



COLLEGE OF ENGINEERING

# LABORATORY SAFETY TRAINING

Mandatory Safety Guidelines for All Laboratory Personnel



# THE FOUNDATION OF SAFETY

*A professional commitment at the University of Bisha*



**"Safety is not a priority,  
it is a precondition."**

— *OSHA Principle*

**"An ounce of prevention is  
worth a pound of cure."**

— *Benjamin Franklin*

**"Attention to detail is not  
optional, it is a matter of life and  
safety."**

— *Engineering Ethics*

At the University of Bisha, laboratory safety is not merely a regulation, it is a professional commitment.

Every student, researcher, and instructor across ALL six engineering departments is responsible for maintaining a safe working environment.

# TRAINING SESSION OVERVIEW



**01**

**General Lab Rules**

Entry, authorization,  
supervision

**02**

**Personal Protective Equipment**

Required gear for all lab  
environments

**03**

**Mechanical Hazards**

Rotating parts, cutting tools,  
presses

**04**

**Thermal and Fluid Safety**

Heat, pressure vessels, fluid  
systems

**05**

**Electrical Safety**

Equipment, wiring,  
lockout/tagout

**06**

**Emergency Procedures**

Fire, injuries, evacuation  
protocols

**07**

**Housekeeping and Hygiene**

Clean workspace, waste  
disposal

**08**

**Incident Reporting**

Reporting requirements and  
procedures



## 1. Mechanical Engineering

### Key Lab Areas:

Thermodynamics, Manufacturing, Mechanics, Materials, CAD/FEA

## 2. Civil Engineering

### Key Lab Areas:

Structural, Geotechnical, Environmental, Construction Materials

## 3. Electrical Engineering

### Key Lab Areas:

Circuits, Digital, Electrical Machines, Communications, Control

## 4. Industrial Engineering

### Key Lab Areas:

Operations, Quality and Metrology, Human Factors and Ergonomics

## 5. Architecture and Building Science

### Key Lab Areas:

Design Studios, Building Materials, Environmental Control, BIM

## 6. Renewable Energy Engineering

### Key Lab Areas:

Solar PV, Wind/Hybrid, Energy Storage, Grid Integration

# LAB ENTRY REQUIREMENTS



## BEFORE ENTERING

- Complete mandatory safety orientation and training
- Obtain written authorization from the lab supervisor
- Review experiment procedure and identify all hazards
- Locate emergency exits, fire extinguishers, and first aid kits
- Verify all required PPE is available and in good condition
- Review machine-specific competency checklist
- Inform supervisor of any medical conditions
- Ensure minimum two persons present for high-risk tasks

## UPON ENTERING

- Put on all required PPE immediately upon entry
- Secure long hair; remove loose jewelry and watches
- Sign the lab logbook if required by department
- Inspect your workstation for any existing hazards
- Identify the nearest emergency stop (E-stop) for your equipment
- Review emergency procedures posted in the lab
- Do not enter if feeling unwell, dizzy, or fatigued
- Never enter a lab that appears unsafe, report to supervisor

# PERSONAL PROTECTIVE EQUIPMENT (PPE)

*Mandatory protective gear*



## Eye Protection

Safety glasses at all times.  
Face shield for grinding/welding.  
Goggles for chemical exposure.

## Foot Protection

Steel-toed safety shoes mandatory in all manufacturing and workshop labs.

## Body Protection

Lab coat or overalls in materials and workshop labs. No loose clothing near rotating machinery.

## Hand Protection

Heat-resistant gloves in thermal labs.  
Cut-resistant gloves in machining.  
Chemical gloves for lubricants.

## Head Protection

Hard hat in structural areas. Hair nets required when working near rotating equipment.

## Hearing Protection

Earmuffs/earplugs mandatory where noise exceeds 85 dB (lathes, grinders, compressors, mills).



# MECHANICAL HAZARDS — ROTATING MACHINERY



Rotating Parts



Flying Debris



Sharp Edges



Hot Surfaces



High Noise

## ✓ SAFE OPERATING RULES

- Remove chuck keys **BEFORE** starting the lathe
- Never reach over or across a running machine
- Clamp workpieces securely, never hand-hold during cutting
- Use a brush to clear chips, **NEVER** use hands or compressed air
- Set correct speed/feed per material specifications
- Ensure machine guards are in place before operation

## ⊘ PROHIBITED ACTIONS

- Operating equipment without proper authorization
- Wearing loose clothing, ties, or dangling jewelry
- Removing or bypassing machine guards
- Leaving machines running unattended
- Using damaged or dull cutting tools
- Touching rotating spindles or chucks
- Using mobile phones while operating machinery

# WELDING and GRINDING SAFETY

*High-hazard operations requiring strict protocols*



## WELDING OPERATIONS

- Wear welding helmet with minimum shade 10 lens (MIG/TIG)
- Conduct welding ONLY in ventilated welding booths with fume extraction
- Place fire-resistant welding blankets to protect surroundings
- Check gas cylinder connections for leaks before ignition
- Store gas cylinders upright and secured with safety chains
- Allow welds to cool completely before handling
- Never weld near flammable materials or in open areas
- Have fire extinguisher within arm's reach during welding
- Use arc shields to protect others from UV radiation

## GRINDING OPERATIONS

- Inspect grinding wheel for cracks (ring test) before mounting
- Face shields required — safety glasses alone are NOT sufficient
- Adjust tool rest to within 3 mm of the grinding wheel
- Never use the flat side of bench grinder wheel unless designed for it
- Allow wheel to reach full speed before applying workpiece
- Stand to the side when starting — never directly in front
- Secure workpiece firmly to prevent kickback
- Never grind aluminum or magnesium without special precautions
- Replace worn or unbalanced wheels immediately

# THERMAL and PRESSURE SYSTEM SAFETY

*Thermodynamics, Heat Transfer, Fluid Mechanics and Related Equipment*



**⚠️ HOT SURFACES AND PRESSURIZED SYSTEMS CAN CAUSE SEVERE BURNS AND EXPLOSIONS — ALWAYS VERIFY BEFORE TOUCHING**



## HIGH-TEMPERATURE EQUIPMENT

- Wear thermal gloves rated for operating temperature
- Inspect pressure safety valves before each run
- Never exceed rated operating pressure of any vessel
- Allow sufficient cool-down time before opening connections
- Secure heating element guards before switching on
- Use tongs for handling hot specimens and materials
- Never leave heating equipment unattended



## FLUID SYSTEMS and PUMPS

- Inspect hose connections for leaks before pressurizing
- Never exceed specified flow rates, risk of cavitation
- Drain and dry all fluid apparatus after experiments
- Ensure relief valves are functional before pressurizing
- Open valves gradually, sudden changes cause water hammer
- Secure all fittings; report drips immediately
- Use correct fluid as specified, no substitutions



## BOILERS and STEAM SYSTEMS

- Only trained and authorized personnel operate boilers
- Check water level and fuel supply before starting
- Monitor pressure gauges continuously during operation
- Never block or tamper with safety relief valves
- Perform leak checks on all steam line connections
- Use proper PPE: face shield, thermal gloves, boots
- Emergency shutdown: follow posted SOP procedures

# ELECTRICAL SAFETY

*Electrical hazards can cause cardiac arrest, severe burns, and death*



## ELECTRICAL CURRENT EFFECTS ON THE HUMAN BODY

<b>1 mA</b>	Threshold of perception, slight tingling
<b>5 mA</b>	Maximum 'safe' current, pain sensation
<b>10–20 mA</b>	Muscle paralysis, unable to release grip (DANGER)
<b>50 mA</b>	Possible ventricular fibrillation
<b>100–200 mA</b>	Cardiac arrest, severe burns, potentially fatal



### BEFORE WORKING WITH ELECTRICAL EQUIPMENT

- De-energize circuits before performing any work
- Apply Lockout/Tagout (LOTO) procedures
- Test circuits with a calibrated voltmeter
- Inspect equipment and cables for visible damage



### DURING ELECTRICAL WORK

- Use only insulated and rated tools
- Keep one hand in pocket (avoids current path through chest)
- Work on dry, non-conductive surfaces only
- Never bypass or defeat safety interlocks
- Avoid wearing metallic jewelry during electrical work



# FIRE SAFETY and PREVENTION

Know your fire extinguisher types and evacuation procedures



## FIRE TRIANGLE

### HEAT

Sparks, hot surfaces, friction, arcing

### FUEL

Oils, solvents, wood shavings, plastics, gases

### OXYGEN

Present in air — 16% minimum needed for combustion

REMOVE ONE ELEMENT TO EXTINGUISH THE FIRE

## FIRE EXTINGUISHER CLASSES

### Class A

#### Water/Foam

Paper, wood, cloth, ordinary combustibles

### Class B

#### CO<sub>2</sub> / Foam

Flammable liquids, oils, solvents, greases

### Class C

#### CO<sub>2</sub> / Dry Powder

Electrical fires and energized equipment

### Class D

#### Dry Powder (Special)

Combustible metals: Mg, Al, titanium

### Class K

#### Wet Chemical

Cooking oils and fats

PASS METHOD: Pull · Aim · Squeeze · Sweep

# EMERGENCY PROCEDURES

Know what to do *BEFORE* an emergency happens



## INJURY / ACCIDENT

- Stop all work immediately, activate E-stop if needed
- Do NOT move injured person unless in immediate danger
- Call Emergency: Campus Security
- Apply first aid if trained, minimize blood loss
- Notify lab supervisor and safety officer
- Do not disturb the accident scene for investigation



## FIRE

- Alert others, pull fire alarm immediately
- Evacuate via nearest emergency exit
- Do not use elevators during evacuation
- Close doors behind you to slow fire spread
- If safe: use appropriate extinguisher (PASS method)
- Assembly point: designated muster station



## ELECTRIC SHOCK

- Do NOT touch the victim directly
- Cut power at main switch or breaker immediately
- Use non-conductive material to separate victim from source
- Call Emergency Services immediately
- Begin CPR if trained and victim is unresponsive
- Keep victim warm until help arrives



## LIQUID / CHEMICAL SPILL

- Alert others and clear the area immediately
- Put on appropriate PPE before approaching spill
- Use spill kit for small, controlled spills only
- Never wash spills down the drain
- Evacuate if spill is large or vapors are detected
- Report to supervisor for proper disposal



# FIRST AID and EMERGENCY EQUIPMENT

*Location and proper use of emergency response equipment in all labs*



## FIRST AID KIT

- Located at lab entrance, know exact position **BEFORE** starting
- Contents: bandages, antiseptic wipes, burn gel, gloves, scissors
- Report usage so kit is restocked promptly
- Do not use for purposes other than first aid
- For serious injuries: first aid is **NOT** a substitute for medical care



## EYEWASH STATION

- Located within 10 seconds walking distance from workstation
- Flush eyes for **MINIMUM 15** minutes continuously
- Hold eyelids open forcibly during flushing
- Remove contact lenses if possible before flushing
- Seek medical attention after use, mandatory
- Weekly activation test required by technician



## SAFETY SHOWER

- For chemical spills on body or clothing
- Activate immediately, every second counts
- Drench entire body for minimum 15 minutes
- Remove contaminated clothing while showering
- Do not stop initially to remove shoes
- Monthly testing required



**KNOW THE LOCATION OF ALL EMERGENCY EQUIPMENT BEFORE STARTING ANY LAB SESSION**





# HOUSEKEEPING and LAB HYGIENE

*A clean, organized laboratory is a safe laboratory*



## ✓ DO's

- Clean workstation, machines, and floor BEFORE leaving
- Clean up spills immediately using appropriate absorbents
- Return tools and equipment to designated storage after use
- Label all containers, specimens, and experiments clearly
- Keep aisles, exits, and emergency equipment paths clear
- Decontaminate work surfaces regularly
- Wash hands thoroughly before leaving the lab
- Report damaged or missing equipment to lab technician
- Store materials at proper heights on appropriate shelving

## ✗ DON'Ts

- Never eat, drink, or smoke inside the laboratory
- Never store food or personal items in the lab
- Never leave experiments running unattended
- Never block access to fire exits or safety equipment
- Never accumulate swarf, chips, or waste materials
- Never pour waste oils or coolants down the drain
- Never work alone when handling high-risk equipment
- Never ignore a spill, leak, or unusual odor
- Never use mobile phones while operating machinery

# WASTE DISPOSAL and ENVIRONMENTAL RESPONSIBILITY

*Proper disposal protects people, equipment, and the environment*



## METAL CHIPS and SWARF

- Collect in designated metal waste bins only
- Never mix with general waste
- Sharp edges, use tool, not hands to handle
- Remove daily, do not allow accumulation
- Recycling collection arranged by lab technician

## OILS and COOLANTS

- Use dedicated labeled containers for waste oils
- NEVER pour down drains or sinks
- Separate cutting oil from coolant fluids
- Contact EHS or facilities for collection
- Clean spills immediately with absorbent pads

## SHARPS and BROKEN GLASS

- Use puncture-resistant sharps containers
- Never overfill containers beyond 3/4 full
- Do not mix with regular trash
- Broken glass in dedicated glass disposal bins
- Seal containers securely before disposal

## ELECTRONIC WASTE

- Circuit boards and components to IT/facilities
- Contains hazardous materials, no regular trash
- Follow university e-waste recycling program
- Remove all data before device disposal
- Label e-waste items clearly



# INCIDENT REPORTING

*All incidents, injuries, and near-misses must be reported — no exceptions*



## WHAT TO REPORT

- All injuries — even minor cuts and burns
- Equipment failures or malfunctions
- Chemical spills, leaks, or unexpected exposures
- Electrical incidents (shocks, short circuits)
- Near-misses: incidents that COULD have caused harm
- Fire or smoke incidents
- Unsafe conditions or practices observed
- Property damage or equipment damage

## REPORTING PROCEDURE

- Provide immediate first aid or call emergency services
- Secure the area if safe to do so
- Notify lab supervisor immediately
- Do not disturb the scene — preserve for investigation
- Complete incident report form within 24 hours
- Include: what, when, where, who, contributing factors
- Cooperate fully with the safety investigation
- Corrective actions must be taken to prevent recurrence

## WHY REPORTING MATTERS

**1** Major Accident

**29** Minor Incidents

**300** Near-Misses

**(Heinrich's Triangle)**  
Report near-misses — your report could save a life.

# AUTHORIZATION and SUPERVISION PROTOCOLS

*Who can work, when, and under what conditions — all departments*



## AUTHORIZATION LEVELS FOR LAB OPERATIONS

<b>Level 1</b>	<b>Basic Operations</b> Observation only; demonstration by instructor — no hands-on access
<b>Level 2</b>	<b>Supervised Work</b> Student with completed safety training, supervised at all times during all operations
<b>Level 3</b>	<b>Assisted Work</b> Authorized student; competency-checked; supervisor present in lab at all times
<b>Level 4</b>	<b>Independent Work</b> Fully authorized; completed competency checklist; demonstrable proficiency in equipment

### SUPERVISION REQUIREMENTS

- Minimum 2 persons when operating heavy or high-temperature equipment
- All sessions must be supervised by a certified technician/faculty member
- Machine-specific competency checklist required before solo

### DISCIPLINARY CONSEQUENCES

- Immediate removal from lab for safety violations
- Academic penalties per University Code of Conduct
- Serious violations: disciplinary proceedings initiated



# NOISE and VIBRATION HAZARDS

Long-term exposure causes permanent hearing loss and musculoskeletal disorders



## NOISE EXPOSURE LEVELS IN ENGINEERING LABS

<b>&lt; 70 dB</b>	<b>SAFE</b> Normal conversation, computers
<b>70–85 dB</b>	<b>LOW RISK</b> Light machinery, background shop noise
<b>85–100 dB</b>	<b>PPE REQUIRED</b> Lathes, milling machines — HEARING PROTECTION REQUIRED
<b>100–120 dB</b>	<b>DANGER</b> Grinders, compressed air — SEVERE RISK

### NOISE CONTROL MEASURES

- Use earmuffs or earplugs rated for noise level
- Limit time in high-noise areas, rotate personnel
- Use sound-dampening enclosures where available

### WHOLE-BODY VIBRATION RISKS

- Use anti-vibration gloves with pneumatic tools
- Limit continuous use of vibrating tools
- Report tingling or numbness in hands immediately

## DEPARTMENT NOISE SOURCES

- ME: Lathes, grinders, CNC equipment
- CE: Concrete mixers, compactors, drilling
- EE: Power supply units, cooling systems
- IE: Production simulation equipment
- Arch: Model-making tools, fabrication equipment
- RE: Wind turbine test rigs, compressors
- All labs: Emergency alarms, compressed air
- Always wear PPE before entering any noisy area

# SAFE WORK PRACTICES

*Professional habits that protect you and your colleagues every day*



## PLAN YOUR WORK

Read all procedures thoroughly before starting. Identify every hazard. Prepare an emergency response plan. Obtain supervisor approval for high-risk work.

## MINIMIZE EXPOSURE

Use minimum quantities of hazardous materials. Apply engineering controls first (guards, ventilation). Keep containers closed when not in use.

## STAY ALERT

Never rush or take shortcuts under pressure. Maintain full focus — avoid all distractions. Stay aware of colleagues working nearby. If unsafe, STOP immediately.

## DOCUMENT and COMMUNICATE

Keep an accurate lab notebook for all experiments. Report all incidents and near-misses promptly. Inform others of any new or observed hazards.

## EQUIPMENT CARE

Inspect tools and equipment before every use. Report damaged, worn, or malfunctioning equipment. Perform scheduled maintenance as required.

## LOOK OUT FOR OTHERS

Watch for unsafe behaviors and address them constructively. New students need guidance — lead by example. Never leave a colleague in a dangerous situation.

# REGULATORY STANDARDS and COMPLIANCE

*International and national frameworks governing laboratory safety*



## Saudi OSHA

### Occupational Safety and Health (KSA)

National workplace safety regulations applicable in Saudi Arabia; legally enforceable

## ISO 45001

### Occupational H and S Management Systems

International framework for occupational health and safety management; adopted by UB

## OSHA (USA)

### Occupational Safety and Health Administration

Sets enforceable safety standards; widely referenced as best practice globally

## NFPA Codes

### National Fire Protection Association

Fire and electrical safety codes; NFPA 70 (National Electrical Code), NFPA 101 (Life Safety)

## GHS

### Globally Harmonized System for Chemicals

Standardized hazard classification and labeling system for chemicals used in all labs

## Vision 2030

### Saudi National Transformation Program

UB labs comply with Saudi Vision 2030 quality and safety targets for higher education

# KEY TAKEAWAYS — YOUR SAFETY COMMITMENT



- 1 Always wear ALL required PPE — no shortcuts, no exceptions, every time you enter
- 2 Know emergency equipment locations BEFORE starting any experiment or operation
- 3 Never operate equipment without proper authorization and supervision
- 4 De-energize, Lockout/Tagout before ANY electrical or mechanical maintenance
- 5 Report ALL incidents, near-misses, and unsafe conditions immediately
- 6 Keep work areas clean — zero tolerance for chip accumulation and clutter
- 7 Speak up — if you see an unsafe practice, you have a duty to address it
- 8 When in doubt, STOP and ask — there are no foolish questions about safety



# EMERGENCY CONTACTS



**911**

EMERGENCY SERVICES



**997**

AMBULANCE



**998**

FIRE DEPARTMENT



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# THANK YOU

*Stay Safe · Work Smart · Protect Each Other*

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