaping gas into a 5% to 15% potassium hydroxide (caustic potash) solution.
Hydrogen sulfide	Discharge the escaping gas into a 10% to 20% sodium hypochlorite solution.
Methyl bromide	Absorb by bubbling the gas into an organic solvent such as ethyl alcohol or toluene.
Nitric oxide	Discharge the gas into a potassium permanganate solution, or into soda lime (a mixture of sodium hydroxide and slaked lime).
Nitrous oxide	Vent into the atmosphere.
Phosgene	Neutralize with agricultural lime (calcium oxide) or crushed limestone (calcium carbonate).
Sulfur dioxide	Discharge into a strong sodium hydroxide (caustic soda) solution.

(Source: J.E. Bowen, Emergency Management of Hazardous Materials Incidents, National Fire Protection Association, 1995)

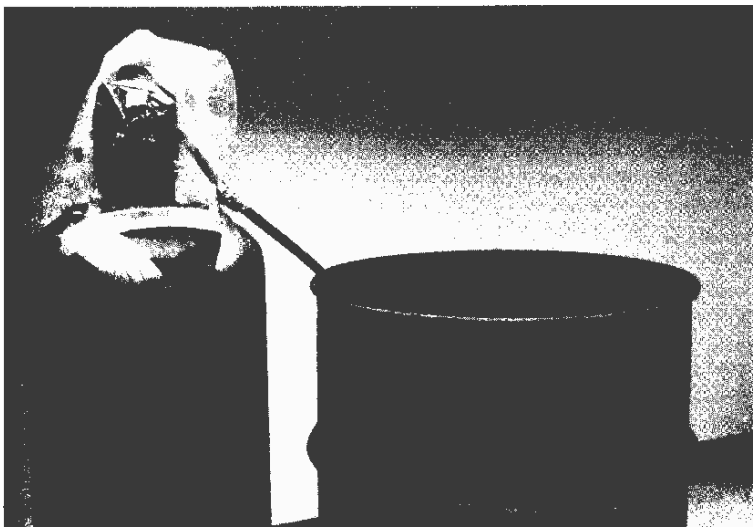


Figure 10 The "contain and divert technique" to Control Gas Leakage

4.5 General Practice to Prevent Chemical Spillage/Leakage

1) Periodically inspect all chemical containers. Change and destroy old, deteriorated containers as appropriate.
2) Have all gas cylinders inspected by experts every six months and keep the telephone numbers of gas distributors and inspectors close to the gas cylinders or telephones in case of emergency.
3) When transporting chemical bottles for a short distance (within the laboratory area), use another hand to support underneath the bottle or use another suitable container to hold the bottle. (See Figure 11.) Do not just hold the bottle neck or handle because it might slip and accidentally fall.

Figure 11 Transporting chemical bottles for a short distance

4) For a long distance transport (out of the laboratory or the chemical store), personal protective equipment is required as well as appropriate containers, such as stainless steel buckets or plastic buckets–both can be obtained from the chemical store, to carry the bottles. Do NOT use basket because it could not prevent spillage if the bottle breaks.
   To transport several bottles that have a chance to break, use suitable cushioning materials.
5) Use stainless steel containers with non-corrosive chemicals such as organic solvents, and use plastic containers with corrosive chemicals like acids.

6) Transportation of large amount of chemicals requires a cart with safety fence. Do not place chemicals directly on the cart but rather use appropriate secondary containers. Be prepared for accidental chemical spill.
7) Transfer of a large quantity of chemicals should be carried out in a suitable fume hood. Emergency plans for spillage/leakage should be prepared. Avoid transferring flammable chemicals near ignition sources.
8) Use only a funnel or beaker or appropriate container to decant liquid from large bottles to smaller containers.
9) The laboratory should have *MSDS* of all chemicals being used as well as personal protective equipment and appropriate spill kit/cleaning devices available in case of emergency.

5. Code of Practice for Personal Injuries

5.1 General Practice to Prevent Personal Accident

1) Laboratory supervisors should provide suitable and suffice personal protective equipment and first-aid kits for the number of laboratory operators and hazard levels involved.
2) Laboratory operators should use suitable personal protective equipment for hazard level of the work to be performed: safety glasses or goggles, laboratory coat, and appropriate footwear (that can fully protect the feet). Long hair should be tied back and properly restrained. Choose suitable gloves on the type of exposure and level of the hazard (consult *MSDS*), but for chemical laboratories, nitrile gloves is preferable to rubber/latex gloves used in medical laboratories.
3) Gaseous or volatile substances that are toxic or have offensive odors must be used in a fume-hood. Appropriate safety mask or respirator is also required.
4) Do not wear laboratory coat and gloves outside the working area, such as public elevator.
5) Never store or consume any food or drink in the laboratory and do not use laboratory reagent containers for food or drink.
6) Nothing shall be stored or left around sink areas for easy emergency access.
7) Safety showers and eye wash stations should be checked regularly and free of non-related items.
8) Children and pets are not allowed in the laboratory. However, working alone is also prohibited.
9) Always wash hands before leaving laboratory.

5.2 Treating Simple Cuts

1) Remove foreign bodies (large splinters, glass, etc.) from the wound.
2) Stop the bleeding by using ice cubes, applying direct firm pressure on the cuts or tying up at blood vessels leading to the cuts, with occasionally loosening to allow blood circulation. **DO NOT** press too long!
3) Wash the wound and dress with appropriate bandage.
4) Larger cuts or serious bleeding should be referred to the CU Health Service Centre or made for direct transport to the emergency unit, Chulalongkorn Hospital.

5.3 Treating Burns Caused by Heat or Fire

1) Flush with very cold water or cover with wet cloth until the burning subsides.
2) Treat with a topical burn ointment or spray.
3) Larger burns should be referred to the CU Heath Service Center or made for direct transport to the emergency unit, Chulalongkorn Hospital

5.4 Spillage onto a Person

1) Any affected clothing should be immediately removed.
2) Thoroughly and immediately wipe out or absorb all traces of contaminant.
3) For water-soluble substances that do not react with water, the affected areas of the skin should be treated with liberal quantities of running water for at least 10 minutes or until it has been thoroughly cleaned. For water-insoluble substances, wash with soap. Use any closest sink or safety shower.
4) For identified substances, follow the specific requirements in the *MSDS* or the following treatment below. For serious spillage, the person involved should immediately seek medical assistance.

For Identified Spilled Substances

1) Acids: Flush the area with a lot of clean water and neutralize with diluted sodium bicarbonate solution
   Safety Note: For concentrated sulfuric acid spillage, use cloth to wipe up or absorb the substance as much as possible before flushing with a lot of clean water.
2) Bases: Flush the area with a lot of clean water and neutralize with diluted acetic acid.
3) Phenol: After washing the affected area with a lot of clean water, apply with bromine-saturated glycerine. Serious phenol absorption may result in (fatal) kidney failure. Immediately refer the injured to the hospital.
4) Hydrofluoric acid: This acid could cause serious pain, although the pain from diluted kinds might not be immediate. Avoid the use of this acid if possible. Any laboratory required to use hydrofluoric acid should make prior emergency arrangement with the medical center. For first aid treatment, wash the spilled area with a large amount of water and rub the wound with calcium gluconate gel 2%. Medical assistance is required for every case of spillage onto the body, no matter how small it seems.

5.5 Spillage into the Eyes

1) Carefully wash at the nearest eye wash station with liberal quantities of water. Occasionally lift lids and hold the eye open during washing, roll the eyes for at least 10 minutes or until they are thoroughly cleaned. Do not neutralize with acids or bases.
2) Immediately refer the person involved to the hospital.

5.6 Inhalation of Toxic Gas

1) Immediately remove the person injured out of affected area. Rescuers must wear adequately and suitably protective equipment, i.e. respirator. Some hazardous gases such as CO, HCN, NO, $COCl_2$ and SO_2 could penetrate through body skin, suitable personal protective equipment should be worn.
2) Loosen clothing. Provide oxygen if available.
3) If unconscious, arrange the person to face down with the face tilted left or right for easy breathing and check if the person stops breathing.
4) If the injured stops breathing, give artificial respiration. Avoid mouth-to-mouth method, especially with HCN inhalation as the rescuer might be intoxicated.
5) Immediately refer the person involved to the nearest hospital.

Accidents from toxic gas inhalation could be prevented by using fume hood. Most toxic gases (except CO) have alarming odors. When such odor is identified, do not continue with the work as your odor sensitivity might be impaired after breathing a certain amount of gas. Inform others if you feel uncomfortable, and alert them of the possible leakage. Then leave for fresh air.

Special Case

For HCN inhalation, provide fresh air and amyl nitrite every 5 minutes. If the injured stops breathing, give artificial respiration. But avoid mouth-to-mouth method. Give heart stimulants if necessary and urgently refer the injured to hospital.

5.7 Accidental Ingestion

1) Strictly follow the *MSDS* instructions. The rule of thumb is to induce vomit so that the substance is immediately removed from the body, either by tickling the back of the throat or drinking concentrated saline solution. Position the victim face-down with the head lower than the hip.
2) There is an exception for an ingestion of corrosive or irritant substances that MSDS suggests not to induce vomit as it might cause more damages. In this case, consuming milk or activated carbon might be of help.
3) For cyanides ingestion, induce vomit and provide amyl nitrite every 2-3 minutes. Also give strong coffee or tea to act as a stimulant.
4) Every chemical ingestion case must seek immediate medical assistance.

For every accidental cases, submit the completed Accident Report Form to Chairman of the Safety Committee, following the instruction in Section 6. Accident and Emergency Report

6. Accident and Emergency Report

6.1 Procedure of Accident and Emergency Report

6.1.1 For Fire Accident

Follow the instruction Section 3. Code of Practice on Fire Accident

6.1.2 For Non-Chemical Accident

Inform security desk of Mahamakut Bldg. (02-218-7500) /Faculty of Science (02-218-5022)

6.1.3 For Chemical Emergency

Contact staff in the following order:

1) The laboratory managers/supervisors whose names and telephone numbers are indicated in the room.
2) For any incident that takes place outside the laboratory or any emergency that might affect other laboratories, also notify floor/department supervisors (Name list is in Appendix 8).
3) If unable to contact the staff in 1-2 or if the situation is beyond control, the staff in 1-2 should alert the Chairman, the Secretary, or any members of the Safety Committee (Name list is in Appendix 7).
4) For serious or uncontrolled incident, notify staff in 1-3 and immediately evacuate.
5) Witnesses must explain the detail of the incident—location, chemicals involved, and other hazardous consequences—to the person in charge in 1-3, at the scene in case of controlled incident, or at other place if the evacuation is required.

The person in charge in 1-2 will assess the situation and decide what action should be done. If the incident could be controlled, submit a written report using Accident Report Form to the Safety Committee. If the incident is deemed uncontrollable, contact the Safety Committee for further consideration. For a serious accident beyond the ability of the Safety Committee to control, contact CU Safety and Traffic Control Center or exterior safety units.

Remark: The accident witnesses should not directly contact the exterior sources by themselves.

6.2 Accident Report Form

Every incident or accident that is unusual for normal laboratory experiment must be reported by

Note: Section 6.2 is now outdated. All accidents reports must go through the university centralized system maintained by SHECU at: https://www.shecu.chula.ac.th/home/content.asp?Cnt=67
Normally the laboratory supervisor should hold the responsibility for reporting accidents to the university. However, unsafe conditions that may lead to accidents can be reported by anyone.

web site: http://www.chemistry.sc.chula.ac.th/ safety/safety.shtml under the menu “Safety Forms > Online Accident Report and Statistics, and will use this as a guideline to prevent similar accident in the future. From July 2015, the new Accident Report Form approved by the Faculty of Science’s Safety Committee must be used (Appendix 1).

6.3 List of Contact Person in case of Emergency

In front of each laboratory in the Department of Chemistry, an up-to-date name list and contact numbers of at least two laboratory supervisors in case of emergency must be clearly posted. Notify the person in the list respectively so that they could make necessary contact with the person in charge.

7. Code of Practice for Safe Use of Equipment and Tools

7.1 Using Gas Cylinders

7.1.1 Gas Cylinder Hazard

Could be derived from one of the following:

1) Gas Pressure: Gas stored in the cylinder is at high pressure. If the valve is broken off (such as by dropping) or if the gas is fed to a closed system without a release channel, the high pressure involved might cause considerable damage.
2) Gas Cylinder: Cylinders are generally heavy. The dropping could result in serious damage and injury. Storing, handing and transporting should be done with care.
3) Gas Nature: Hazards associated with gases vary. Some are flammable (Hydrogen, Butane), others are toxic (chlorine, carbon monoxide). Some gases are non-toxic but can act as asphyxiants by displacing the air (nitrogen, argon).

7.1.2 General Practice on Gas Cylinder Usage

1) While in use, the gas cylinder should be secured in an upright position by belts or chains affixed to a wall.
2) Properly label the gas cylinder and store it in dry, well-ventilated area, away from heat and electric generators.
3) If possible, gas cylinder should be stored or located outside the laboratory with a connecting tube or line for laboratory usage.
4) Cylinders under transport should be mounted in a cylinder trolley with the valve cover in place.
5) Select proper pressure gauges for gas content and make proper connection to outlet of regulator fitting or valve. Do not use excessive force or any lubricants when connecting the cylinder to the regulator/pressure gauge.
6) Before turning on the cylinder valve, ensure that there are ways for the gas to escape.
7) Partially-used gas cylinders without the pressure regulator in place should be protected by the valve cover .
8) Store full and empty cylinders separately with clear identifying labels.
9) For mass storage, keep gas cylinders in a secure storage or rack. If no storage, use, secure them with strong materials (chain, strap) or two-point restraint system.

7.1.3 Emergency Practice

1) Notify the laboratory supervisor or floor/building supervisor.
2) Immediately remove others from the affected areas.
3) Try to turn off main valves, if possible.
4) Identify the gas. Information is usually labeled on the cylinder or at the pressure regulator. Some gases have specific odors, such as ammonia, or could be traced with specific reactions.
5) For non-toxic, non-flammable gas, be careful of asphyxiation as the leaked areas might have lower oxygen level. An artificial respirator is extremely necessary.

6) Be especially careful with ignition sources in the vicinity of leaking flammable gas.
7) For toxic or corrosive gases, the "contain and divert technique" (Figure 5) is necessary to trap leaked gas and divert it to a suitable scrubber.
8) Inform the gas cylinder supplier (Have the telephone numbers close at hand in case of emergency).

7.2 Using Solvent Still

1) Select suitable drying agent for required solvent:
   Use CaH_2 for Hexanes, CH_2Cl_2
   Use Na for Toluene, Ether, THF
2) Left-over sodium should be disposed immediately (use 2-propanol). Leaving it might cause hazardous consequences.
3) For other solvents, consult chemical handbooks such as D. D. Perrin and W. L. F. Amarego, *Purification of Laboratory Chemicals*, 3rd Ed., Pergamon Press, Oxford, 1988.
4) Never use $LiAlH_4$ to dry solvent as the risk involved is too high.
5) Never use Na to dry chlorinated solvent as it might explode.
6) Distillation of a dried solvent should be operated under an inert atmosphere of nitrogen. Before turning on the valve, always make sure that the solvent still has a way for the gas to escape (i.e. not a closed system).
7) Distillation flasks containing residual solvents and drying agents are dangerous. They should have clear labels stating the solvent, the drying agent, and the last date of use. Still operators should take the responsibility for safe disposal of these materials.
8) All solvents should be distilled into a receiver containing an overflow connector when the solvent is fully collected. The volume of the still should be less than the volume of liquid in the distillation flask to prevent accidental drying out which is very dangerous.
9) Solvent stills should never be left running unattended.
10) Disposal of sodium (in THF still)
    - Take the remaining metallic sodium from the still and drop into a big beaker with at least 1/3 full of 2-propanol. Try to add in small pieces and wait until the reaction has ceased before adding more. Repeat the process until no more sodium can be taken out.
    - Pour 2-propanol in the flask to dissolve sodium. (Do not pour down 2-propanol without taking most of the sodium out as an uncontrollable reaction might occur.)
    - Wait until all the sodium metal is destroyed (which might take several hours). Wash the solvent down the sink with lots of water. Small amounts of ethanol could be added to accelerate the dissolution.
    - The remaining 2-propanol containing dissolved sodium should be disposed off as usual (see section 8)
11) Disposal of CaH_2
    - Similar to the disposal of sodium, but use methanol instead (25 mL/g CaH_2) A small quantity of water may be added to accelerate the dissolution.

7.3 Refluxing

1) Always check the correct temperature for the reflux.
2) The size of the heating mantle should fit that of the round bottom flask.

3) Use silicone oil bath for any reflux with temperature lower than 200 $^{\circ}$C. For higher temperature reflux, use sand bath. Do not use vegetable oil or mineral oil.
4) Make sure that the water is running through the condenser at all times. For tap water, the operator must be on the watch, or have automatic heat deactivating system whenever the water stops running, or use circulating water pump. Any accidental block of the water flow during the reflux will result in solvent loss, which leads to damages to the experiment and other hazardous consequences.
5) For any reflux to be left unattended, tightly secure all tube connections with a copper wiring to prevent the tubes from bursting off from the condenser. Details of the reaction and emergency response information must be clearly attached.
6) Unattended overnight reflux should be avoided. If possible, switch off the heat and resume on the next day.

7.4 Reactions that Require Special Attention and Risk Assessment

1) Large-scale reactions

2) Reactions using water- or air-sensitive compounds
   Alkali metals (Li, Na, K)
   Fine metal powders (Pd, Ni, Al, Zn)
   $LiAlH_4$, NaH and other metal hydrides
   RLi, RMgX, LDA and other organometallic compounds
   Acid halides such as PCl_3, $POCl_3$, $SOCl_2$, acetyl chloride

3) Reactions using vigorous oxidizers or explosive compounds
   Azides
   Organic peroxides
   Chlorates and perchlorates
   Hydrogen peroxide (> 35%)
   Concentrate nitric acid
   Diazomethane

4) Reactions using highly toxic compounds
   Arsenic compounds
   Mercury compounds
   Lead compounds
   Cadmium compounds
   Cyanides

5) Reactions using carcinogenic or other compounds that generate other irreversible effects
   Nickel compounds
   Formaldehyde
   Benzidines
   Naphthylamines
   Acrylamide
   Acrylonitrile
   Epichlorohydrin and epoxides

Benzene
HMPTA
1, 2-Dibromoethane
Dimethyl sulfate
Alkyl halides, sulfate, sulfonates, especially alkyl iodides and reactive halides
N-Nitroso compounds
Hydrazine and derivatives

6) Reactions carried out under unusually high or low pressures
7) Reactions involving radioactive substances
8) Reactions involving hydrogen gas
9) Reactions involving incompatible compounds, such as acid-base (concentrated or in large quantity), oxidizing and reducing agents
10) Heated reactions that will continue for a long period, such as overnight reactions or reactions to be left unattended

7.5 Risk Level and Guideline for Risk Assessment

Prior to beginning any laboratory procedure that is "a reaction that requires special attention" as described in 7.4, laboratory operators should perform a risk assessment in a Risk Assessment Form (Appendix 2). The Form should be signed by both operating and supervising parties. The laboratory supervisor should keep one copy of the completed form. The laboratory operator should keep another copy by having it fixed with the laboratory notebook, ready for immediate submission to the person in charge in case of emergency. For the reaction experiments 1-10 in Section 7.4, another copy must be attached where the reactions take place for a proper course of action in case of emergency.

7.5.1 Experiments with Level A Risk

The experiments with level A risk include:

1) Reactions that use air-sensitive or water-sensitive substances at a scale higher than 10 mmol
2) Hydrogenation reactions at a scale higher than 10 mmol
3) Reactions involving explosive, highly toxic, carcinogenic ~~substances~~, or other substances that have long term/irreversible effect in any quantities
4) Reactions involving radioactive substances
5) Reactions under atmospheric pressure of higher than 5 atm or less than 1 mmHg (except drying and vacuum distillation).

The experiments with level A risk must be approved and signed by the laboratory supervisor and supervised by the laboratory supervisor or a designated personnel.

7.5.2 Experiments with Level B Risk

The experiments with level B risk include the reactions that could be classified in categories 1-10 of Section 7.4, but exclusive from level A risks.

The laboratory supervisor or designated personnel should sign the Risk Assessment Form. The experiment should be supervised by the laboratory supervisor or designated personnel.

7.6 The Use of Fume Hood, Personal Protective Equipment and Other Safety Equipment

7.6.1 Fume Hood

Fume hood helps protect lab operators from chemical vapor and offensive smell. Guideline to use fume hood effectively is as follows:

1) Work with hazardous chemicals or chemicals with offensive smell in fume hood whenever possible.
2) Keep the fume hood clean and clear of unnecessary chemicals, equipment and belongings.
3) Make sure that the sash is open to a proper operating level, i.e. keep it at lowest possible position during use for the most effective suction power of the hood.
4) The laboratory's fume hood should be serviced and monitored for air flow regularly.
5) Never extend your head inside a fume hood for any reason.

7.6.2 Personal Protective Equipment (PPE)

PPE is the last shield to protect the laboratory operators from chemical contact.

1) Eye protection
   - Safety glasses: protect or reduce the chance of hazardous chemicals entering the eyes. This is a minimally required PPE in all chemical laboratories. Safety glasses are designed to have plastic side shields, which normal prescription eyeglasses could not be used as a substitute.
   - Safety goggles: provide better protection than safety glasses with pliable flange that seals around the eyes snugly, but one disadvantage is that the lens might fog up. Choosing between safety goggles or safety glasses depends on the risk involved in the experiment. For example, preparing large amounts of acidic solution has a higher chance of splashing, safety goggles are more suitable than safety glasses.
   - For higher risk tasks (such as potentially explosive experiments), other protective equipment, i.e. face shield, should be used in addition to safety glasses/goggles.
2) Laboratory coat
   - Apart from dirt protection, laboratory coat helps reduce the danger of fire and spillage as it could be taken off immediately in emergency cases. It is another minimally required PPE in all chemical laboratories.
3) Gloves
   - Using gloves depends on the amount and hazard of chemicals to be contacted. Always consult *MSDS* or the laboratory supervisor for recommendation.
   - There are many types of standard gloves to be used depending on the hazard level of chemicals. For example, rubber/latex gloves are not suitable for handling corrosive substances or organic solvents. Nitrile gloves are good for general chemicals except some solvents, i.e. dichloromethane (DCM). Check with *MSDS* or the laboratory supervisor.

- Bear in mind that used gloves are likely to be contaminated. Do not leave the laboratory while wearing the gloves and do not touch items such as doorknobs, water tap handle, computer keyboard or mobile phone with gloved hands.
- Carefully remove the gloves to avoid touching the exterior of the gloves which is probably contaminated.
- Never reuse disposable gloves.
- Used gloves should be disposed as combustible waste.

7.6.3 Other Protective Equipment

Other important protective equipment includes safety shower and eye wash stations. Both should be fixed in an easy access area with unobstructed path and ready to be used at all time. Check on water flow and quality on a regular basis, preferably every week.

8. Chemical Laboratory Waste Disposal Guideline

Chemical waste is all left-over substances in chemical laboratories: unknown chemicals, expired or deteriorated chemicals, spilled chemicals that were collected, organic solvents. In other words, everything that is no longer useful in the laboratory and must be disposed in some ways is considered hazardous waste.

The following symbols indicate the control level of waste from chemical laboratory.

✓ => Disposable

 => Treat required before disposing

 => Submit for proper disposal

8.1 Reusing and Recycling

The most effective laboratory waste management strategy involves waste minimization by careful planning of all experimental procedures. Waste recycling and reusing must be the first option for all waste items before any disposal, by using the following guidelines:

1) Any single solvent that contains little other volatile impurities, such as solvent from the rotary evaporator or acetone used to clean glassware, could be collected and reused after a proper fractional distillation. Although the process is complicated and energy-consuming, it is worth considering with a large amount of solvent.
2) Any chemicals suspected of being deteriorated should be tested before disposal.
   For example, metal salts that are highly soluble in water always absorb atmospheric moisture and might appear saturated, but the chemical properties do not change.
   They might possibly be usable for some kinds of experiments that do not require exact concentrations such as qualitative analyses.
3) Old or expired chemicals that seemed deteriorated could be purified by proper methods. The purification process can be found in reference handbooks such as D. D. Perrin and W. L. F. Amarego, *Purification of Laboratory Chemicals*, 3rd Ed., Pergamon Press, Oxford, 1988.
4) Unidentified chemicals or chemicals with removed or faded labels that are still in good conditions should be tested for identity using a simple qualitative analysis. Every laboratory unit should try its best to identify the substance before labeling it unidentified waste as the cost of unidentified chemical waste disposal is extremely high.
5) Bottles or containers of known non-hazardous chemical waste should be thoroughly washed. Containers of volatile organic solvents (boiling point below 100 °C) can be reused or used for other hazardous chemicals after leaving the solvents to evaporate in the fume hood. Those to be disposed or used outside the laboratory should be labeled as washed and clean.
6) Reusing chemicals could help save money two-folded; <u>one from the unnecessary acquisition of new chemicals and another from the disposal.</u>

8.2 Guideline for Self-Organized Waste Management

Some kinds of waste from chemical laboratory are not considered hazardous. Even some hazardous waste, after being pre-treated, might be disposed or eliminated in a normal process.

8.2.1 Waste Bin

The following guideline helps decide which items should be thrown down the waste bin:

✓ Ready to be disposed to waste bin:

1) Used filter paper that has no organic solvents and/or toxic, corrosive, oxidizing or flammable substances
2) Drying agents such as Na_2SO_4 and $MgSO_4$ that have no organic solvents and/or toxic, corrosive, oxidizing or flammable substances
3) Non-hazardous salts: any salts of neither heavy metal ions nor harmful anion such as nitrate, perchlorate and cyanides, etc.

✋ Think before disposing:

1) Non-hazardous and water-miscible liquid waste, including chemicals that might absorb atmospheric moisture and look liquid-like, could be flushed down the drain and followed by a large amount of water (consult *MSDS* first!). Hazardous liquids, however, must be sorted and separated and submitted for proper disposal.
2) For clean, broken glassware from chemical laboratories, separate the repairable broken glasses such as ground glass joint or glasses with minor cracks. The rest should be kept in covered cardboard provided by the Department of Chemistry for proper disposal arrangement. Do not mix with regular garbage.
3) Broken glasses that are contaminated should be disposed separately as non-combustible solid waste.
4) Sharp metal pieces such as razor blades and needles should be disposed in covered cardboard or plastic boxes. Do not mix with regular garbage.

☠ The following must be collected and submitted for proper disposal process.

Never throw into trash bin.

1) Unused silica gel or alumina from column chromatography or its lefts-over should be left in fume hood so that the vapor of such organic solvents would be exhausted.
2) Broken glasses from chemically contaminated laboratory experiments such as unclean droppers, chemically contaminated glassware, and unclean bottles containing hazardous chemicals.
3) All solid waste that are contaminated with organic solvents and/or toxic, corrosive, oxidizing or flammable chemicals.
4) Solid waste with heavy metal contamination.

8.2.2 Sewer/Drain

The following items could be flushed down the drain with large amounts of water afterwards:

✓ Certain materials are suitable for drain disposal:

1) Less than 50 mL of water-miscible organic solvents that are non-toxic, such as glycerol or ethanol that contain no impurity of other toxic substances.
2) A small amount of water-miscible organic and non-organic substances that are not highly toxic, for example, those used in semi-micro qualitative analysis.
3) Diluted acidic or basic solutions (<10 %) with the volume less than 1 Litre. For concentrated solutions, any small quantity should be diluted before flushing while large quantity should be neutralized before flushing.

4) Solutions with metal ions that are not highly toxic such as Fe, Al, Mn, Zn and/or alkaline, alkaline earth ions except Be^{2+} and Ba^{2+}.

The following must be properly treated before disposing or submitting for proper disposal process. It should be stored to reach significant quantity, such as at the end of the semester.

- Acids-Bases

  Substances include: Aqueous solutions of mineral acids/bases with no heavy metal contamination.

  Disposal: Neutralize with sodium bicarbonate (acid) or acetic acid (base) before flushing down the drain with a large amount of water. The most economical and effective method is using other acidic or basic waste for neutralization. (Beware of highly exothermic reaction when performing a large scale neutralization)

- Cyanides

  Substances include: Cyanide salts of alkali and alkaline earth metal ions, cyanide complexes such as $K_3Fe(CN)_6$ and organic cyanide that can release HCN such as cyanohydrin, trimethylsilyl cyanide (TMSCN) but do not include nitrile compounds (R-CN or Ar-CN).

  Disposal: Cyanides could be destroyed by oxidization, for example, reacting with hypochlorite solution under basic conditions. Detect free cyanide ion by using Prussian Blue Test. Those with negative results can be disposed of as aqueous waste.

- Air and/or Water Reactive Substances

  Substances include: 1. Acid halide, anhydrous inorganic halide such as PCl_5, $SOCl_2$, $POCl_3$, $AlCl_3$, BF_3
  2. Metal hydride (CaH_2, $LiAlH_4$, NaH)
  3. Alkali metals (Li, Na, K)
  4. Organometallic reagent such as BuLi, Grignard reagent

  Disposal: Decompose by reacting with water (HX/H_2 emission must be performed in fume hood!) or alcohol and, if necessary, neutralize before washing down the drain. Dispose lithium aluminium hydride ($LiAlH_4$) by reacting with ethyl acetate. As the reaction would not result in H_2 gas formation, the risk from fire hazard is thus not likely.

- Sulfides or Thiols

  Substances include: 1. Organic sulfide
  2. Thiols (mercaptans)

  Disposal: Destroy with oxidization. Like cyanides, react it with hypochlorite in basic condition (high pH).

- Oxidants

  Substances include: 1. Organic peroxide
  2. Inorganic/hydrogen peroxide

	3. Chromate/dichromates
	4. Permanganates
Disposal	Destroy with reducing agent. Study for special techniques designated to each oxidants from the reference handbooks.

☠ The following must be stored for proper disposal process. Never flush down the drain even in small quantities.

1) Oil and other petrochemical products.
2) Non water-miscible organic solvents.
3) Chlorinated organic solvents.
4) Organic solvents that are water-soluble but highly toxic (TLV < 100 ppm) such as methanol, dioxane, acetonitrile.
5) Phenol and derivatives such as cresol, resorcinol.
6) Solutions containing heavy metal ions, especially highly toxic substances, such as Cr, Cu, Ba, Pb, Ni, As, Cd, Hg in any oxidation state.

8.3 Guideline for Laboratory Waste Submission to Central Waste Storage for Disposal (WasteTrack)

8.3.1 Guideline for Waste Management

- For identified compounds:
  1) Follow the separate instructions in 8.3.2 for identified compounds.
  2) For expired or deteriorated chemicals that could no longer be used, properly destroy and separately dispose in accordance with waste classification in 8.3.2. Heavy metal compounds should be disposed as solid waste if possible. In this case, throwing away the whole bottle is considered safer, even if it consumes more space.
- For unidentified compounds:
  1) For usable chemicals with removed or faded labels, try to analyze and identify chemical properties by using a proper qualitative analysis or appropriate spectroscopic techniques.
  2) For waste chemicals, try to categorize them by testing their properties as follows; (See Figure 12 for details)

- Waste Classification Test

Use only a small amount of substances for the test and wear suitable personal protective equipment: gloves, coat, goggles, safety shield and/or face shield and respirator. All chemicals should be treated as highly hazardous. Always remember that danger might incur from an event as insignificant as opening a bottle. The test should be in the following order:

1) Physical appearances
2) Reaction with water: Slowly put the substance drop-wise into water and observe the reactions, e.g. temperature, gas emission, or flame.
3) Solubility: If there is no reaction with water, observe further for the solubility of the substance. For a non-soluble substance, note whether it is lighter or heavier than water. For example, most halogenated organic solvents are usually heavier than water.

4) pH: For soluble or partially soluble substance, measure the pH of solution.
5) Flammability: Put 5-6 drops of the substance on crucible lids. Ignite and observe the characteristics of flame.
6) Oxidizing agents: Put a small amount of the substance in 10% sodium iodide solution acidified with 1 M HCl or test with starch-iodide paper after acidified with 1 M HCl.
7) Inorganic sulfide: For a soluble substance with pH>10, test for sulfide by adding 2-3 droplets of concentrated HCl and test for gas formation by using filter paper strips soaked in lead(II) acetate (Perform in the fume hood!).
8) Inorganic cyanide: For a water soluble substance with pH>10, test for cyanide using Prussian Blue Test.
9) Halogen: Burn a clean copper wire until it becomes red-hot with colorless flame. Dip the wire in the substance and burn it again. If the substance has halogen compound, the flame will become greenish. Other elements such as N, S, P could also result in greenish flame.

Remark:

- Substances that could be identified should be sorted as suggested in Section 8.3.2, or properly treated before disposal.
- Only really unidentified substances should be treated as unidentified hazardous waste. Be fully aware that the disposing cost of unidentified waste is far higher than identified ones. (Keep in mind that WasteTrack does not accept unidentified waste.)

With the WasteTrack system of waste classification up and running, unidentified waste should no longer exist at the Department of Chemistry. Any laboratory producing such waste must be responsible for its analysis, identification and safe disposal.

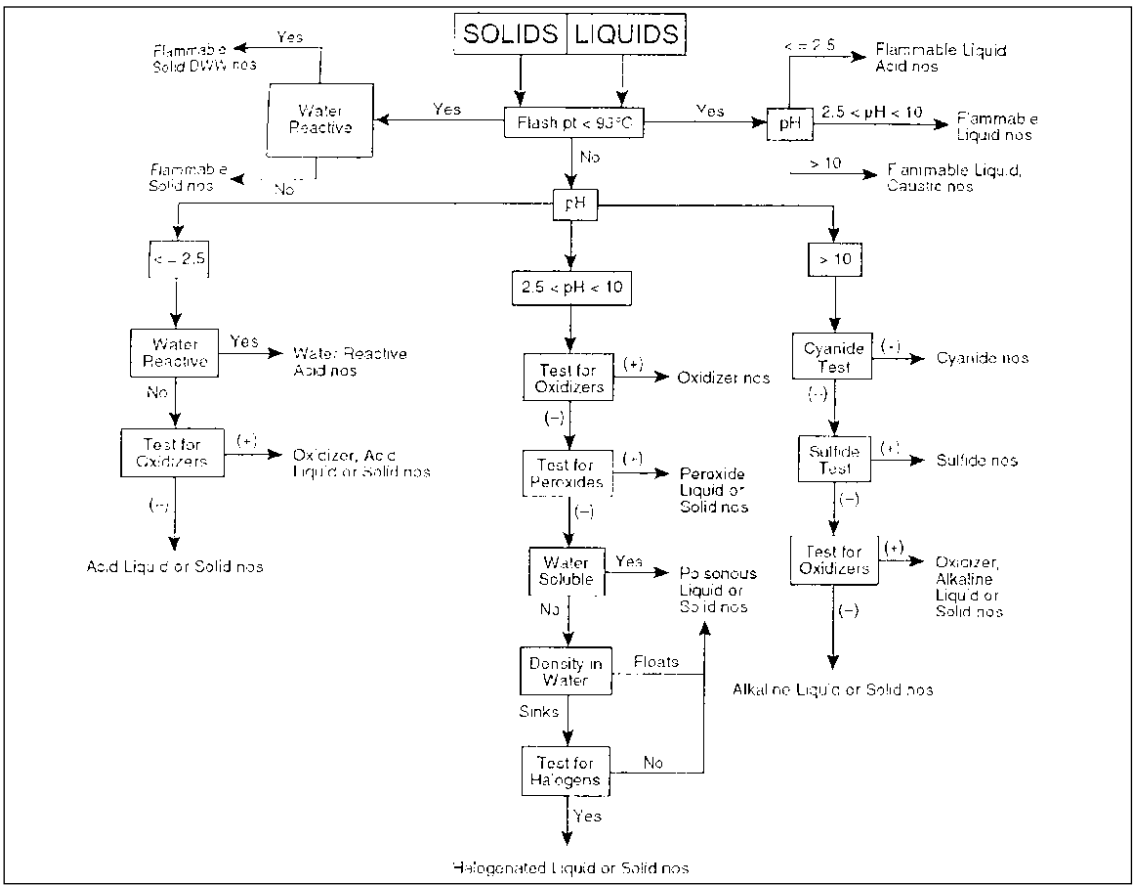


Figure 12 Guideline for chemical waste categorization (Source: Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, National Academy Press, 1995.)

8.3.2 Classification of Hazardous Waste

Follow the provision in Chulalongkorn University's Central Waste Disposal System (Wastetrack: http://chemtrack.chula.ac.th/wastetrack), which classifies hazardous waste into 14 categories (I-XIV) as follows:

I Special waste (that could not be classified into II-XIV such as mixture of organic substance and water)

II Cyanide waste (in any state)

III Oxidizing aqueous waste except chromate/dichromate

IV Mercury waste (in any state)

V Aqueous waste containing chromate/dichromate

VI Aqueous waste containing heavy metal

VII Acidic aqueous waste

VIII Basic aqueous waste

IX Liquid waste from petroleum products and hydrocarbon

X Oxygenated inorganic liquid waste

XI Organic liquid waste containing NPS (Nitrogen, Phosphorus, Sulfur)

XII Halogenated liquid waste

XIII a) Combustible Solid b) Non-combustible Solid

XIV Aqueous waste with organic or non-toxic salt less than 5 percent

Guideline for classification should be considered according to the Flowchart in Figure 13

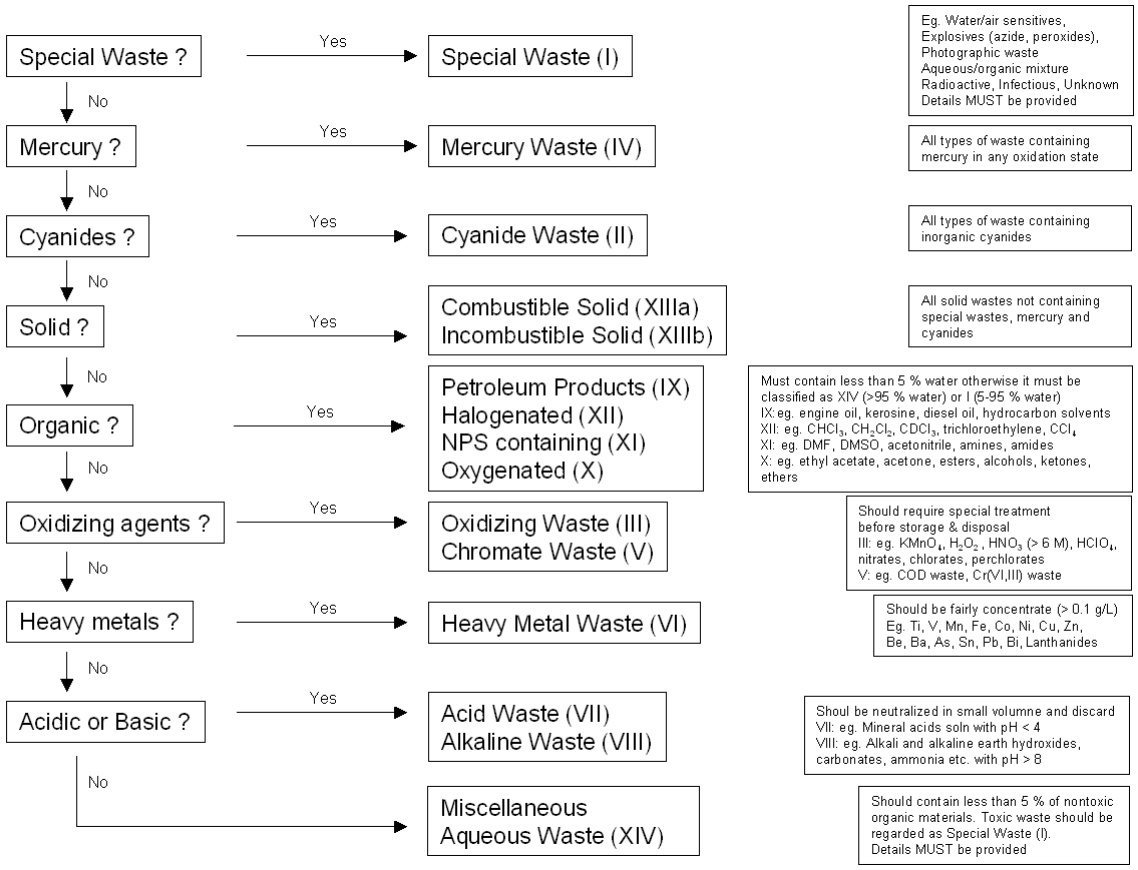


Figure 13 WasteTrack Classification of Hazardous Waste

Remarks:

1) Do not mix chemical wastes from different categories. Handle them separately (using guideline in the above flowchart, Figure 13), such as water-organic solvents; chlorinated or non-chlorinated solvents; mercury and other heavy metal waste; waste with cyanides and without cyanides, etc.
2) Any mixed chemicals must be classified as a more hazardous class. For example, if a cyanide waste is mixed with a non-cyanide waste, the mixture should be treated as cyanide waste (which has higher disposal cost). Generation of a waste mixture that contains water and organic solvent in the range of 5-95% should be avoided since it will be classified as special waste.
3) For reverse phase HPLC solvent, classification can be done by considering its component. If water is a major component, the mixture should be treated as miscellaneous aqueous waste (XIV). If organic solvent is a major component, the waste will be treated according to that organic solvent such as methanol-Oxygenated (X), acetonitrile-NPS (XI).
4) Mixing waste from different classifications might result in highly hazardous consequences. For example, mixing nitric acid with an organic substance in a 2.5-litre bottle might cause a severe explosive reaction and the toxic gas emission might harm or kill people in the vicinity.

8.3.3 Containers for Hazardous Waste Disposal Used at the Department of Chemistry

1) Use material-wise containers appropriate for each class of waste (e.g. do not use metal container with corrosives, do not use plastic container with oxidizers, etc.)
2) The approved standard containers are: 20-litre plastic gallon, glass bottles of 1.0 L (GB1), 2.5 L (GB2.5), 4.0 L (GB4), 18-litre (MC18) tin can or thick plastic bags (BG1-BG5). Remark: For plastic bags, identify the weight of disposed substances in kilogram. Fraction of a kilogram is counted as one. Each bag should not weigh more than 5 kilograms.
3) Capacity of waste container is measured by the container's size. Therefore, half-filled containers should not be submitted for disposal. However, do not fill more than 90% of the volume of the container. Always allow enough air space for vapor expansion to avoid an explosion.
4) All waste containers must be attached with the Label for Waste Container (Appendix 3). The waste containers should be stored in the laboratory until the pick-up date and time announced by the Central Waste Disposal Unit (WasteTrack).

8.3.4 Guideline for Laboratory Waste Submission to WasteTrack

Usually, a waste collection is scheduled every one or two months. Waste Disposal Request Form should be turned in no later than the 20th of the month and waste should be picked up around the 25th. The sender should fill the Waste Disposal Request Form (Appendix 3). The form, as well as guideline for filling the form, is available on the Department's web site: http://www.chemistry.sc.chula.ac.th/safety/safety.shtml under Menu Safety Forms > Waste Report Form.

Waste submission to WasteTrack is as follows:

1) Submit the completed WasteTrack Disposal Form (Appendix 4) to the WasteTrack Program coordinator for the Department of Chemistry (Prof. Dr. Tirayut Vilaivan, or designated personnel).
2) Upon receiving the Form, WasteTrack will issue a reference number (WasteTrackID) to be put on in the Label for Waste Container. Wait for the pick-up date that would be officially announced in due time.
3) Take your waste to the pick-up point for collection on the informed date and time.
   Remark: WasteTrack will not accept any waste containers that have no Waste Disposal Request Form and WasteTrackID.

In transportation of hazardous waste containers, ensure that the covers or lids are secured. Any liquid container should be placed in a secondary container to minimize spillage. Use a suitable trolley and freight elevator to transport waste containers. Never use a passenger elevator. For any spillage, follow the instruction in Section 4 and immediately notify the person in charge.

9. Chemical Storage

9.1 Hazard Data and Symbols

Chemical storage should be arranged with the idea to keep it in an orderly, easy-to-locate and safely fashion. The information on properties of the substances, which would be useful in assigning the right location and storing method, could be retrieved from chemical labels, MSDS, and other references such chemical vendor's website. For any substances that such information is not available, use a chemist's common sense or seek advice from the laboratory supervisor.

9.1.1 The National Fire Protection Association (NFPA) Symbol System

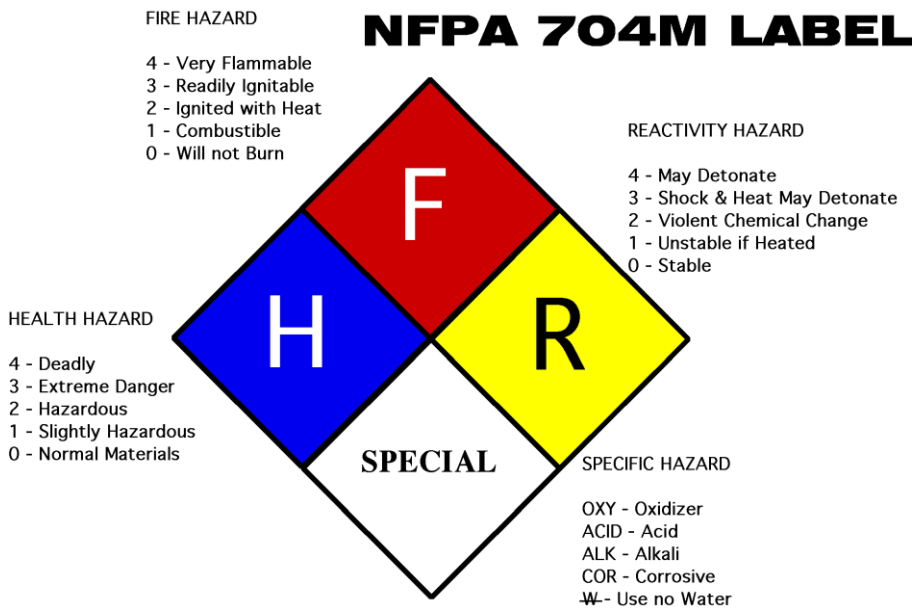


Figure 14 NFPA diamond-shaped labels for hazardous chemicals and substances

9.1.2 UN Label Pictograms

The UN chemical classification has 9 classes of hazardous substances. The hazard symbol will be displayed in diamond-shaped squares that are easily understood with a number to identify the hazard level, and possibly have another number after "." for further clarification of hazard level. (See Figure 15)

9.1.3 The EEC (European Economic Community) Classification

Directive 67/548/EEC introduced common provisions on the classification of dangerous substances. The black hazard symbol will be displayed in framed square with orange background. See Figure 16.

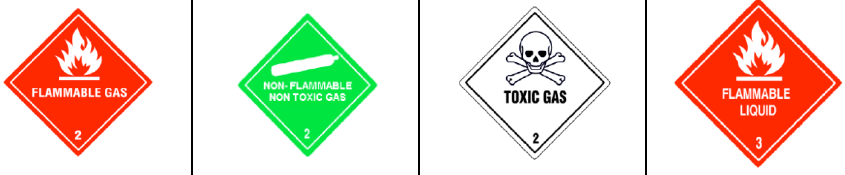
Class E	explosive.	Symbol with the word 'explosive'
Class F/F^{+}	flammable/highly flammable	Symbol of a flame in a flame
Class O	oxidizing agent	Symbol of a circle under a flame
Class T/T^{+}	toxic/highly toxic	Symbol of a skull and cross bone
Class X_n	harmful	Symbol of a cross and 'h'

Class X_i	irritant	Symbol of across and 'i'
Class C	corrosive	symbol of a droplet from tube on a hand and metal
Class N	Eco-toxic	Symbol of a dead tree and a dead fish

<u>Class 1</u> Explosives

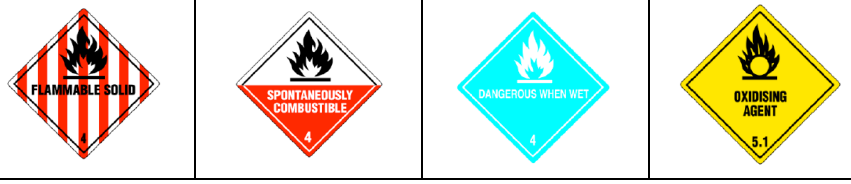
<u>Class 2</u> Gases

<u>Class 3</u> Flammable Liquids



<u>Class 4</u> Flammable Solids

<u>Class 5</u> Oxidizing Agents and Organic Peroxides)

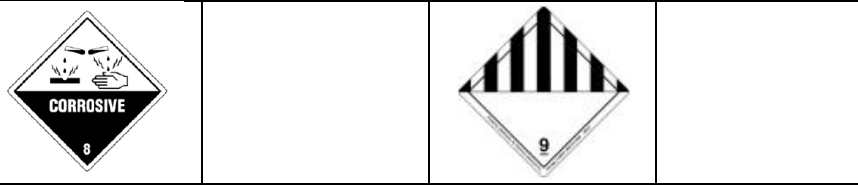


<u>Class 6</u> Toxic/Poisonous and Infectious Substances

<u>Class 7</u> Radioactive

<u>Class 8</u> Corrosives

<u>Class 9</u> Miscellaneous Dangerous Goods



<u>Figure 15</u> UN diamond-shaped labels for hazardous chemicals and substances

Class	Symbol	Hazardous risk	Symbol
Explosive		Flammable	
Oxidizing		Toxic	
Harmful		Irritant	
Corrosive		Eco-toxic (dangerous for the environment)	

Figure 16 EEC labels for hazardous chemicals and substances

9.1.4 The GHS (Globally Harmonized System of Classification and Labeling of Chemicals) system

The GHS is a new system created and approved by the United Nation to standardize a classification and labeling of chemicals around the world. As it is an internationally agreed-upon system, more chemical vendors and importers tend to adopt this system over the years. Thus, it is necessary to understand the classes and symbols used in this system (Figure 17). In most parts, GHS classification is similar to that of UN system (Section 9.1.2) with only few exceptions such as GHS stops using numbers identifying classes and hazard levels and also changes older symbols and descriptions for better communication. Substances are grouped into 5 sub-categories for their hazard/toxicity level: from category 1 (severe toxicity, LD_{50} < 5 mg/kg) to category 5 (low acute toxicity, 2000 < LD_{50} < 5000 mg/kg). Categories 1 to 3 use skull and crossbones. Category 4 uses exclamation mark. Category 5 has no pictogram symbol. There might be an accompanying number and description to identify the hazard level. (1,2: danger, fatal if swallowed/inhaled; 3: danger, toxic if swallowed/inhaled; 4: warning, harmful if swallowed/inhaled; 5: warning, may be harmful if swallowed/inhaled.)

Figure 17 GHS labels for hazardous chemicals and substances

(source: “GHS: Risk Management in Hazardous Waste Management Program” brochure by Bangpoo’s SMEs and Responsible Care Group, The Federation of Thai Industry)

9.2 Code of Practice for Chemical Storage

1) The laboratory should have the up-to-date inventory of all chemical substances in its possession, either in the form of a hard copy or an electronic database that is frequently updated. And within 2008, all laboratories of the Department of Chemistry that have acquired and/or stored chemicals are to be registered with Chulalongkorn University's chemical management system (ChemTrack: http://chemtrack.chula.ac.th). The data should be regularly updated.
2) Substance containers shall remain clearly and legibly labeled as prepared by the manufacturer. Information on any label must include:
   - Name and chemical formula with CAS no.;
   - Risk phrases and Safety phrases, identifying hazard classification, such as corrosive, flammable;
   - Dangerous goods classification and risk labels;
   - Specific warnings;
   - Emergency procedures;
   - Precautions for safe use and handling;
   - Date of Purchased, or Date of Receipt and/or Expiry Date.
3) Have a systematic filing or computer server that collects *MSDS* information of all hazardous chemicals used in the laboratories for easy reference in case of emergency and update regularly.
4) Containers and chemical labels:
   - Store chemicals in suitable containers
   - All chemical containers must carry proper identifying labels
   - Regularly inspect chemical containers and labels
5) Store chemicals separately using a suitable criterion. For example, physical appearance, hazard risk and incompatibility as suggested in the Chemical and Hazardous Substance Storage Manual (2007) by Department of Industrial Works, which suggests 13 categories as follows:
      1. Explosive substances
      2. Compressed, liquefied and dissolved gases
      3. Flammable liquids
      4. Flammable solids, spontaneously combustibles and substances that emit flammable gases in contact with water
      5. Oxidizing substances and infectious substances
      6. Toxic substances and infectious substances
      7. Radioactive substances
      8. Corrosive substances
      9. (N.A.)
      10. Combustible liquids
      11. Combustible solids
      12. Non-combustible liquids
      13. Non-combustible solids

In practice, it is generally sufficient to separate flammables, corrosives, oxidizers, air and water reactive substances or substances that require special care (e.g. in refrigerator). The sub-categories might be required, depending on the physical states of the substances.

6) Chemicals should be safely kept in a proper storage cabinet/place. Never put any chemicals on corridor or walking path.
7) Chemical storage areas should have properly identifying labels
8) Never keep any food or drink in a refrigerator used for chemical storage.
9) Storage of Flammables:
   - Flammables should be well away from heat, electric generator, flame, spark and direct sunlight.
   - Flammables should be separated from other substances.
   - In laboratories, store flammables in containers with no more than 20-litre capacity.
   - Large amount of flammables (more than 50-litre inclusive) should be kept in specially assigned cabinet.
   - Flammables requiring refrigeration should be stored in a safe and suitable refrigerator.
10) Storage of Corrosives:
   - Store corrosive bottles (both acids and bases) in low-level cabinet.
   - Acidic bottles should be stored separately with additional containers.
   - Never store corrosives in or under fume hood and sink.
11) Storage of Oxidizers
   - Separate oxidizers from organic substances, flammables and combustibles.
   - Store strong oxidizers (e.g. chromic acid) in glassware or inert containers.
   - Never use corks or rubber stoppers with bottles containing oxidizers.
12) Storage of Reactive Substances
   - Cabinet with reactive substances should have a clear sign (for example, “Reactive Substances – Keep Water Away”).
   - Store peroxides from heat, light and fire/spark.
   - Peroxides containers should have tight and sturdy lids. Do not use glass stoppers.
   - Regularly check reactive substances for peroxidation (if applicable) and to ensure that they are in good condition.
13) Storage of Gases
   - Firmly secure gas cylinders with strong material restraints.
   - Every gas cylinder should have protective cap and guarding cover.
   - Store full and empty cylinders separately with proper labels.
   - Separate non-compatibles (e.g., oxygen) from fuels, flammables, combustible substances or use non-combustible wall.
14) Compressed gas cylinders should be stored outside the laboratory with a connecting tube for usage inside the room. The gas cylinders must be in an upright position and firmly secured by restraining chains that would not easily fail.
15) Avoid exposure of pyrotechnics to heat or direct sunlight, which may lead to an undesired reaction or chemical degradation. They should be stored in the refrigerator or any appropriate container as indicated by manufacturers.
16) Low boiling point solvents should be kept in a well-ventilated area and away from direct sunlight.
17) Do not store large quantities of unnecessary chemicals in the laboratory.
18) Keep chemicals currently in use on tables/shelves only temporarily.

19) Never store chemicals in fume hood.
20) Never store chemicals in or under fume hood or under sink. If absolutely necessary, store only non-corrosive or non-water-reactive substances and ensure that suitable safety measures (such as using another protective box) are applied.
21) Specially controlled chemicals must be stored in locked cabinet.
22) Some substances need special storage:
    - Hydrofluoric Acid: stored in an acid-resistant plastic container. Do not use glass or metal ware.
    - White phosphorus: stored under water.
    - Sodium and other alkali metals: stored in oil.
    - Picric: stored under water.
    - Ether: in amber-colored bottles.
    - Peroxides, organometallics: in a refrigerator.
23) The laboratory should provide suffice and suitable cabinets and shelves for chemical strogate as well as emergency equipment such as fire extinguishers, personal protective equipment, and spill kits that are suitable for the type and hazards level associated with the chemical to be stored.
24) For further application, see the "Chemical Storage and Safety" survey form in *Chemicals and Safety Handbook* by Pichai Tovivich, Supawan Tantayanon, and Prapaipit Chamsuksai, Department of Chemistry, Faculty of Science, Chulalongkorn University; and *ESPReL: Laboratory Safety Assessment Manual*, 1st Revision (2014). The ESPReL Checklist and instruction could be downloaded at http://esprel.labsafety.nrct.go.th.

10. Laboratory Safety Assessment

10.1 Laboratory Safety Survey With ESPReL Checklist

The Enhancement of Safety Practice of Research Laboratory in Thailand, ESPReL Program, which is supported by the National Research Council of Thailand, has created a helping tool for laboratory safety assessment called ESPReL checklist. This checklist covers 7 main elements for the overall safety of chemical laboratories that are systematically connected:

1) Safety Management Administration
2) Chemical Management
3) Waste Management
4) Laboratory's Physical Appearance, Equipment and Tools
5) Hazard Prevention and Control Systems
6) Basic Laboratory Safety Training
7) Data and Document Management

Figure 18 ESPReL's 7 Elements of Laboratory Safety

To create a safe working environment and to allow faculty members and administrative team to find gaps or weak points on improper safety management, as well as to reach the desirable laboratory safety standard, the Safety Committee of the Faculty of Science, Chulalongkorn University, has a new policy that all Faculty's laboratories are to complete a regular self-assessment procedure, using ESPReL checklist. This would be taken place at least once a year, officially in June. (The Safety Committee would send a written notification to all laboratories in due time). All participating

laboratories should register with the ESPReL web site (http://esprel.labsafety.nrct.go.th) to gain access to ESPReL checklist. To maximize the benefits of this safety assessment, laboratory supervisors and operators of all levels should discuss and complete the survey question together, providing descriptive explanation to every question. After the online checklist is completed, the computerized system would provide graphic feedbacks and scores on each of seven criteria. Laboratory supervisors could check the results and compare with others within specific time frame. For further information, please visit http://esprel.labsafety.nrct.go.th.

10.2 Laboratory Follow-Up Inspection

To accomplish the Department of Chemistry's objective on Safety Policy, one major obligation of the Department's Safety Committee is to have a laboratory safety inspection for both the laboratory and its operators every semester. Time schedules and inspection criteria will be announced in advanced so that laboratory supervisors could make necessary arrangement with laboratory operators. (The most recent criteria are in Appendix 5 and 6). The written results of each semester will be informed. Laboratories that fail will subject to some degree of penalty: for example, paying fines at the rate specified by the Safety Committee and approved by the Department of Chemistry's Administrative Committee.

Prepared by the Safety Committee, Department of Chemistry
1 June 2004
1st Revision 8 August 2005
2nd Revision 21 February 2007
3rd Revision 20 May 2008
4th Revision 16 May 2010
5th Revision 29 May 2013
6th Revision 8 July 2015

Appendix 1: Accident Report Form (page 1 of 2)

Note: This form is outdated. All accidents reports must go through the university centralized system maintained by SHECU at: https://www.shecu.chula.ac.th/home/content.asp?Cnt=67
Normally the laboratory supervisor should hold the responsibility for reporting accidents to the university. However, unsafe conditions that may lead to accidents can be reported by anyone.

Time of Accident..... Estimated Time Deviation .....

Usual Place of Work .....

Place of Accident (name the place) .....

Accident Location (name the location: near the entrance, near the fire exit, at the window, etc.)

.....

Incident or Injury (provide details of the incident: slipped and fell down on the floor, etc.)

.....

How did it happen? (What did you do at the time of the accident? (Attachment is encouraged.)

.....

.....

What type of PPE did you use at the time of the accident?

.....

.....

What medical treatment or health service did you receive after the accident?

.....

Who else was involved in the accident? If any, please provide detailed information.

.....

.....

Consequences of the Incident

Injury	**Affected person**	**Damage**	
☐ sick/death	☐ visitor	☐ building	฿ .....
☐ unable to work	☐ employee/operator	☐ tools	฿ .....
☐ medical treatment	☐ supervisor	☐ equipment	฿ .....
☐ first-aid	☐ others	☐ others	฿ .....
☐ no injury			

Accident Report Form 1st page (July 2015)

Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 1: Accident Report Form (page 2 of 2)

Note: This form is outdated. All accidents reports must go through the university centralized system maintained by SHECU at: https://www.shecu.chula.ac.th/home/content.asp?Cnt=67
Normally the laboratory supervisor should hold the responsibility for reporting accidents to the university. However, unsafe conditions that may lead to accidents can be reported by anyone.

The person you report the accident to .....

The time you report the accident .....

In your opinion, the practical safety measures to prevent the repetition of the accident

.....

Did you call the ambulance? ☐ No ☐ Yes Number .....

Did you call the police? ☐ No ☐ Yes Number .....

Did you inform the advisor on your injury? ☐ No ☐ Yes Date of contact .....

Did you get any medical assistance? ☐ No ☐ Yes At .....

Date and Time .....

....

(Reporter) (Signature) (Date of Report)

For Supervisor Only

Who did you report the accident? Chairman of the Safety Committee (Prof. Dr. Tirayuth Wilaiwan)

Accident report date and time .....

Initial investigation and opinion

.....

.....

Requirement for follow-up inspection

.....

.....

Projected date of follow-up inspection .....

Person designated for the follow-up .....

Any injured employee/operator to be absent more than 7 days? ☐ No ☐ Yes

Can current remedial actions prevent the reoccurrence of the accident? ☐ No ☐ Yes

..... (Signature and Name of Supervisor)

(Date and Time)

Accident Report Form 2nd page (July 2015)

Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 2: Risk Assessment Form

Lab ..... Floor ..... Mahamakut Building

Date & Time of the Experiment ..... Experiment Operator .....

Information on the experiment

Class (1-10) .....

Risk Level ( ) A ( ) B

(See definition in the Safety Manual Section 7.4)

Experiment Summary

Chemicals used (specify name, quantity and hazard)

.....

.....

.....

.....

.....

Risk assessment and emergency plan

.....

.....

.....

.....

Signature ..... Signature .....

(.....) (.....)

Experiment operator Laboratroy Supervisor

Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 3: Waste Report Form for Waste Container

ของเสียอันตราย
(Hazardous Waste)

WasteTrackID

ปริมาณ (ระบุหน่วยเป็น l/kg)_____

ประเภทของเสีย (เลือกเพียง 1 รายการเท่านั้น)

- ☐ I: Special waste
- ☐ II: Cyanide waste
- ☐ III: Oxidizing waste
- ☐ IV: Mercury waste
- ☐ V: Chromate waste
- ☐ VI: Heavy metal waste
- ☐ VII: Acid waste
- ☐ VIII: Alkaline waste
- ☐ IX: Petroleum products
- ☐ X: Oxygenated waste
- ☐ XI: NPS containing
- ☐ XII: Halogenated waste
- ☐ XIIIa: Combustible solid
- ☐ XIIIb: Incombustible solid
- ☐ XIV: Miscellaneous aqueous waste

ภาควิชาเคมี คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ชื่อห้องปฏิบัติการ_____

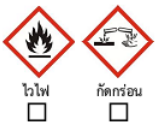
ชื่อผู้รับผิดชอบ_____

หมายเลขโทรศัพท์_____

วันที่เริ่มบรรจุ_____

วันที่หยุดบรรจุ_____

สัญลักษณ์แสดงอันตราย
(เลือกได้มากกว่า 1 ข้อ)



ไวไฟ ☐ กัดกร่อน ☐

เป็นพิษ ☐ ตัวออกซิไดส์ ☐

อื่นๆ (ระบุ)

ส่วนประกอบ	ปริมาณ (%)

ของเสียอันตราย (Hazardous Waste)

WasteTrackID

ประเภทของเสีย (เลือกเพียง 1 รายการเท่านั้น)

ปริมาณ (ระบุหน่วยเป็น l/kg)_____

- ☐ I: Special waste
- ☐ II: Cyanide waste
- ☐ III: Oxidizing waste
- ☐ IV: Mercury waste
- ☐ V: Chromate waste
- ☐ VI: Heavy metal waste
- ☐ VII: Acid waste
- ☐ VIII: Alkaline waste
- ☐ IX: Petroleum products
- ☐ X: Oxygenated waste
- ☐ XI: NPS containing
- ☐ XII: Halogenated waste
- ☐ XIIIa: Combustible solid
- ☐ XIIIb: Incombustible solid
- ☐ XIV: Miscellaneous aqueous waste

ส่วนประกอบ	ปริมาณ (%)

สัญลักษณ์แสดงความเป็นอันตราย (เลือกได้มากกว่า 1 ข้อ)

ไวไฟ ☐ กัดกร่อน ☐ เป็นพิษ ☐ ตัวออกซิไดส์ ☐

อื่นๆ (ระบุ)

ภาควิชาเคมี คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ชื่อห้องปฏิบัติการ_____

ชื่อผู้รับผิดชอบ_____

หมายเลขโทรศัพท์_____

วันที่เริ่มบรรจุ_____

วันที่หยุดบรรจุ_____

Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 4: WasteTrack's Waste Disposal Request Form (1st page)

Information of Waste Disposer

Lab Register No. _____	**Dept.** Chemistry	**Fac./Ins.** Science **Date** _____
Lab No. _____	**Bldg.** Mahamakut	**Lab advisor/supervisor** _____ **Tel.** _____
	Lab Type	☐ Research lab ☐ Instrumental lab ☐ Teaching lab
	Source of expense	☐ Research Fund ☐ Faculty/Institute ☐ Department ☐ Others___

Waste Information

WasteTrackID	Type*	Name and Description	Container*

* Please read the guideline for filling the form. WasteTrack will not process any form that is incomplete, incorrect or has not complied with the regulations.

Sender _____ (Tel._____)
Lab Personnel _____ (Tel._____)
Lab Advisor _____ (Tel. _____)
Inspector _____ (Tel. _____)

Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 4: WasteTrack's Waste Disposal Request Form (2nd pages)

Guide to Filling out the Form

1. Lab Register No: Use the acronym of the research unit, subject code, lab advisor's initials, or name registered with the WasteTrack Program. Also complete all information on waste disposal sender section.

2. Waste container: each item (container) must be listed separately.

3. WasteTrackID: Put a reference number that could be tracked back. After registration, WasteTrack will issue a new reference number to be put on the container labels. WasteTrack will not accept waste containers that have no reference numbers supplied by WasteTrack.

4. Type of Waste: Specify classification number of each waste according to the Flowchart below. For waste classification I to XIV, give all waste detail in 'Name and Description' column. Keep in mind that waste that is classified as 'unknown waste' would have a highly expensive disposal cost.

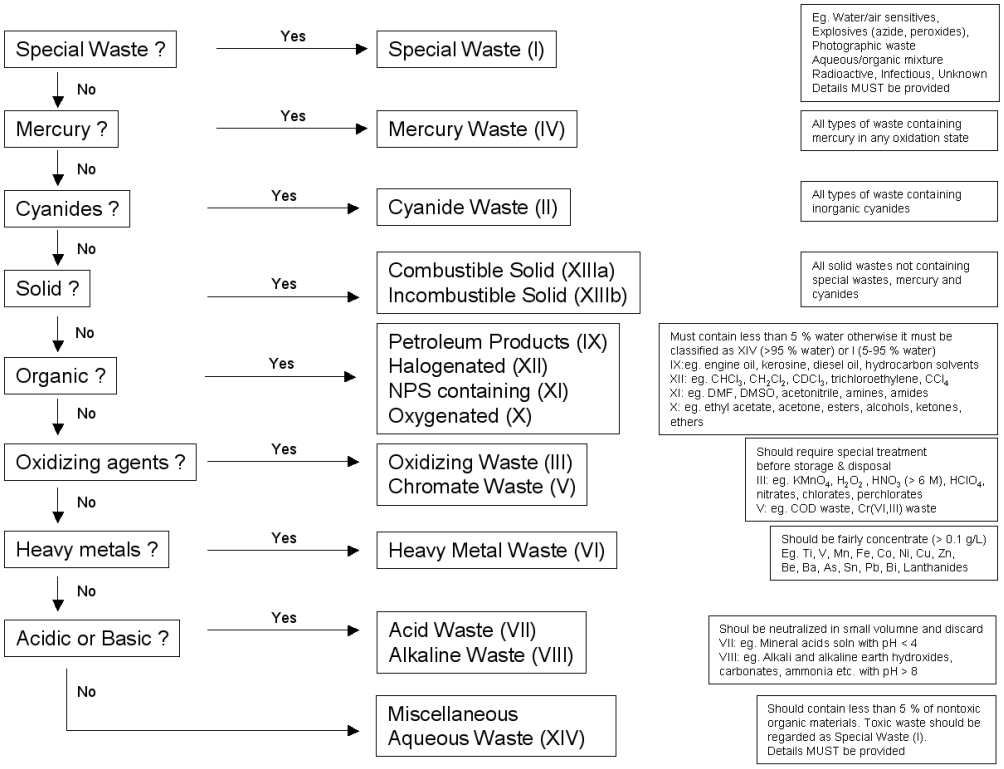
5. Container: Select proper containers for the waste and fill up both type and size of such containers. The standard containers are plastic gallon of 20 L (GL20), glass bottle of 1.0 L (GB1), 2.5 L (GB2.5), 4.0 L (GB4), tin can of 18 L (MC18) or thick plastic bags (BG1-BG5). (For plastic bags, the weight will be calculated in kilograms. Any fraction of one kilogram should be counted as one. Each bag should not exceed the maximum of 5 kilograms. Waste supplied in containers that are not properly listed will not be processed.

6. Capacity of the waste container is measured by container's size. The containers should not be overfilled or removed to the disposal area before they become full.

7. Transaction ID will be automatically given by WasteTrack during the registration.

8. The form must be signed by sender, lab personnel, and lab supervisor with telephone numbers.

Flowchart of Toxic Waste Classification



Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 5: Example of Laboratory Safety Inspection Form (March 2015)

Laboratory Safety Inspection Form

Lab No. ..... Date of Inspection ..... Inspector .....

Laboratory Advising Professor .....

	Inpection Criteria	Pass	Fail	N/A	Remarks
1.*	Laboratory information mandated by the Department of Chemistry's system is clearly visible with updated information (with names and phone numbers of at least two persons in charge).				
2.	The chemical inventory is updated and examinable. Person in charge of the chemical inventory:.....				
3.	All chemicals (both self-prepared and purchased) are kept in suitable containers with proper labels.				
4.	All chemicals are systematically and safely stored.				
5.	Gas cylinders are safely stored.				
6.	Laboratory waste is classified and kept for disposal/treatment, using WasteTrack standard. Person in charge of the waste disposal:				
7.	Laboratory waste is clearly labeled and kept in suitable containers and area.				
8.	Physical appearances of the laboratory and vicinity (e.g. corridor, fire exit) are in safe condition.				
9.	Equipment and electrical apparatus, together with plugs and switches, are in safe condition.				
10.	Fume hoods are in order and in operating conditions.				
11.	Safety campaign signs suitable for laboratory's nature and activities are clearly displayed.				
12.	Floor plan with fire exits is clearly visible and every lab member acknowledges it.				
13.	First-aid kits suitable for laboratory's nature and activities are suffice, in good condition, and accessible to all.				
14.*	PPE sets suitable for laboratory's nature and activities are suffice and wearing them is compulsory.				
15.	Other emergency equipment (such as safety shower, eye wash, spill kits) suitable for laboratory's nature and activities are in good condition, suffice and accessible.				
16.	The laboratory has active risk management and supporting plans for activities required risk assessments and other hazardous activities.				
17.	Laboratory operators have basic knowledge and act accordingly in safely performed experiments (pass evaluation test, regulation acknowledgement, having suitable PPE, properly dressed). (The interview is as listed below. One failed case is considered Fail.)				
18.*	The latest version of Department of chemistry's Safety Manual is available in hard copy.				
19.	The laboratory has Accident Report Form (apart from Safety Manual) and has a statistic record on lab accidents.				
20.*	The laboratory has self-assessed using ESPReL safety standard. The latest date of self-assessment is				
Remark: Passing standard is 16 out of 20 criteria, in which all star-marked criteria must be passed.					

Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 6: Laboratory Operator Safety Inspection Form (March 2015)

Laboratory Operator (Students/Researchers) Safety Inspection Form

Lab No./ Lab Supervisor	No. of lab operators	No. of inspected operators	Name of inspected operators	PPE	Safety card	Safety mind	Result of Assess-ment*	Remarks

* Result of Assessment (Pass/Fail) – passing standard is to pass all three criteria (PPE, safety card, safety mind)

Downloadable at http://www.chemistry.sc.chula.ac.th/safety/safety.shtml

Appendix 7: List of Department of Chemistry's Safety Committee

(The current committee is appointed by official notification no. 27/2555,
Term duration: 1st November 2012 – 30th September 2016)

Department Head (Assoc. Prof. Dr. Vudichai Parasuk)	Consultant
Prof. Dr. Tirayut Vilaivan	Chairman
Dr. Puttaruksa Varanusupakul	Secretary
Assist. Prof. Dr. Saowarux Fuangswasdi	Member
Assist. Prof. Dr. Boosayarat Tomapatanaget	Member
Assist. Prof. Dr. Sumrit Wacharasindhu	Member
Dr. Panuwat Padungros	Member
Dr. Thanit Praneenararat	Member
Dr. Prompong Pianpinijtham	Member

The Safety Committee takes responsibility on managing all hazardous waste and chemicals in accordance with the University's strategy. The integrated process and cooperation in division, department and university levels are introduced to accomplish the objective and effectively react in case of emergency.

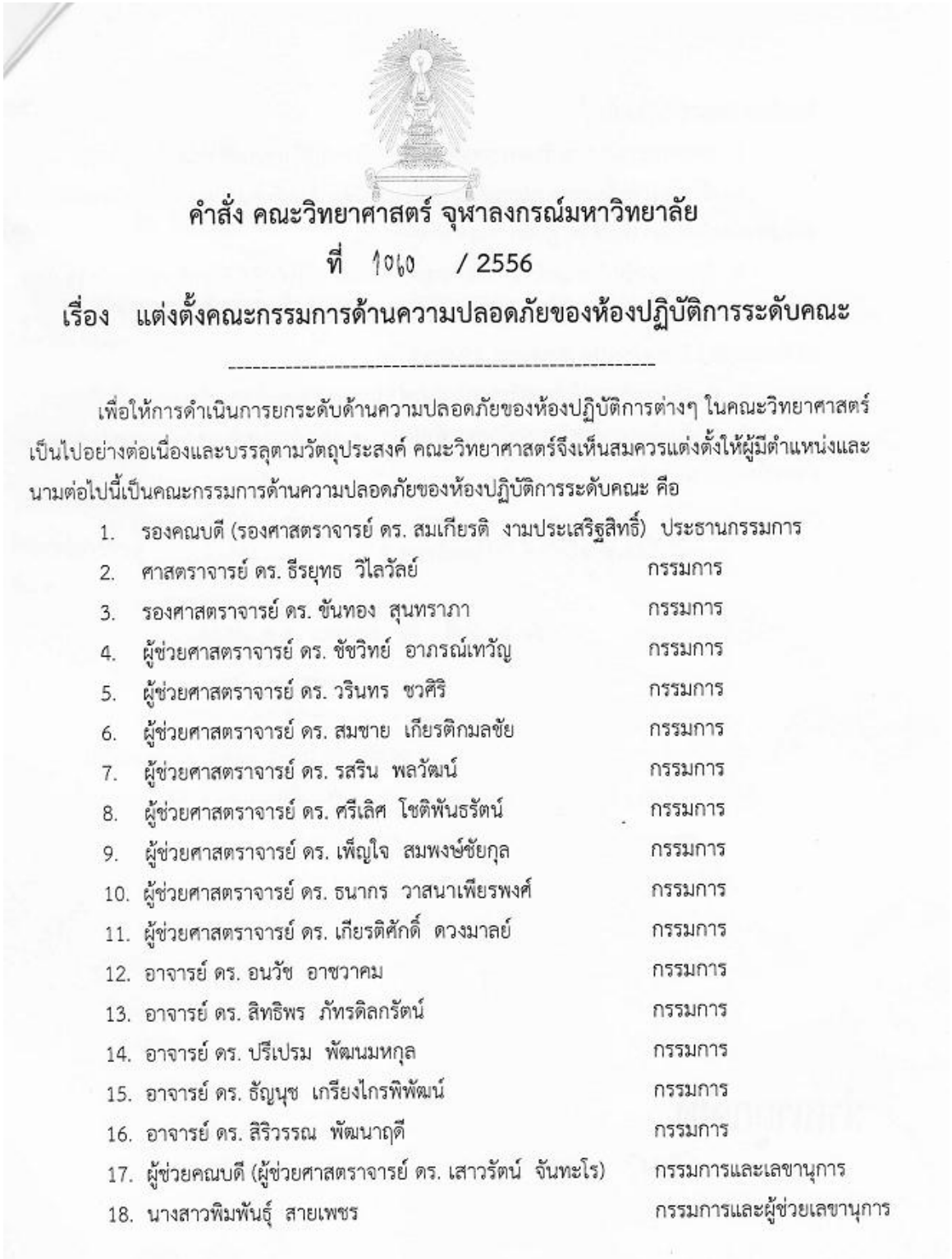
Responsibility of the Safety Committee – Department of Chemistry

1. Set up a safety policy on the use of chemicals and waste disposal of the Department.
2. Prepare and revise the Safety Manual for laboratory use in the Department.
3. Regularly inspect all laboratories in the Department to ensure safe and suitable condition every semester.
4. Arrange training on safety use of chemicals and waste disposal to students at the beginning of every academic year.
5. Arrange an evaluation test on chemical laboratory safety practice for students and researchers of the Department.
6. Take care of the course 2302704 Chem Safe Res Lab—a required course for master program of the Department of Chemistry. (Chairman of the Safety Committee has all the rights to solve any problems incurred) during the time when the course has not been assigned to any particular person.
7. Complete other safety-related tasks as assigned.

Appendix 8: Name List and Telephone Numbers of Floor Supervisor for Emergency Contacts in the Department of Chemistry

Floor	Name	Room	Number
Department Supervisor	Assist. Prof. Dr. Soamwadee Chaianansutcharit	1302	089-123-1544 0-2218-7619
Assistant to the Dept. supervisor	Assist. Prof. Dr. Boosayarat Tomapatanaget	1536	081-557-5370
7	Lect. Ponwason Eamchan	905/6	085-361-6609
8	Assoc. Prof. Dr. Surachai Pornpakakul	1519	081-562-0555
9	Dr. Passapol Ngamukot	905/4	081-692-4049
10	Dr. Sakulsuk Unarunothai	1009	089-111-4158
11	Assoc. Prof. Dr. Pornthep Sompornpisut	1115	089-500-5795
12	Assist. Prof. Dr. Apichat Imyim	1203	085-358-6675
13	Dr. Aticha Chaisuwan	1303	084-003-2185
14	Assist. Prof. Dr. Sumrit Wacharasindhu	1405/6	084-375-8009
15	Assist. Prof. Dr. Boosayarat Tomapatanaget	1536	081-557-5370
Chairman of the Safety Committee	Prof. Dr. Tirayut Vilaivan	1340	0-2218-7627 083-986-8772
Secretary of the Safety Committee	Dr. Puttaruksa Varanusupakul	1228/6	0-2218-7612 089-188-7043

Appendix 9: Faculty of Science's Laboratory Safety Committee (Page 1 of 2)



คำสั่ง คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ที่ 1040 / 2556

เรื่อง แต่งตั้งคณะกรรมการด้านความปลอดภัยของห้องปฏิบัติการระดับคณะ

เพื่อให้การดำเนินการยกระดับด้านความปลอดภัยของห้องปฏิบัติการต่างๆ ในคณะวิทยาศาสตร์เป็นไปอย่างต่อเนื่องและบรรลุตามวัตถุประสงค์ คณะวิทยาศาสตร์จึงเห็นสมควรแต่งตั้งให้ผู้มีตำแหน่งและนามต่อไปนี้เป็นคณะกรรมการด้านความปลอดภัยของห้องปฏิบัติการระดับคณะ คือ

1. รองคณบดี (รองศาสตราจารย์ ดร. สมเกียรติ งามประเสริฐสิทธิ์) ประธานกรรมการ
2. ศาสตราจารย์ ดร. ธีรยุทธ วีไลวัลย์ กรรมการ
3. รองศาสตราจารย์ ดร. ขันทอง สุนทราภา กรรมการ
4. ผู้ช่วยศาสตราจารย์ ดร. ชัชวิทย์ อาภรณ์เทวัญ กรรมการ
5. ผู้ช่วยศาสตราจารย์ ดร. วรินทร ชวศิริ กรรมการ
6. ผู้ช่วยศาสตราจารย์ ดร. สมชาย เกียรติกมลชัย กรรมการ
7. ผู้ช่วยศาสตราจารย์ ดร. รสริน พลวัฒน์ กรรมการ
8. ผู้ช่วยศาสตราจารย์ ดร. ศรีเลิศ โชติพันธรัตน์ กรรมการ
9. ผู้ช่วยศาสตราจารย์ ดร. เพ็ญใจ สมพงษ์ชัยกุล กรรมการ
10. ผู้ช่วยศาสตราจารย์ ดร. ธนากร วาสนาเพียรพงศ์ กรรมการ
11. ผู้ช่วยศาสตราจารย์ ดร. เกียรติศักดิ์ ดวงมาลย์ กรรมการ
12. อาจารย์ ดร. อนวัช อาชวาคม กรรมการ
13. อาจารย์ ดร. สิทธิพร ภัทรดิลกรัตน์ กรรมการ
14. อาจารย์ ดร. ปรีเปรม พัฒนมหกุล กรรมการ
15. อาจารย์ ดร. ธัญนุช เกรียงไกรพิพัฒน์ กรรมการ
16. อาจารย์ ดร. สิริวรรณ พัฒนาฤดี กรรมการ
17. ผู้ช่วยคณบดี (ผู้ช่วยศาสตราจารย์ ดร. เสาวรัตน์ จันทะโร) กรรมการและเลขานุการ
18. นางสาวพิมพันธุ์ สายเพชร กรรมการและผู้ช่วยเลขานุการ

Appendix 9: Faculty of Science's Laboratory Safety Committee (Page 2 of 2)

โดยมีขอบเขตหน้าที่ดังต่อไปนี้

1. ร่วมกำหนดนโยบายเรื่องความปลอดภัยของห้องปฏิบัติการระดับคณะ
2. นำนโยบายเรื่องความปลอดภัยของห้องปฏิบัติการระดับคณะไปสู่การปฏิบัติระดับภาควิชา/หลักสูตรบัณฑิตศึกษา (ที่มีห้องปฏิบัติการของหลักสูตรเอง)
3. พิจารณาข้อกำหนดด้านความปลอดภัยที่จะนำมาใช้ปฏิบัติโดยยึดหลักการของโครงการยกระดับมาตรฐานความปลอดภัยห้องปฏิบัติการวิจัยในประเทศไทย (Enhancement of Safety Practice of Research Laboratory in Thailand, ESPReL)
4. ส่งเสริม/สนับสนุนให้ภาควิชา/หลักสูตรดำเนินการตามข้อกำหนดด้านปลอดภัยดังกล่าว
5. กำกับให้แต่ละภาควิชา/หลักสูตร ดำเนินการตามข้อกำหนดด้านความปลอดภัยอย่างต่อเนื่องให้เป็นส่วนหนึ่งของงานประจำ

ทั้งนี้ตั้งแต่บัดนี้เป็นต้นไป โดยมีวาระ 2 ปี

สั่ง ณ วันที่ 28 สิงหาคม พ.ศ. 2556

(ศาสตราจารย์ ดร. สุพจน์ หารหนองบัว)
คณบดีคณะวิทยาศาสตร์