

# **Heat Engine Laboratory Safety Plan**

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## 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	 <p data-bbox="704 428 808 447">Electric Hazard</p>	Risk of getting electric shock. (The device might give mild to severe electric shock.)
Flammable Material	 <p data-bbox="685 648 821 667">Flammable Material</p>	Presence of combustible materials (a substance that can easily burn)
Explosive Material	 <p data-bbox="688 821 824 840">Explosive Material</p>	Presence of explosive and/or self-reactive substances
Hot Surface	 <p data-bbox="704 1003 808 1022">Hot Surface</p>	Risk of burning if you touch with naked hands

Entry/Working requirement symbols in the lab

Name of the symbol	Symbols	Meaning
Gloves Required	 <p data-bbox="698 1436 818 1455">Gloves Required</p>	Must use protective gloves in this area/while working in this area
Safety Glasses Required	 <p data-bbox="675 1646 837 1665">Safety Glasses Required</p>	Must use protective/safety goggles in this area/while working in this area
Safety Shoes Required	 <p data-bbox="675 1839 837 1858">Safety Shoes Required</p>	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="721 835 792 856">First Aid</p>	The place with the first aid box and materials
Drinking Water	 <p data-bbox="695 1079 818 1100">Drinking Water</p>	Indicates safe water for drinking
Fire Blanket	 <p data-bbox="704 1318 808 1339">Fire Blanket</p>	The location where the fire blanket is placed
Fire Hose	 <p data-bbox="714 1566 799 1587">Fire Hose</p>	The location where the hose with water or any fire retardant is placed
Emergency Bell	 <p data-bbox="691 1822 821 1843">Emergency Bell</p>	Bell to be pressed during an emergency like fire or accident.

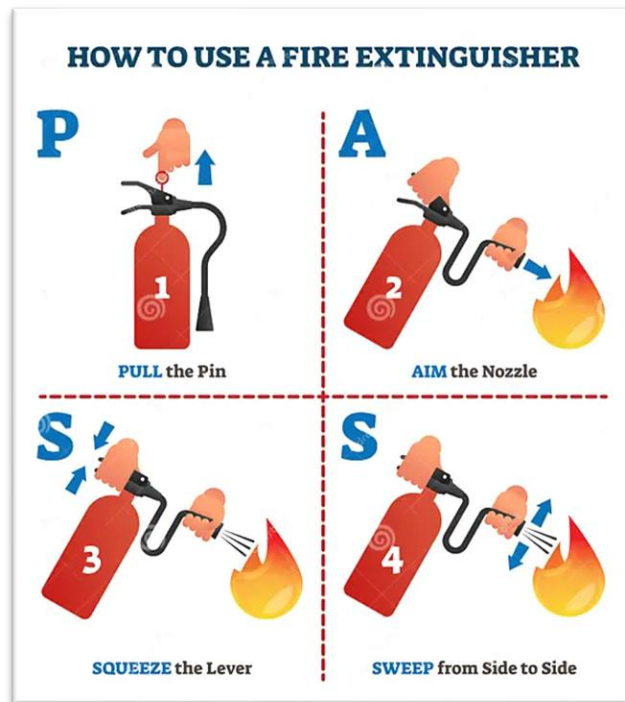
## 6. Emergency Procedures

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, CO<sub>2</sub>, 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 Heat Engine Lab

### Sessional Courses: ME 418, ME 420

The experiments of ME 418 as well as ME 420 are conducted in Heat Engine Laboratory, on the ground floor of Old Academic Building.

### Heat Engine Laboratory

**Location:** Old Academic Building, Ground Floor

Heat engine lab conducts courses based on the fundamentals of internal combustion engines and power plant engineering. Students of level-04, term-01 and level-04, term-02 are taught here.

Heat engine lab conducts courses and research in internal combustion engines and power plant engineering. It provides facilities for undergraduate teaching, final year projects and research work leading to postgraduate degrees.

This lab provides several cutaway setups of different types of engines which facilitate the study of engine basics. Students can dismantle the engines as well as the components to get a comprehensive knowledge about different systems and subsystems of the engine. It facilitates with

several standard dynamometer setup for the measurement of engine performance and exhaust emissions. A historic Ruston Diesel engine and a Grey marine engine can attract the young enthusiasts. The laboratory is equipped with a Natural gas supply line, used for various experimentation.

A fully functional cut-way section of an automobile in the lab gives a detailed access of understanding how a vehicle works. Additional sections of automatic transmission and vehicle drive train are available. This lab also houses experimental setups of a fully functional gas turbine and a cut-section model of a real Jet engine unit which help students to study the basics of power plant engineering.

It also serves the needs of the industries through consultancy services. Examples of consultancy services are performance test of engines, vehicles etc. Availability of various equipment and technical support provided by the laboratory staff members greatly assist the postgraduate research work.

Experiments conducted in this laboratory under ME 418: Heat Engine Sessional and ME 420: Steam and Power plant Sessional:

1. Assembly of an SI engine.
2. Automobile system identification.
3. Assembly of a CI engine.
4. Study of Gray Marine Diesel Engine.
5. Performance test of a Petrol Engine for WOT.
6. Performance test of a Diesel Generator engine.
7. Study of a Rover Gas Turbine.
8. Study of an Turbo Jet Engine of an Aircraft.
9. Performance Test of Gilkes (GT85-2) Two Shaft Gas Turbine at Constant Load.

Apparatus



Gilkes (GT85-2) Two Shaft Gas Turbine setup



Rover Gas Turbine setup



Turbo Jet Engine setup

## Apparatus



Performance test of a Diesel Generator engine setup



Gray Marine Diesel Engine setup



CI engine setup

## Apparatus



SI engine setup



Performance test of a Petrol Engine setup

### Safety Requirements

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

1. Always wear shoes and Apron 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
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<b>Place</b>	<b>Mobile</b>	<b>Phone</b>
Polashi	01716354370	02-8628688
Mirpur Road	01730002229	02-9001055
Mohammadpur	01712970093	02-9112078

**Police & Security:**

<b>Designation</b>	<b>Phone</b>
Emergency Call	999
DMP Police Emergency	01713398311/9551188
DMP Control Room	01817602050/9575500

**University security & other**

<b>Designation</b>	<b>BUET Office</b>
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

