

Applied Mechanics Laboratory Safety Plan

Contents

| | |
|--|----|
| Introduction..... | 03 |
| General Laboratory Safety Rules..... | 03 |
| Laboratory Safety Symbols, Signs, and Meanings | 04 |
| Some common Warning and Hazard symbols in the lab..... | 04 |
| Entry/Working requirement symbols in the lab | 05 |
| Location symbols of a specific object in the lab | 06 |
| Emergency Procedures..... | 08 |
| Earthquake Response Procedures..... | 10 |
| First Aid Procedures for Common Injuries..... | 11 |
| Safety in Laboratories for Applied Mechanics Lab | 11 |
| Sessional Course: ME 350 and ME 244 | 12 |
| Applied Mechanics Laboratory..... | 12 |
| References | 14 |
| Emergency Contact List..... | 15 |

1. Introduction to Laboratory Safety

Laboratory settings are essential for research and education, but because of the inherent dangers of chemicals, biological agents, machinery, and other elements, they can be extremely dangerous. This handbook's objective is to provide an overview of the safety procedures required to safeguard everyone in the laboratory. By reducing hazards and averting mishaps, these protocols guarantee a secure and effective atmosphere for students, employees, and guests.




2. General Laboratory Safety Rules





- **Personal Protective Equipment (PPE):**
 - Lab coats, gloves, and safety goggles must be worn at all times.
 - Specific PPE (e.g., face shields, respirators) must be used depending on the hazards present (e.g., working with corrosive materials, biological substances, or volatile chemicals).
 - Always inspect PPE before use for damage or contamination.
- **No Eating or Drinking:**
 - No food or beverages are allowed in the laboratory. This reduces the risk of chemical ingestion or contamination.
 - Ensure that hands are thoroughly washed before leaving the laboratory.
- **Work Area Organization:**
 - Keep workspaces clean and uncluttered to reduce the risk of spills, accidents, and contamination.
 - Avoid leaving hazardous materials unattended.
- **Access to the Laboratory:**
 - Access to restricted areas (e.g., chemical storage rooms, biohazard labs) should only be granted to authorized personnel who have received appropriate safety training.

- **Chemical Hygiene:**
 - Always check the labels on containers to verify their contents.
 - Use fume hoods and ventilated spaces when handling volatile or toxic substances.
- **Equipment Handling and Training:**
 - Proper training is required before operating any equipment.
 - Only use equipment for its intended purpose. Ensure all equipment is in good working condition and properly calibrated.
- **Waste Disposal:**
 - Dispose of hazardous materials according to specific guidelines (chemical, biological, radioactive, or general waste).
 - Label waste containers clearly with contents and hazard class.




3. Laboratory Safety Symbols, Signs, and Meanings








Understanding the various symbols and signs used in the laboratory is crucial for personal safety. Each symbol represents specific hazards that can be dangerous to health.

| Name of the symbol | Symbols | Meaning |
|--------------------|--|--|
| General Warning |  <p style="text-align: center;">General Warning</p> | Presence of possibly hazardous materials/environment |
| Health Hazard |  <p style="text-align: center;">Health Hazard</p> | Presence of chemical, physical, or biological factors with the potential to have a negative effect on our health |
| High Voltage |  <p style="text-align: center;">High Voltage</p> | Supply of high-voltage electricity |







| Name of the symbol | Symbols | Meaning |
|--------------------|---|--|
| Electric Hazard |  Electric Hazard | Risk of getting electric shock. (The device might give mild to severe electric shock.) |
| Flammable Material |  Flammable Material | Presence of combustible materials (a substance that can easily burn) |
| Explosive Material |  Explosive Material | Presence of explosive and/or self-reactive substances |
| Hot Surface |  Hot Surface | Risk of burning if you touch with naked hands |

Entry/Working requirement symbols in the lab

| Name of the symbol | Symbols | Meaning |
|-------------------------|--|--|
| Gloves Required |  Gloves Required | Must use protective gloves in this area/while working in this area |
| Safety Glasses Required |  Safety Glasses Required | Must use protective/safety goggles in this area/while working in this area |
| Safety Shoes Required |  Safety Shoes Required | Must use closed-toe shoes in this area/while working |

| Name of the symbol | Symbols | Meaning |
|------------------------------|--|---|
| Lab Coat Required |  <p data-bbox="695 432 818 453">Lab Coat Required</p> | Must wear lab coat (apron) while in this area |
| Protective Clothing Required |  <p data-bbox="695 611 818 632">Protective Clothing Required</p> | Must wear full protective clothing |
| Respirator Required |  <p data-bbox="695 800 818 821">Respirator Required</p> | Must wear a breathing mask/respirator; the presence of contaminated air |
| Face/Safety Mask Required |  <p data-bbox="695 989 818 1010">Face Mask Required</p> | Must wear face/dust/safety masks |
| Face Shield Required |  <p data-bbox="695 1199 818 1220">Face Shield Required</p> | Must wear face shield while working |
| Hair Protection Required |  <p data-bbox="695 1388 818 1409">Hair Protection Required</p> | Must wear hair protection before working |
| Hearing Protection Required |  <p data-bbox="695 1577 818 1598">Hearing Protection Required</p> | Must wear a hearing protection device while working |

Location symbols of a specific object in the lab

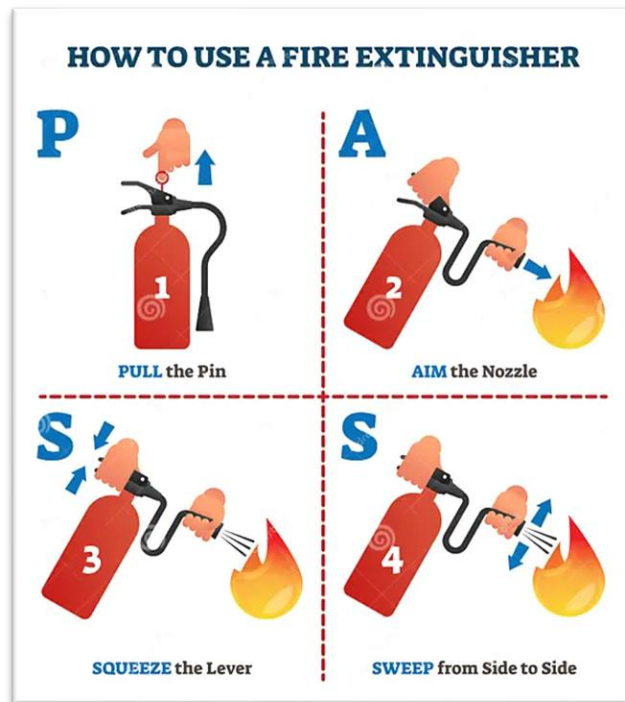
| Name of the symbol | Symbols | Meaning |
|--------------------|---|--|
| Fire Extinguisher |  <p data-bbox="683 594 829 615">Fire Extinguisher</p> | The location where the fire extinguisher is placed |
| First Aid |  <p data-bbox="716 835 797 856">First Aid</p> | The place with the first aid box and materials |
| Drinking Water |  <p data-bbox="691 1079 821 1100">Drinking Water</p> | Indicates safe water for drinking |
| Fire Blanket |  <p data-bbox="699 1318 813 1339">Fire Blanket</p> | The location where the fire blanket is placed |
| Fire Hose |  <p data-bbox="708 1566 805 1587">Fire Hose</p> | The location where the hose with water or any fire retardant is placed |
| Emergency Bell |  <p data-bbox="691 1814 821 1835">Emergency Bell</p> | Bell to be pressed during an emergency like fire or accident. |

6. Emergency Procedures

Lab safety relies on preparedness. In case of an emergency, knowing what to do can save lives.

- **General Emergency Response:**
 - **Remain Calm:** Try to keep a clear mind and follow emergency procedures.
 - **Alert Others:** Call for help and alert everyone in the lab of the emergency.
Activate the nearest emergency alarm if necessary.
 - **Evacuation:** Follow evacuation protocols as per the building's emergency plan.
Do not use elevators during a fire emergency.
- **Fire Safety:**
 - **Fire Prevention:** Regularly inspect lab equipment and wiring to prevent electrical fires. Ensure that combustible materials are stored properly.
 - **Evacuation Plans:** Familiarize yourself with escape routes and emergency exits.
Conduct regular fire drills to practice evacuation procedures.
 - **Fire Extinguisher Types:** Know the difference between extinguishers (e.g., water, CO₂, foam) and which ones are suitable for different types of fires (A, B, C, D, K).
 - A fire extinguisher is a "first aid" tool (It's not meant for controlling large fires).
 - Suitable only for small, contained fires (Do not attempt to fight a large fire).
 - Limited duration: Depending on size, it sprays for 10 to 30 seconds.
 - Limited range: Typically, 5 to 10 feet, depending on the type and size.
 - Fire in front, exit behind: Always position yourself between the fire and your exit route.
 - Have a backup extinguisher and an observer: Ensure you have someone watching with an extra extinguisher for support.
 - If you're unsure, evacuate! If you don't feel confident in handling the fire, don't attempt it.
 - How to use a portable fire extinguisher: Follow the "P.A.S.S." method to tackle the flames:
 - **P – Pull the Pin**
This unlocks the extinguisher, ensuring it's ready for use.

- **A – Aim at the Base of the Flames**
Direct the nozzle towards the fire’s source, where it’s most effective. Aiming at the flames themselves won’t do the trick!
- **S – Squeeze the Trigger**
Gently press the trigger to release the extinguishing agent, all while keeping the extinguisher upright for optimal performance.
- **S – Sweep Side to Side**
Move the nozzle in a sweeping motion, covering the entire fire area. Continue until the fire is fully out, or you need to retreat for safety.
- By following these four easy steps, you can take control of small fires and prevent them from escalating. Always remember: safety comes first-if in doubt, evacuate and call for help!



- **Chemical Spill Response:**
 - **Small Spills:** For minor chemical spills, use spill kits available in the lab. Contain the spill and neutralize or absorb with appropriate materials.

- **Large Spills:** Evacuate the area and contact the emergency response team immediately. Use the emergency eyewash and safety shower if necessary.
- **Explosion or Chemical Reaction:**
 - In case of an explosion, immediately evacuate and do not attempt to extinguish the fire unless trained to do so.
 - Isolate the area and inform emergency responders of the substances involved.
- **Medical Emergencies:**
 - **Cuts or Burns:** Clean the wound with water and apply bandages. For burns, apply cool water but avoid ice.
 - **Chemical Exposure:** For chemical splashes, rinse the affected area with water for 15 minutes and seek medical attention.
 - **Cardiopulmonary Resuscitation (CPR):** If someone stops breathing due to a shock or injury, call for medical help and begin CPR if you are trained to do so.

7. Earthquake Response Procedures

While laboratory accidents are common, natural disasters like earthquakes can pose unique challenges.

- **Before an Earthquake:**
 - Secure heavy equipment to prevent it from falling.
 - Know where your emergency supplies are located.
- **During an Earthquake:**
 - **Drop, Cover, and Hold On:** Drop to the ground, cover your head, and hold onto furniture until the shaking stops.
 - Move away from windows, shelves, and overhead equipment.
- **After an Earthquake:**
 - **Check for Injuries:** Assess yourself and others for injuries and provide first aid.
 - **Inspect the Lab:** Check for chemical spills, broken glass, and equipment malfunctions.
 - **Evacuate:** Follow the building's evacuation protocols and wait for further instructions from emergency personnel.

8. First Aid Procedures for Common Injuries

- **Eye Exposure to Hazardous Chemicals:**
 - Use the nearest eyewash station immediately. Flush eyes for at least 15 minutes, lifting the eyelids to ensure thorough rinsing.
 - Seek medical attention if irritation persists.
- **Cuts, Punctures, and Lacerations:**
 - Clean the wound with antiseptic, apply pressure to stop bleeding, and cover with a sterile dressing.
 - For severe injuries, seek immediate medical attention.
- **Electrical Shock:**
 - **Do not touch the person** if they are still in contact with the power source. Cut off the power if safe to do so.
 - Begin CPR if necessary and call for emergency medical assistance.

Safety in Laboratories for Applied Mechanics Lab

Sessional Course: ME 350 and ME 244

The experiments of the courses ME 350 (*Mechanics of Machinery Sessional*) and ME 244 (*Mechanics of Solids Sessional*) are conducted in Applied Mechanics Laboratory, on the 4th floor (East) of ME Building.

Applied Mechanics Laboratory

Location: ME Building, 4th Floor (East)


Applied Mechanics lab conducts experiments based on the fundamentals of solid mechanics. Students of level-3 Term-1 and Level-2 Term-2 are taught here.

Applied Mechanics laboratory is one of the most significant laboratories of this department. It provides facilities for undergraduate teaching, final-year projects, and for research work leading to postgraduate degrees. This lab consists of several experimental setups for verifying the basic laws of solid mechanics. Various instruments like a Torsion testing machine, Instron machine, Hardness testing machine, Balancing machine, Hydraulic cutter, gyroscope etc. are available here.

Torsion Testing machine is used for the torsional shear test of materials. Instron Machine is used for tensile, compressive and elongation test of materials. Hydraulic cutter is used to pressurize PVC pipe and cut the pipes. Including sessional classes; it also serves the needs of the industries through consultancy and testing services. PVC pipe testing and G.I. pipe testing are mostly available in this laboratory. Besides these tests, solvent cement testing, rod test, and rubber pad test are also available in this laboratory.

Experiments conducted in this laboratory under ME 350 (*Mechanics of Machinery Sessional*) and ME 244 (*Mechanics of Solids Sessional*) Sessional courses:

1. Static and Dynamic Balancing of a Shaft
2. Bifilar Suspension
3. Free Vibration of a Single Degree of Freedom System
4. Determining Mass Moment of Inertia of a Flywheel
5. Study of Compound Pendulum
6. Study of Gyroscope
7. Critical Speed of a Shaft
8. Study of Cam
9. Helical Spring Test
10. Slender Column Test
11. Direct Shear Test of Metal

| Apparatus | |
|---|--|
|  | <p>Static and Dynamic Balancing of a Shaft</p> |

Apparatus



Bifilar Suspension



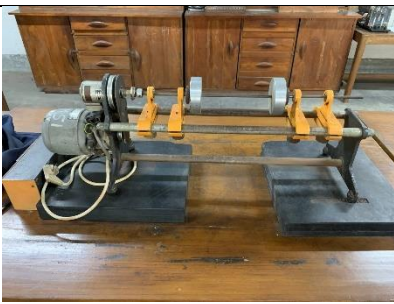



Free Vibration of a Single Degree of Freedom System






Determining Mass Moment of Inertia of a Flywheel

Apparatus

| | |
|---|-----------------------------------|
|  | <p>Study of Compound Pendulum</p> |
|  | <p>Study of Gyroscope</p> |
|  | <p>Critical Speed of a Shaft</p> |
|  | <p>Study of Cam</p> |

Apparatus

| | |
|--|----------------------------|
|  A photograph of a helical spring testing machine. It features a blue frame with a central vertical column. A circular dial with a needle is mounted on the column. Below the dial, a helical spring is held in a fixture. A green circular weight is placed on a platform at the bottom of the column. The machine is labeled 'A M' on its base. | Helical Spring Test |
|  A photograph of a slender column testing apparatus. It consists of two vertical metal columns supported by a wooden frame. The columns are positioned in a laboratory setting with wooden chairs and a whiteboard in the background. | Slender Column Test |
|  A photograph of a direct shear testing machine. It has a black frame with a horizontal beam. A circular dial is mounted on the left side. A metal specimen is held in a fixture on the beam. A white control box with a red button is in the foreground. A hand crank is visible on the right side. | Direct Shear Test of Metal |

Safety Requirements

Some of the safety requirements while doing these experiments are enlisted but not limited to the followings:

1. Always wear shoes before entering lab.

2. Do not touch anything without the permission of instructor/lab assistant.
3. Read carefully the lab manual before performing experiments.
4. Check electrical connections before starting the equipment.
5. Do not put your hands while the machine is in operation.
6. Do not tamper measuring instruments.
7. Do not open the casing of the equipment.
8. Do not unplug any electrical connection.
9. Switch off the power supply to the experimental setup on completion of the experiment.
10. Do not leave the dye container on the working tables.
11. Use safety goggles wherever necessary.
12. Familiarize yourself with emergency shut-off procedures for main electric switches in case of accidents.
13. Have a first aid kit readily available and ensure personnel are trained in basic first aid.
14. Ensure all personnel are aware of fire exit routes and procedures in case of an emergency.
15. Keep fire extinguishers readily accessible and ensure personnel are trained in their use.

References

1. **U.S. Occupational Safety and Health Administration (OSHA):** *Laboratory Safety Standards.* <https://www.osha.gov>
2. **Centers for Disease Control and Prevention (CDC):** *Biosafety in Microbiological and Biomedical Laboratories.* <https://www.cdc.gov>
3. **National Fire Protection Association (NFPA):** *Fire Safety in Laboratories.* <https://www.nfpa.org>
4. **American Chemical Society (ACS):** *Guidelines for Chemical Safety.* <https://www.acs.org>
5. **American National Standards Institute (ANSI):** *Laboratory Safety Guidelines.* <https://www.ansi.org>
6. <https://microbenotes.com/laboratory-safety-symbols/>
7. <https://www.ou.edu/>
8. <https://www.dreamstime.com/>

Emergency Contact List

| Designation | Name | Phone No. |
|-----------------------------|-------------------|--|
| Head of the Department (ME) | Dr. Md. Afsar Ali | Office: 880-2-9665636 Mobile: 01552415088 |

| BUET telephone operator (PABX) | Phone No. | BUET Office |
|---|------------------|--------------------|
| | 55167100 | 0 |

Medical Center:

| | |
|-----------------------|------------------|
| Emergency | 6666/01726698851 |
| Medical Centre office | 7798 |
| Reception | 2222 |

| Designation | Name | Phone No. | BUET Office |
|------------------------|-----------------------------|------------------|--------------------|
| Chief Medical officer | Dr. Abu Hena Abid Zafr | 01309005333 | 7344 |
| Senior medical officer | Dr. Md. Hasib Iskandar | 01720960997 | 7817 |
| Senior medical officer | Dr. SK. Hasanul Banna | 01737392095 | 7823 |
| Medical officer | Dr. Josmina Akter Chowdhury | 01980090205 | 7729 |
| Medical officer | Dr. Rokeya Sultana Sumi | 01763494945 | 6863 |
| Medical officer | Dr. Sazzad Hossain Razib | 01710960241 | |

Fire service and civil defense:

| | |
|--------------------------------|-----|
| Fire Brigade Emergency/Enquiry | 199 |
|--------------------------------|-----|

| Place | Mobile | Phone |
|-------------|-------------|------------|
| Polashi | 01716354370 | 02-8628688 |
| Mirpur Road | 01730002229 | 02-9001055 |
| Mohammadpur | 01712970093 | 02-9112078 |

Police & Security:

| Designation | Phone |
|----------------------|---------------------|
| Emergency Call | 999 |
| DMP Police Emergency | 01713398311/9551188 |
| DMP Control Room | 01817602050/9575500 |

University security & other

| Designation | BUET Office |
|--------------------------------|-------------------|
| Security Emergency Call | 7777 |
| Security officer | 7482 |
| Electricity & Plumbing | 7323 /01997902626 |
| Shaheed Minar Gate (Main Gate) | 7812 |
| West Palashi (Main Gate) | 6592 |
| Bakshi Bazar R/A Gate | 7825 |
| Dhakeswari R/A Gate | 7759 |
| Palashi R/A Gate | 7692 |
| Azad R/A Gate | 7760 |
| 71,72 No. Building Gate | 6330 |

