



Safety

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Life is very precious and we have one life Safe working protects:

You Other lab workers Cleaners Visitors Your work Your surrounding

What does law say?

Health & Safety at Work Act 1974

You must work safely You must not endanger others You must not misuse safety equipment



Penalty – up to 2 year in prison &/or an unlimited fine Hence you must perform risk assessment before each operation

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Lab safety begins before you go to the Lab

Always plan well ahead before the start of your experiment (Reaction procedure, glassware, Chemicals required, Precautions related to chemicals and reaction conditions)

If you are not sure about anything dont hesitate to bother your supervisor/senior member in lab





Know your Chemical before you start



Read Material safety data sheet (MSDS)



MSDS contains informations about

- Flammability
- Toxicity
- Exposure Risks (contact, inhalation, ingestion)
- Reactivity and Fire Hazards
- Mixing Hazards (with other chemicals)
- Emergency First Aid Procedures
- Spill Handling Procedures
- Disposal Procedures

Some terms in MSDS

- LD₅₀ Lethal Dose, 50% Mortality mg/kg
- TLV Threshold Limit Value mg/m³ (ppm)
- PEL Permissible Exposure Limit mg/m³ (ppm)
- STEL Short-Term Exposure Limit mg/m³ (ppm)
- Carcinogen a substance shown to cause cancer
- Teratogen a substance shown to cause birth defects

Control measures

Use a less risky substance

Use a safer form of that substance solution instead of powder)

Totally enclose the process (Ex. a glove-box)

Partially enclose the process (Ex. with a fume cupboard)

Ensure good general ventilation

Use gloves when handling chemical bottles

Clean the bottles from outside





Incompatible storage





Chemicals vaporize and react with each other and surroundings

Control Measures

- Separate Groups with Barriers (eg: acids and bases)
- Flammables Cabinets
- Corrosives Below Eye Level
- Inspect Containers and Labels Weekly
- Keep Chemical Use Areas Free From Contamination
- Close/Cap All Containers Not in Use.
- Clean Drips and Spillage of Container
- Maintain the Minimum on the Work Surface





Potential shock sensitive materials

Ammonium nitrate, Ammonium perchlorate Ammonium picrate, Calcium nitrate, Copper Acetylide, Cyanuric triazide, Trinitroanisole Trinitrobenzene, Trinitro -----?

Potential peroxide forming materials

Acetal Ether (Glyme), Cyclohexene , Decahydronaphthalene, Tetrahydronaphthalene, Methyl Acetylene Dicyclopentadiene, Isopropyl Ether, Diethyl Ether, Tetrahydrofuran (all ethers)

Control Measures

- Store the compatible chemicals together
- Reduce exposure times, increase distance, reduce volumes of chemicals



Personal protective equipment (as a last resort for primary protection). Before that you should take all the precautionary measures listed above.

Proper Lab behavior

Never indulge in horseplay or behavior that could lead to an injury/accident to others Eg: Playing holi in lab, playing with ice/dry ice etc.

Do not consume lab ice or deionised water or chemicals meant for laboratory purpose (eg: Citric acid, sucrose, NaCl etc.)

Do not apply cosmetics in lab

Never pipette by mouth







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Proper Lab behavior

- It is advisable not to work alone in the lab. Nobody should work alone between 8PM to 7AM. Under special conditions one may work alone during these hours with supervisor's permission.
- Try to maximise your work when most of the lab members are there (preferably in daytime)
- Unattended operations require
 (i) Permission (ii) Fail-safe Plan; (iii) Emergency Instructions; (iv) Lights On

Proper Lab behavior

- Public access must be prohibited to visitors and non-institute personnel. If needed, they must come with a a senior member with safety glasses.
- Lock lab doors when unoccupied
- Lab staff who are unwell should consult their personal physician and provide them with the details of the chemicals they use
- Never touch your face, mouth or eyes
- Never suck pens or chew pencils/nails
- Remove your gloves before using instruments, telephone and leaving the laboratory

Remove the lab coat when you come out of the lab

Proper dressing

Use goggles, gloves and lab aprons. Face shields do not replace eye protection

Contact lenses are not to be worn in the lab

Due to the dangers of broken glass and corrosive liquid spills one must use shoes in the lab



Loose clothing and untied hair are restricted







Proper dressing

Closed toed shoes of non-woven material with non-slip soles

Clothing that covers arms and legs, NO SHORTS

- Lab coats with closed fasteners
- Non-flammable, non-porous aprons when using corrosives
- Remove before leaving the lab
- Launder separately



Proper dressing



goggles

glove

lab coat

- There are many different types of protective glove
- Use the correct ones for the job you will be doing
- Clean or discard after you use
- Remember that you need to select chemical protection gloves according to the materials and/or substances with which you will be working

Do not use latex gloves for protection from organic chemicals

Safe Lab practices

- Learn the location and proper usage of the eyewash fountain, fire extinguisher, safety shower, fire alarm box, telephone numbers, evacuation routes, clean-up brush and dust pan, glass/chemical disposal can.
- Never look directly into a test tube. View the contents from the side. Point test tubes that are being heated away from you and others.

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- Never taste any material in the lab.
- Food, drink and gum are prohibited in lab.







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Safe Lab practices

Never smell a material in a test tube or flask directly. Instead, with your hand, "fan" some of the fumes to your nose carefully.





All labs should have first aid boxes maintained

Emergency lamps (Bulbs) to be fixed in each lab and appropriate places in the corridor, that can help to vacate lab in case of emergency exits or power failure. (each costs around Rs 350)

Safe Lab practices

Cap All Containers when transporting

- Tightly Sealed, Inside Secondary Containment
- Use Freight Elevator, Use trolleys for carrying big containers
- Ground Metal Containers When Dispensing Flammable Liquids



In the event of Lab accident

- Report all accidents regardless of how minor to your supervisor. For minor skin burns, immediately plunge the burned area into cold water and notify your supervisor.
- If you get any chemical in your eye, immediately wash the eye with the eye-wash fountain for 15 min and notify the supervisor.
- Immediately notify the supervisor of any chemical spill and clean up the spill as directed. If the chemical is very hazardous it is better to leave the space.

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In the event of Lab accident

- If the skin is exposed to moderate concentrations of acid/ base/hazardous chemicals, wash thoroughly with running water.
- Remove any contaminated clothing at once
- If noxious gas has has been inhaled, contact authorities immediately and get fresh air asap
- In the event of injury consider dialing emergency number
- It better to have an extra cautious attitude while judging the situation (toxicity, deep burn, deep cut etc)

What are the general hazards in a laboratory?

Se Fire

- Breakage of glassware
- Sharps (broken glass/syringe needles)
- Spillages
- Pressure equipment & gas cylinders
- Extremes of heat & cold
- Chemical hazards
- Biological hazards



How to avoid

Flammable substances

Use minimum quantity

Store in special storage cabinet

Use temperature-controlled heating sources

How to minimize the damage ?

Make sure that you know what to do: If you have a fire

- Only Trained Individuals May Use fire extinguisher: PASS Method: Pull, Aim, Squeeze, Sweep.
- Once used replacement should be done soon

Breakage of Glassware

Use correct techniques for the insertion of tubing onto glassware

- Never use glassware under pressure or vacuum unless it is designed for the job and suitably shielded
- Dispose off chipped or broken glassware it is a risk to you and others
- Always dispose off broken glass in a glass bin or sharps bin and not in a general waste bin

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Don't use the glassware with cracks and sharp edges





Spillage of Chemicals

Clear up spillage promptly

You might have determined how to do this as part of your risk assessment

Dispose of any hazardous material as toxic waste

In the event of a spill: If the spill represents an increased risk of exposure you or others, GET HELP! Leave the area, close all doors and call for assistance



Messy workers are usually incompetent workers!!

Gas cylinders

- Never use without formal training
- Minimize the number in a laboratory
- Store externally whenever possible
- Cylinders are heavy and can do serious damage to you if they fall
- Ensure that they are chained when in use
- Move only with a cylinder trolley
- Use regulators & control equipment suitable for the gas concerned
- Consider the consequences if your cylinder leaks

Cryogenics

Liquid gasses are extremely cold and can cause burns

Liquid gases evaporate and many can cause asphyxiation

If you need to take cryogens in a lift, there are special procedures to follow – speak to your supervisor or a senior member of technical staff

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You must have special training to use them





Electrical equipment

- Always do a visual check on electrical equipment before use, looking for obvious wear or defects
- All portable electrical equipment should be checked from time to time
- NEVER use defective equipment
- In case of any unexplained sparks, shorts, heating or sudden malfunctioning of electrical devices;
 - (a) call electrician for immediate check up (2915)
 - (b) Do not use that and neighboring connections before completion of (a)
- In case of electrical fire turn off the mains and notify immediately



General tidiness



- Keep your workplace tidy
- Clear up waste, deal with washing up and put things away as you finish with them
- Make sure everything is safe before you leave things unattended
- A tidy laboratory avoids accidents to everyone
- Work at least 6 inches into the hood

General tidiness

Maintain clear working places

- Maintain Clear Access to Fire Extinguishers, Safety Showers and Eyewashes
- Label Doors that Are Blocked
- Keep Storage shelves off the floor and Out of the Halls
- Corrosive chemicals should be stored below eye levels

Laboratory equipment

Never use any laboratory equipment/analytical instrument unless you are trained & have been authorized to do so

As well as injuring yourself you may cause very costly damage which can not be repaired



First aid

All laboratory workers should undergo simple first aid training

For all chemical splashes, wash with plenty of water for 10 minutes

In the case of cuts, control bleeding with direct pressure, avoiding any foreign bodies such as glass

Use proper bandage and take to doctor

Report all accidents to your supervisor or departmental safety officer





Protecting your health

- If you have an allergy to lab materials or suffer from a medical condition which may affect you in the laboratory (eg diabetes or epilepsy), ensure that your supervisor knows
- Routes of exposure to chemicals
- Inhalation
- Absorption
- Ingestion
- Injection



Solution of the material being used.

Inhalation

- Primary Route of entry is nose
- Airborne contaminants such as gases, vapors and particulate matter that enter directly into lungs.
- Chemical fume hood is the primary control available.



Respiratory protection or specialized exhaust may be necessary where a fume hood cannot be used.

Injection

Includes all puncture wounds. Ex: needle sticks, glass shards, cannula or capillary tubes puncturing skin

- Difficult to protect against
- Use carefully planned procedures and personal diligence, including needle blocks.





Absorption

Can occur very quickly through cuts or abrasions on the skin.

Depending on the characteristics of the contaminant, absorption may occur through intact skin (example: phenol)



- Mucous membranes and eye tissue are particularly vulnerable
- Barrier protection (such as gloves) and personal hygiene are the primary control measures.

Ingestion

Solution Includes direct tasting of chemicals.

More often occurs when contaminated items are placed in the mouth.

Purpose for banning food, drink, tobacco, and cosmetics in the lab.

Personal hygiene, labeling and housekeeping are very important to ingestion hazard control.



Waste materials

Part of your risk assessment will be to determine how to dispose off waste lab materials safely

- Solvents and oils must be segregated into the correct waste bottle or drum
- Your department will help you determine what to do with chemical or biological materials

Do not put materials down the drain or in with normal waste unless authorized to do so

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Destroy before disposal

- Alkyl boranes, Aluminum Alkynes, Ammonium Nitrate
- Benzoyl Peroxide
- Calcium Carbide, Chromic Acid, Cyanides
- Ethers
- Grignard Reagents
- Hydrogen Peroxide
- Iron Sulfide
- Metal Alkyls, Metal Hydrides
- Peracetic Acid Solution, Peroxide Forming Compounds, Picric Acid
- Sulfides
- Water reactive metals (Lithium, Potassium, Sodium, Cesium)

Avoid Chemical contamination

- Do not put chemicals back into reagent bottles. If they are contaminated, then whole bottle will be useless.
- Returning an unused chemical to a container risks contamination.
- Take only the amount you need.
- Extra material must be placed in the appropriate chemical waste container.
- Take only as much as you need.

Solvent disposal

- Try to recycle and reuse most of the organic solvents
- Try to minimize the use of hazardous solvent
- Solvents for disposal should be separated into halogenated and nonhalogenated
- Corrosive Acids and bases should be stored separately in glass containers with tight cap

Working outside normal hours/at weekends

- You will need to have permission from your supervisor before working outside normal hours
- Most experimental work is not permitted
- Your supervisor will explain the requirements in more detail

When in doubt - ASK!!!

Do not carry out a new or unfamiliar procedure until you have been fully trained & understand the precautions necessary for safe working

DO NOT GUESS!!!!

Asking prevents an accident!!



At the end of lab session

- Replace all lab materials and equipment to their proper places after use.
- Dispose off all chemicals AS DIRECTED BY YOUR SUPERVISOR!
- Wash and dry all equipment, your lab bench and your clean-up area.
- Switch off/disconnect all the instruments that are not in use when you leave (vacuum pump, fume hood, oven, running reactions, solvent distillation unit)



At the end of lab session

- Heating systems are off/at proper temperatures
- Taps & lights turned off Wash hand/arms before leaving the lab
- Keep the lab coat in a proper place to avoid contamination and restrict the labcoat to lab



Choose the least hazardous chemical, Purchase in small Quantity

Develop a departmental chemical inventory so as to reduce the spending and unnecesary accumulation of chemicals

Minimize storage, Be Aware of Materials with Shelf Life

Discard chemicals not used in past 3 years or not identified for future procedures

Store chemicals in compatible groups

- Maintain Labels on Incoming Containers
- Replace Torn or Defaced Labels
- Label Secondary Containers Immediately
- Label Content
- Name of Hazardous Chemical
- Hazard Warning
- Name of Responsible Party
- Date of Preparation







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- Do not block Air Supply or Return Grills
- Do Not Remove Ceiling Tiles
- Do Not Store Chemicals in Chemical Fume Vent Hoods
- Use Toxic or Odorous Chemicals in Fume Hoods
- Use For All Operations Where Odoriferous, Volatile, Toxic or Harmful Release Possible
- Assure Hood is Properly Functioning
- Annual hood testing is necessary



Hoods are tested with dry ice & face velocity is measured
A sticker will be placed indicating maximum sash height
Hoods that do not pass will be posted out of service
Ductless or Recirculating Fume Hoods are PROHIBITED





Contact numbers

Emergency safety numbers to be displayed in every lab (may be on the door or near telephone)

- a. IITG Hospital (2099) Emergency (2097)
- b. Ambulance (Dist. Admin) 102;
 Emergency (Dist. Admin) 108
- c. Fire (Dist. Admin) 101
- d. Security 2140, 2141 (Security control room, Admin Block)
- e. Electrician: 2915
- f. Police (Dist. Admin) 100
- e. Numbers of all students and supervisor

Safety committee rules

The rules to be maintained by all labs

- a. No Food allowed inside the Laboratory
- b. Desktops and benches should be kept clean : every chemical properly labeled
- c. Solvent bottles should remain closed at all times
- d. Lab coats, and safety goggles to be worn while handling chemicals
- e. Shoes (no sandals) to be worn inside labs at all times
- f. Storage and disbursal of unused chemicals can solvents should be done in a proper way
- g. Between 8pm-7am, one should not work alone in the laboratory

h. A first aid box should be maintained in each lab

Department of **Chemistry**



Acknowledgements

Various sources from internet

Have a safe working atmosphere Care about yourself and others, while you work



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