LABORATORY SAFETY MANUAL (LSM)
PHARMACEUTICAL LABORATORY
UNIVERSITY OF BENGKULU

QUICK START GUIDE

The Laboratory Safety Manual (LSM) is a handy guide to ensure that all laboratory activityis performed according to the standard safe laboratory practice in a pharmaceutical laboratory University of Bengkulu. This LSM contains useful information and certain rules that need to be fulfilled before, during, and after performing laboratory activity. Your laboratory supervisor/tutor will always tell you to read the LSM thoroughly before beginning your lab act. The same information will be shared at the beginning of each lab session as a partof standard safety measures

Maintaining safety while working in the laboratory is as important as the learning process in the practical session, therefore completing reading this LSM should always be our priorityat the beginning of each semester. If you ever need assistance in understanding this LSM, donot hesitate to ask the question to your lab supervisor/tutor and consult each chemical MSDS before handling them. Pay attention to all symbols, evacuation routes, and emergency numbers so you can always make immediate reactions when a chemical accident happens.

IMPORTANT CONTACT

PHARMACY TEAM

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EMERGENCY TELEPHONE NUMBER

Police/Polisi	110
Firefighter/Pemadam Kebakaran	113
Ambulance/Ambulans	118 and 119

NEAREST HOSPITAL AND CLINIC

Rumah Sakit M Yunus Bengkulu *M Yunus Hospital*	0736-345100
Rumah Sakit Harapan & Doa *Harapan & Doa Hospital*	+62 812-1269-7721
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PART 1. CLOTHES AND PROTECTIVE WEAR

Shorts, short-sleeved shirts, and dresses do not offer adequate protection when performing laboratory activity and should not be worn unless any exposed skin can be covered by a lab coat. Proper footwear must be used which comprises closed toes and heels. Flip-flops, open-weave shoes, and sandals are not appropriate to use in the lab while performing laboratory activities. Before conducting any activity in the laboratory, all students/staff/guest should wear the following personal protective equipment:

- ✓ Lab coat made of cotton with long sleeves
- ✓ Safety goggles
- ✓ Gloves
- ✓ Closed shoes or protecting work shoes

Figure 1. Wearing Lab Coat Before Entering Laboratory Working Area

Laboratory coats and gloves **SHOULD NOT** be worn outside the lab since it can be contaminated with hazardous chemicals.

Contact lenses should not be put on when performing laboratory activity. Gases and vapors canbe concentrated under the lenses and will cause permanent eye damage. If chemicals splash into/come in contact with the eyes, it is almost impossible to remove lenses to irrigate the eye due to spontaneous spasms of the eyelids.

As part of general laboratory practice, any form ofjewelry is also prohibited to wear when doing activities in the laboratory. When handling certain chemicals, specific protective wear may be required (e.g. Respirator), please consult individualchemical MSDS provided in the lab.

Locate the nearest eyewash station and make sure you know how to operate it. Put on goggles every time you will handle chemicals or working with equipment under pressure, particularly when working with a caustic substance, concentrated acids/bases, and substance/process that can generate droplets/vapor/aerosols.

Figure 2. Taking Off and Storing Lab Coat

PART 2. BEHAVIOR IN LABORATORY

When performing any activities in the laboratory, each person is responsible for his/her own safetyand needs to act accordingly to make sure that he/she does not cause harm to other people. In general, food, drink, and eating utensils should never be brought into the laboratory working area to avoid accidental ingestion of hazardous chemicals.

Do not eat, drink, smoke, apply cosmetics or apply contact lenses in the laboratory area.

Always wash your hand thoroughly after handling any chemical to avoid self-harm and cross-contamination. Do not touch the door handle or switch while wearing gloves since gloves can becontaminated with hazardous chemical.

Figure 3. Touching Door Handle

Figure 4. Touching Door Handle

Only bring the necessary equipment and document in the working area and leave your bag and jacketin the designated area/locker. Emergency exits and evacuation route is the important facility and the route must be kept clear during any occasion. Do not place anything in the route even if you want to move it immediately because an accident can happen at any time.

Pay attention to symbols on each packaging/bottle of chemical. Hazardous chemicals must be handled under the fume hood to avoid spreading its vapor/fume to the laboratory area. When pouring liquid out of its container make sure that:

- ✓ The etiquette position is upright to avoid damage
- ✓ The stopper underside should not be put facing the work surface
- ✓ Always use funnel

Figure 5. Transferring a Relatively Safe Chemical (Stopper Position)

Figure 6. Transferring a Relatively Safe Chemical (Using Funnel)

Figure 7. Transferring a Relatively Safe Chemical (Drop Spill)

Figure 8. Transferring a Relatively Safe Chemical (Closing the Bottle)

In the case of flammable liquid, do not transfer or store flammable chemicals near the heat sourceor electronic equipment because of the potential of fire ignition upon exposure of such chemicals to the heat source.

Do not work with boiling liquid under direct sunlight. Use a spatula, spoon, or powder funnel when taking the solid substance.

Be careful to not spill any chemicals around the weighing or working area and any spill should be cleaned immediately using appropriate techniques.

PART 4. WORKING WITH LOW-PRESSURE EQUIPMENT

Working with low-pressure equipment has its own risk of imploding, especially when using glassware. Imploding glassware can cause harm and spread glass particles around the working area. When distilling solvent (e.g. using a rotary evaporator), sucking away precipitate with vacuum filtration or drying substance using a vacuum drying oven or vacuum desiccator, always make sure that:

- ✓ All equipment and glassware are in perfect condition, do not use cracked equipment/glassware
- ✓ Use round vessel
- ✓ Use adhesive plastic to coat the apparatus

Figure 9. Working with Rotary Evaporator

Figure 10. Low-Pressure Safe Equipment Material

PART 5. TRANSPORT OF CHEMICAL

Always read the MSDS before handling any chemicals.

When transporting the chemicals, always make sure that:

- ✓ Have adequate knowledge of the transported chemicals, always read the MSDS first
- ✓ Use a holder or bucket to transfer liquid, do not transport liquid chemicals without a holder because of the risk of dropping and spilling chemicals
- ✓ Do not use food containers/bottle
- ✓ Put on laboratory coat and personal protective equipment

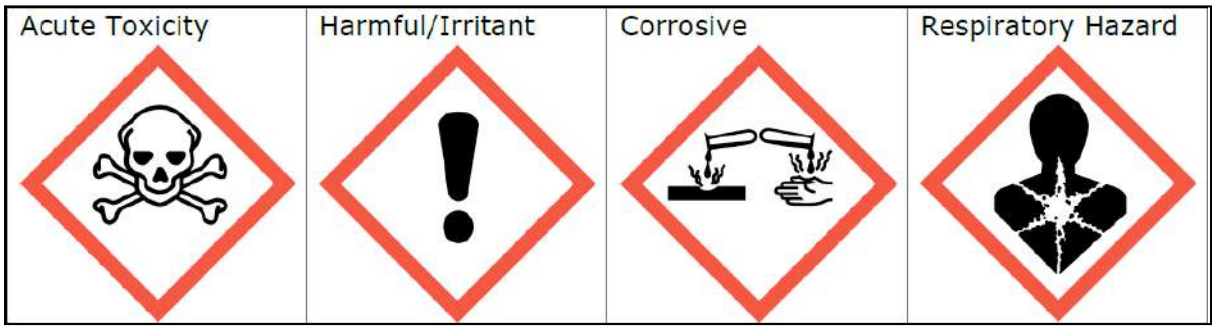
Figure 11. Transport of chemicals

Figure 12. Transporting Chemicals (Putting Chemical Bottles into Carrying Bucket)

PART 6. DANGEROUS SUBSTANCE WARNING

All students, staff, and guests who work/visit the laboratory should understand all chemicalhazard symbols and their meaning.

Health Hazard Symbols

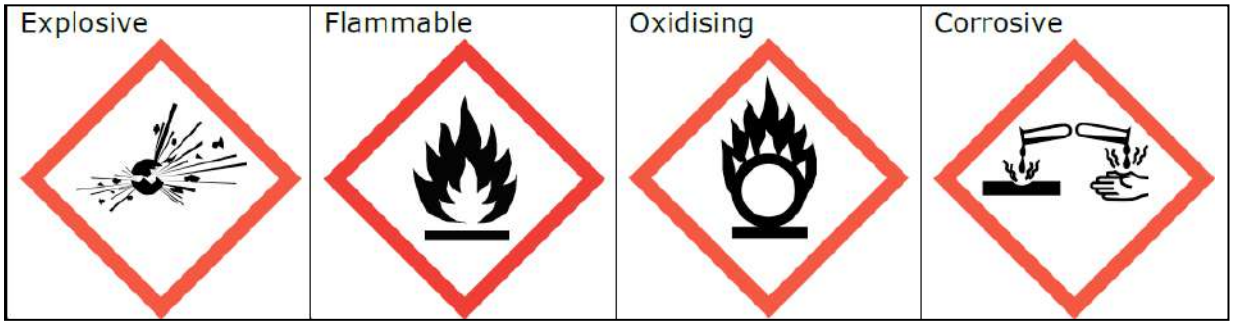


Toxicity Rating System

Toxicity Rating	Commonly Used Term	LD_{50} Single Oral Dose for Rats (g/kg)	4 hours Vapor Exposure Causing 2 to 4 deaths in 6-rat Group (ppm)	LD_{50} Skin for Rabbits (g/kg)	Probable Lethal Dose for Human
1	Extremely Toxic	≤0,001	<10	≤0,005	Taste (1 grain)
2	Highly Toxic	0,001-0,05	10-100	0,005-0,043	4 ml
3	Moderately Toxic	0,05-0,5	100-1000	0,044-0,340	30 g
4	Slightly Toxic	0,5-5,0	1000-10.000	0,35-2,81	250 g
5	Practically Non-Toxic	5,0-15,0	10.000- 100.000	2,82-22,6	500 g
6	Relatively Harmless	>15,0	>100.000	>22,6	>500 g

Figure 13. Example of Chemical with Health Hazard

Physical Hazard Symbols



(Further reading see Part 8-11)

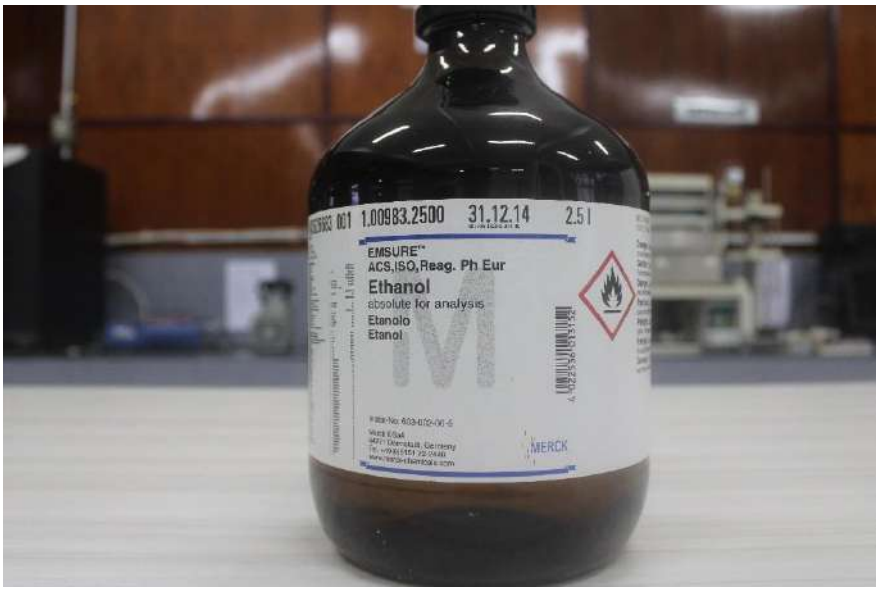


Figure 14. Example of Chemical with Physical Hazard

Environmental Hazard Symbol

Figure 15. Example of Chemical with Physical Hazard

PART 7. “R” AND “S” PHRASES

Pay attention to these indicators:

Indicators of special dangers (R phrases)

R1	Explosive when dry
R2	Risk of explosion by shock, friction, fire or other sources of ignition
R3	Extreme risk of explosion by shock, friction, fire or other sources of ignition
R4	Forms very sensitive explosive metallic compounds
R5	Heating may cause an explosion
R6	Explosive with or without contact with air
R7	May cause fire
R8	Contact with combustible material may cause fire
R9	Explosive when mixed with combustible material
R10	Flammable
R11	Highly flammable
R12	Extremely flammable
R14	Reacts violently with water
R15	Contact with water liberates extremely flammable gases
R16	Explosive when mixed with oxidizing substances
R17	Spontaneously flammable in air
R18	In use, may form flammable/explosive vapour-air mixture
R19	May form explosive peroxides
R20	Harmful by inhalation
R21	Harmful in contact with skin
R22	Harmful if swallowed
R23	Toxic by inhalation
R24	Toxic in contact with skin
R25	Toxic if swallowed
R26	Very toxic by inhalation
R27	Very toxic in contact with skin
R28	Very toxic if swallowed
R29	Contact with water liberates toxic gas.
R30	Can become highly flammable in use
R31	Contact with acids liberates toxic gas
R32	Contact with acids liberates very toxic gas
R33	Danger of cumulative effects
R34	Causes burns
R35	Causes severe burns
R36	Irritating to eyes
R37	Irritating to respiratory system
R38	Irritating to skin
R39	Danger of very serious irreversible effects
R40	Limited evidence of a carcinogenic effect
R41	Risk of serious damage to eyes
R42	May cause sensitization by inhalation
R43	May cause sensitization by skin contact

R44	Risk of explosion if heated under confinement
R45	May cause cancer
R46	May cause heritable genetic damage
R48	Danger of serious damage to health by prolonged exposure
R49	May cause cancer by inhalation
R50	Very toxic to aquatic organisms
R51	Toxic to aquatic organisms
R52	Harmful to aquatic organisms
R53	May cause long-term adverse effects in the aquatic environment
R54	Toxic to flora
R55	Toxic to fauna
R56	Toxic to soil organisms
R57	Toxic to bees
R58	May cause long-term adverse effects in the environment
R59	Dangerous for the ozone layer
R60	May impair fertility
R61	May cause harm to the unborn child
R62	Possible risk of impaired fertility
R63	Possible risk of harm to the unborn child
R64	May cause harm to breast-fed babies
R65	Harmful: may cause lung damage if swallowed
R66	Repeated exposure may cause skin dryness or cracking
R67	Vapours may cause drowsiness and dizziness
R68	Possible risk of irreversible effects

Combinations of R phrases

R14/15	Reacts violently with water, liberating extremely flammable gases
R15/29	Contact with water liberates toxic, extremely flammable gases
R20/21	Harmful by inhalation and in contact with skin
R20/22	Harmful by inhalation and if swallowed
R20/21/22	Harmful by inhalation, in contact with skin and if swallowed
R21/22	Harmful in contact with skin and if swallowed
R23/24	Toxic by inhalation and inn contact with skin
R23/25	Toxic by inhalation and if swallowed
R23/24/25	Toxic by inhalation, in contact with skin and if swallowed
R24/25	Toxic in contact with skin and if swallowed
R26/27	Very toxic by inhalation and in contact with skin
R26/28	Very toxic by inhalation and if swallowed
R26/27/28	Very toxic by inhalation, in contact with skin and if swallowed
R27/28	Very toxic in contact with skin and if swallowed
R36/37	Irritating to eyes and respiratory system
R36/38	Irritating to eyes and skin
R36/37/38	Irritating to eyes, respiratory system and skin
R37/38	Irritating to respiratory system and skin
R39/23	Toxic: danger of very serious irreversible effects through inhalation
R39/24	Toxic: danger of very serious irreversible effects in contact with skin

R39/25	Toxic: danger of very serious irreversible effects if swallowed
R39/23/24	Toxic: danger of very serious irreversible effects through inhalation and in contact with skin
R39/23/25	Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/24/25	Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/23/24/25	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R39/26	Very Toxic: danger of very serious irreversible effects through inhalation
R39/27	Very Toxic: danger of very serious irreversible effects in contact with skin
R39/28	Very Toxic: danger of very serious irreversible effects if swallowed
R39/26/27	Very Toxic: danger of very serious irreversible effects through inhalation and in contact with skin
R39/26/28	Very Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/27/28	Very Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/26/27/28	Very Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R42/43	May cause sensitization by inhalation and skin contact
R48/20	Harmful: danger of serious damage to health by prolonged exposure through inhalation
R48/21	Harmful: danger of serious damage to health by prolonged exposure in contact with skin
R48/22	Harmful: danger of serious damage to health by prolonged exposure if swallowed
R48/20/21	Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/20/22	Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/21/22	Harmful: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/20/21/22	Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R48/23	Toxic: danger of serious damage to health by prolonged exposure through inhalation
R48/24	Toxic: danger of serious damage to health by prolonged exposure in contact with skin
R48/25	Toxic: danger of serious damage to health by prolonged exposure if swallowed
R48/23/24	Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/23/25	Toxic: danger of serious damage to health by prolonged exposure through

	inhalation and if swallowed
R48/24/25	Toxic: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/23/24/25	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R50/53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R52/53	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R68/20	Harmful: possible risk of irreversible effects through inhalation
R68/21	Harmful: possible risk of irreversible effects in contact with skin
R68/22	Harmful: possible risk of irreversible effects if swallowed
R68/20/21	Harmful: possible risk of irreversible effects through inhalation and in contact with skin
R68/20/22	Harmful: possible risk of irreversible effects through inhalation and if swallowed
R68/21/22	Harmful: possible risk of irreversible effects in contact with skin and if swallowed
R68/20/21/22	Harmful possible risk of irreversible effects through inhalation, in contact with skin and if swallowed

Safety advice (S phrases)

(S1)	Keep locked up
(S2)	Keep out of the reach of children
S3	Keep in a cool place
S4	Keep away from living quarters
S5	Keep contents under ... (appropriate liquid to be specified by the manufacturer)
S6	Keep under ... (inert gas to be specified by the manufacturer)
S7	Keep container tightly closed
S8	Keep container dry
S9	Keep container in a well-ventilated place
S12	Do not keep the container sealed
S13	Keep away from food, drink and animal foodstuffs
S14	Keep away from ... (incompatible materials to be indicated by the manufacturer)
S15	Keep away from heat
S16	Keep away from sources of ignition – No smoking
S17	Keep away from combustible material
S18	Handle and open container with care
S20	When using do not eat or drink
S21	When using do not smoke
S22	Do not breathe dust

S23	Do not breathe gas/fumes/vapour/ spray (appropriate wording to be specified by the manufacturer)
S24	Avoid contact with skin
S25	Avoid contact with eyes
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
S27	Take off immediately all contaminated clothing
S28	After contact with skin, wash immediately with plenty of ... (to be specified by the manufacturer)
S29	Do not empty into drains
S30	Never add water to this product
S33	Take precautionary measures against static discharges
S35	This material and its container must be disposed of in a safe way
S36	Wear suitable protective clothing
S37	Wear suitable gloves
S38	In case of insufficient ventilation wear suitable respiratory equipment
S39	Wear eye/face protection
S40	To clean the floor and all objects contaminated by this material use (to be specified by the manufacturer)
S41	In case of fire and/or explosion do not breathe fumes
S42	During fumigation/spraying wear suitable respiratory equipment (appropriate wording to be specified by the manufacturer)
S43	In case of fire use ... (indicate in the space the precise type of fire-fighting equipment. If water increases the risk add - Never use water)
S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)
S46	If swallowed, seek medical advice immediately and show this container or label
S47	Keep at temperature not exceeding ... °C (to be specified by the manufacturer)
S48	Keep wet with ... (appropriate material to be specified by the manufacturer)
S49	Keep only in the original container
S50	Do not mix with ... (to be specified by the manufacturer)
S51	Use only in well-ventilated areas
S52	Not recommended for interior use on large surface areas
S53	Avoid exposure - obtain special instructions before use
S56	Dispose of this material and its container at hazardous or special waste collection point
S57	Use appropriate containment to avoid environmental contamination
S59	Refer to manufacturer/supplier for information on recovery/recycling
S60	This material and its container must be disposed of as hazardous waste
S61	Avoid release to the environment. Refer to special instructions/safety data sheet

S62	If swallowed, do not induce vomiting seek medical advice immediately and show this container or label
S63	In case of accident by inhalation: remove casualty to fresh air and keep at rest
S64	If swallowed, rinse mouth with water (only if the person is conscious)

Combinations of S phrases

(S1/2)	Keep locked up and out of the reach of children
S3/7	Keep container tightly closed in a cool place
S3/7/9	Keep container tightly closed in a cool, well-ventilated place
S3/9/14	Keep in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer)
S3/9/14/49	Keep only in the original container in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer)
S3/9/49	Keep only in the original container in a cool, well-ventilated place
S3/14	Keep in a cool place away from... (incompatible materials to be indicated by the manufacturer)
S7/8	Keep container tightly closed and dry
S7/9	Keep container tightly closed and in a well-ventilated place
S7/47	Keep container tightly closed and at temperature not exceeding ... °C (to be specified by the manufacturer)
S20/21	When using do not eat, drink or smoke
S24/25	Avoid contact with skin and eyes
S27/28	After contact with skin, take off immediately all contaminated clothing, and wash immediately with plenty of ... (to be specified by the manufacturer)
S29/35	Do not empty into drains; dispose of this material and its container in a safe way
S29/56	Do not empty into drains, dispose of this material and its container at hazardous or special waste collection point
S36/37	Wear suitable protective clothing and gloves
S36/37/39	Wear suitable protective clothing, gloves and eye/face protection
S36/39	Wear suitable protective clothing and eye/face protection
S37/39	Wear suitable gloves and eye/ face protection
S47/49	Keep only in the original container at temperature not exceeding ... °C (to be specified by the manufacturer)

Source: **Safety in University Chemistry Courses,** An Introduction for Students, Deutsche Gesetzliche Unfallversicherung (DGUV), Berlin, 2009, pp. 124 - 130

PART 8. EXTREMELY OR HIGHLY FLAMABLE LIQUIDS

Attention! Always read the MSDS before handling any chemicals.

Any solution compounded from flammable reagent should also be labeled as flammable liquid. Pay attention to this indication of danger for every flammable liquid.

No.	Indication of Danger	R Phrase	Hazard Symbol	Flash Point	Boiling Point	Example
1	Extremely Flammable	R12	F+	<0°C	≤35°	Acetaldehyde
2	Highly Flammable	R11	F	<21°C	56-57°C	Acetone
3	Flammable	R10	-	21 ≤ FP ≤55 °C	98-100 °C	butan-2-ol

Source: **Safety in University Chemistry Courses,** An Introduction for Students, Deutsche Gesetzliche Unfallversicherung (DGUV), Berlin, 2009, pp. 124 - 130

When working with Extremely or Highly Flammable Liquid, make sure that:

- ✓ Use provided fume hood to control hazard. Some flammable liquids are also volatile
- ✓ Maximum volume of 1 L per handling
- ✓ Keep the bottle closed when not used
- ✓ Keep away from heat source
- ✓ Store in appropriate cabinet (Do not store in refrigerator or freezer)

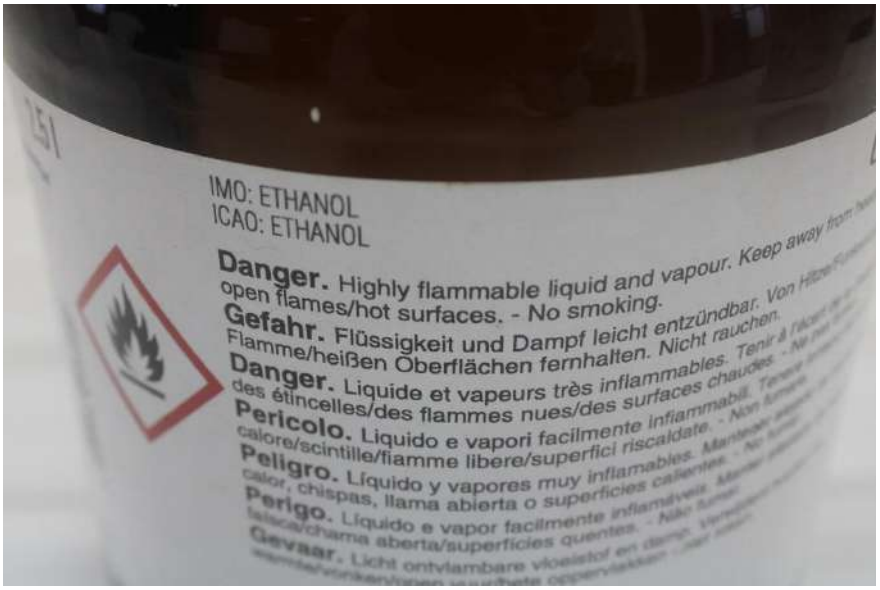


Figure 16. Warning on Highly Flammable Liquid

Vapor of flammable chemicals can travel a considerable distance and ignite fires even at a point remote from the chemical source. Ignited substance generate heats which will worsen

the fire because it will vaporize more substance to fuel the fire. So, it is important to handle these substances in are free of ignition source. Always pay close attention when handling such chemical

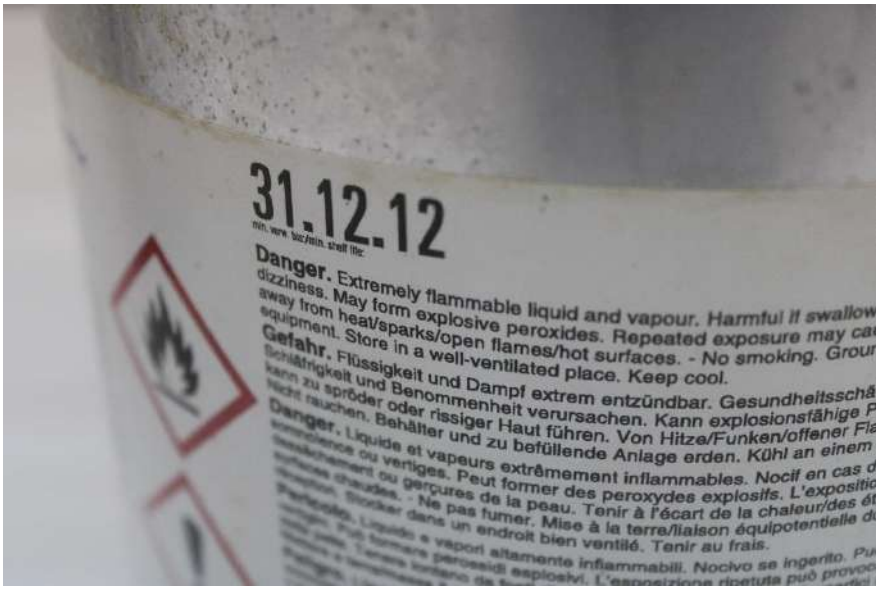


Figure 17. Warning on Extremely Flammable Liquid

PART 9. SELF-IGNITING SUBSTANCES

Attention! Always read the MSDS before handling any chemicals.

Self-igniting substances are chemicals that spontaneously ignite upon contact with air and/or water. Self-igniting substances are another source of fire hazard than can cause laboratory fire or explosion. Alkali metals and their hydrides and white phosphorus are particularly common in lab. Pay attention when handling such substance.

PART 10. POTENTIALLY EXPLOSIVE SUBSTANCE AND MIXTURE

Attention! Always read the MSDS before handling any chemicals.

Potentially explosive substances or mixture of substances can react violently upon exposure to thermal energy such as heat and flames or mechanical energy such as friction or shock and hence release high energy and form high pressure results in very fast propagation of shock waves. Types of explosion include:

- ✓ Confined vapor cloud explosion: gas or vapor burns in a confined volume and rapid expansion of the ignition products is restrained until failure of the container or building occurs.
- ✓ Boiling liquid expanding vapor explosion: follows failure of a pressurized container of flammable liquid, e.g. LPG, or a sealed vessel containing volatile flammable liquids, under fire conditions. Ignition results in a fireball and missiles.
- ✓ Dust explosion
- ✓ Explosion due to thermal deflagration or detonation of a solid or liquid.
- ✓ Unconfined vapor cloud explosion: a large flammable gas or vapor–air cloud burns in free space with enough speed to generate pressure waves, which spread through the cloud and into the surrounding air. This kind of events are extremely rare.

Some example of potentially explosive substance are:

- Nitroso and nitro compound
- Highly nitrated aromatic compounds (TNT, picric acid)
- Esters of nitric acid
- Compound with N-N bonds (azo and diazo compounds, hydrazoic acid, azides)
- Fulminates (HCNO)
- NCl_3 and ICl_3
- Acetylides
- Peroxidic compounds (peroxy acid, peroxy esters, peroxides, hydroperoxide)

PART 11. WORKING WITH PEROXIDE FORMING SUBSTANCE

Attention! Always read the MSDS before handling any chemicals.

Ether (like diethyl ether), when comes in contact with air (and react with oxygen), could form explosive peroxide, which includes the headspace in the reagent bottles. This peroxide can be concentrated, e.g. by distillation. To prevent explosion, follow these following rules:

- ✓ Store in brown bottle and do not put the container under direct sunlight exposure
- ✓ Minimize the headspace by ensuring the container always full if possible
- ✓ Add Potassium Hydroxide (KOH) if the chemical will be stored for a long time
- ✓ Use peroxide test kit to test peroxide formation in the substance before using it
- ✓ Peroxide can be separated from the ether using chromatography

Figure 18. Diethyl Ether is a commonly peroxide forming compound. Adding KOH is recommended when storing ether for long time period (to form insoluble peroxide salt)

PART 12. WORKING WITH CARCINOGENIC, MUTAGENIC AND REPRODUCTION TOXIC SUBSTANCE (CMR)

Attention! Always read the MSDS before handling any chemicals.

When working with CMR chemicals, pay attention to these following rules:

- ✓ If possible, do not use those substance, try to find a substitute chemical (like by replacing Benzene with Toluene)
- ✓ Use proper protection equipment (Lab Coat, Googles, Masker)
- ✓ Always work with such chemical under fume hood (acid cabinet)
- ✓ Do not leave the chemical unattended
- ✓ Dispose accordingly

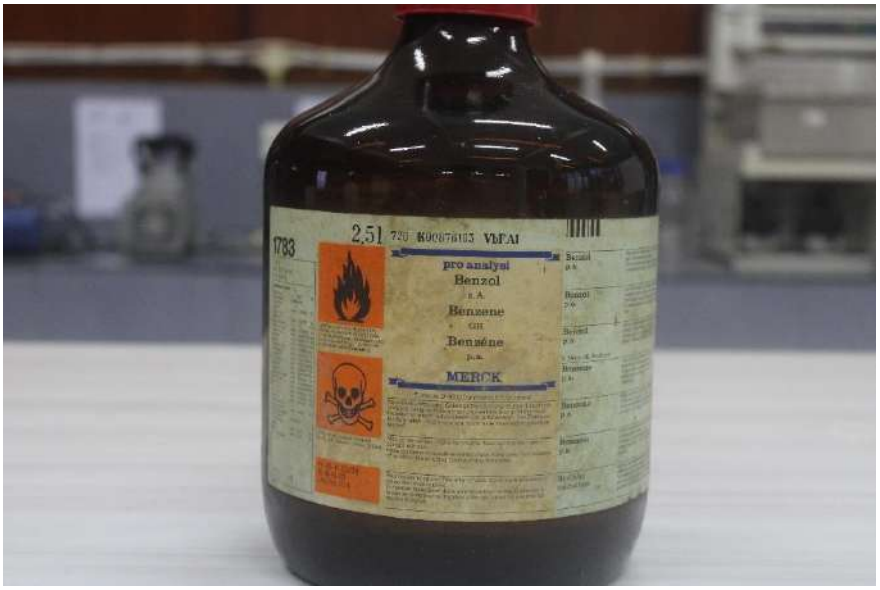


Figure 19. Benzene

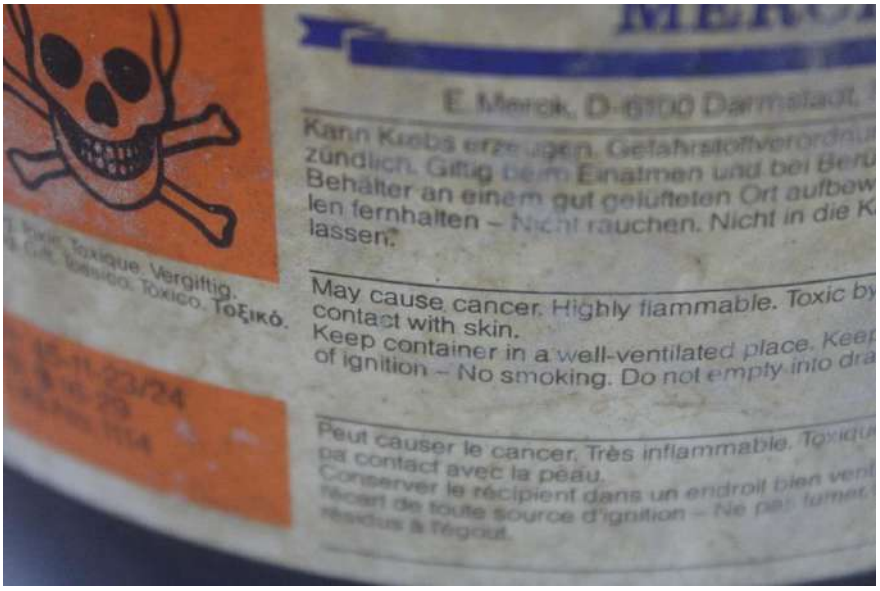


Figure 20. Carcinogenic Warning

PART 13. CLEANING AND DISPOSAL

Attention! Always read the MSDS before handling any chemicals.

When disposing used chemicals or cleaning apparatus, make sure that:

- ✓ Always refer to Cleaning and Disposal SOP
- ✓ Do not dispose organic substance waste into lab sink
- ✓ Calculate the exact amount of chemical need for pre-treatment. Such chemical will react to neutralize/reduce/oxidize the chemical substance, so it is safer to handle. It is important to make sure that the chemical waste fully react before disposing it.
- ✓ Collect all organic liquid in special container. Mineral oil waste typically dangerous to the environment and should be stored in different container and labelled appropriately
- ✓ Solid waste must be collected separately
- ✓ Use appropriate protective garment when cleaning or disposing chemicals
- ✓ Flush residual chemical from vessel using suitable and non-toxic solvent and dispose the solvent accordingly
- ✓ Do not dry the solvent rinsed equipment in the oven/drying cabinet with heater because the risk of fire ignition
- ✓ Aggressive or corrosive cleaning agent may be used when other cleaning agent have been found ineffective
- ✓ Usage of dichromate-sulphuric acid as cleaning agent is allowed in special cases and make sure that no hazardous reaction will happen upon cleaning with the substance
- ✓ Cleaning with detergent should only be performed after abovementioned pre-cleaning treatment

*Figure 21. Example of Lab Sink. Unless stated so, **DO NOT DISPOSE ANYTHING INTO THE SINK***

PART 14. PRE-DISPOSAL TREATMENT

Attention! Always read the MSDS before handling any chemicals.

Chemical	Treatment	Disposal
Sugars ad amino acid	Do not require pre-treatment	Dispose into sink
Dilute buffer solution	Do not require pre-treatment	Dispose into sink
Low volume of low toxic organic solvent such as ethanol or isopropanol (<100 ml)	Dilute with water to reach concentration <10%	Dispose into sink
Strong Acid and Bases	Added dropwise into excess of ice water, neutralized	Dispose into sink
Anhydride of Carboxylic Acid, Chloride of Carboxylic Acid, Phosphoroxychloride, Thionychloride and Phenylsocyanate	Added dropwise into excess of ice water or solution of 10% Sodium Hydroxide (NaOH), Neutralized	Collect in special container, do not dispose into sink
Alkali metals	Cut into small pieces and add to suitable alcohol under constant stirring, dilute with water	Collect in special container, do not dispose into sink
Thiol, Sulphide	Oxidized with excess of 15% Sodium Hypochlorite	Collect in special container, do not dispose into sink
Bromine, Iodine	Neutralized/Reduced with Sodium Thiosulfate	Dispose into sink
Mercury	Use special adsorbent to collect small pieces of Mercury droplets (e.g. when mercury thermometer is broken)	Collect in special container, do not dispose into sink
Peroxides in small amount	Reduce with Fe^{2+}, Zn^{2+}, Sn^{2+} salt or bisulphite, neutralized	Collect in special container, do not dispose into sink
Dimethylsuphate	Added dropwise into cold ammonia, neutralized	Collect in special container, do not dispose into sink
Cyanide	Oxidized with excess of 15% Sodium Hypochlorite	Collect in special container, do not dispose into sink

PART 15. LABORATORY ANIMAL WASTE AND BIOLOGICAL SAMPLE

All animal waste (whole or organs) must be double bagged in a heavy-duty, dark colored bag. The bag must be properly sealed to hold its content and to prevent any leakage or odor release. Before sealing and transporting animal waste, ensure no free-flowing liquid is inside the bag. All fluid must be absorbed and disposed separately. Each bag should notexceed 10 kg to ease transport and to avoid bag rupture.

*Figure 22. Example of Lab Sink. Unless stated so, **DO NOT DISPOSE ANYTHING INTO THE SINK***

PART 16. GLASSWARE SAFETY AND WASTE

Before working with glassware, review it for imperfection thoroughly, imperfect glassware can be dangerous when used. If defects are found, glassware should be returned immediately to the lab technician to be replaced with new one. Use appropriate gloves when handling glassware and carry it using two hands. When storing glassware, remember to keep it away from the shelf/table edge.

Glassware are fragile and breaks easily so extra care and precaution should be taken when handling glassware. When accident happen, consider this following rule:

If the glassware is falling, do not try to catch it. The glassware may break in your hand and cause injuries.

- ✓ Wear cut-resistant gloves when handle broken glass whenever possible.
- ✓ Use mechanical means to pick up broken glass pieces
- ✓ Never use bare hands when picking broken glass. Use thongs, tweeters or forceps to collect broken glass pieces
- ✓ Make sure to notify nearby lab mates or any other person so they do not step on broken glasses before you finish cleaning them.
- ✓ Dispose the broken glass in a rigid, puncture resistance container
- ✓ Separate clean glass waste with contaminated broken glass, keep the contaminated glass in separated sealed container

*Figure 23. **CORRECT** to handle and transport glassware*

PART 17. FIRST AID IN CASE OF CHEMICAL ACCIDENTS

Follow this procedure upon chemical accidents:

- ✓ Rescue injured or poisoned person from the danger zone
- ✓ Pay attention when rescuing the victim, do not cause self-harm during the process
- ✓ The place for first aid should be selected so that immediate transport to the hospital is possible and no further helpers need to enter the danger zone
- ✓ Use appropriate protective garment when helping the victim to ensure that the helper/first aider does not cause self-harm
- ✓ Immediately call the emergency department hospital (M Yunus Hospital). Notify emergency medical service with complete information about **where it has happened**, **what has happened**, **how many people were injured**, and **which kind of injury** and wait for further inquiry.
- ✓ Organize the transport to the hospital
- ✓ Make a report of any accident that happened in the lab. Make sure that the lab head is notifiedimmediately.
- ✓ Facilitate fresh air supply by opening constraining clothing and immediately removing contaminated clothing.
- ✓ Rinse exposed skin with plenty of water. Use the air shower provided in the lab.
- ✓ If the chemicals have got into contact with eyes, immediately rinse both eyes with water using an eye shower provided in the lab for at least 10 minutes while holding open the eyelid with fingers

Figure 24. Using Laboratory Shower