Department of Sustainable Energy Engineering
Indian Institute of Technology Kanpur

Laboratory Safety: Essential Guidance

For all persons working in the Department's laboratories | Version 1.0, October 2026

1. Purpose and scope

1.1 This document sets out essential safety information for all persons who work in, or visit, the laboratories of the Department of Sustainable Energy Engineering (SEE), IIT Kanpur, including students, project staff, postdoctoral researchers, faculty, technical staff and external users.

1.2 It does not replace the rules, standard operating procedures (SOPs) or risk assessments of individual laboratories, or the safety manuals of research groups. Where these are more stringent, they take precedence.

1.3 In this document, **"must"** denotes a statutory requirement, with the relevant provision cited; **"should"** denotes recommended good practice.

1.4 Any person who is uncertain whether an activity is safe should stop and consult the laboratory in-charge or their supervisor before proceeding.

2. Emergency contacts

Service	Institute extension	From a mobile or outside line
Health Centre: emergency and ambulance (24 hours)	**7777**, 7666, 2222 or 2228	0512-259-7777; ambulance mobile 87654 36535
Security Control Room	**7999** or 7994	0512-259-7999
Campus Fire Service	**6777**	Call Security

2.1 When calling, the caller should state their name, the building, floor and room, and the nature of the emergency.

2.2 When requesting an ambulance, the caller should give the patient's condition, the location and a contact number and, where possible, arrange for a person to wait at the roadside to direct the ambulance (IIT Kanpur Health Centre, ambulance protocol).

3. Before commencing work

3.1 Before working in a laboratory, each person should be informed by the laboratory in-charge or their supervisor of the location of the exits and emergency equipment, the hazards particular to that laboratory, its rules, and whom to contact.

3.2 Instruments and experimental setups should be operated only by persons who have been trained and authorised by the person responsible for the equipment, and in accordance with its SOP. Observation alone does not constitute training. Settings, interlocks and connections should not be altered beyond what the SOP permits.

3.3 The Safety Data Sheet (SDS) of each chemical should be read before its first use, in particular section 2 (hazard identification), section 4 (first-aid measures), section 7 (handling and storage) and section 8 (exposure controls and personal protection).

3.4 Any new or hazardous procedure should be planned with the supervisor before work begins, identifying what could go wrong, who could be harmed, and the controls required. The planning should consider the whole process and not only the material: heating in a sealed vessel, the handling of fine powders or a charged capacitor can render an everyday material or circuit hazardous.

4. General laboratory practice

4.1 Personal protective equipment (PPE) should be worn as the laboratory requires. Where chemicals, hot materials or furnaces are present, the minimum should be a laboratory coat, safety glasses or goggles, closed footwear and clothing that covers the legs. Ordinary prescription spectacles do not constitute eye protection.

4.2 At rotating machinery, long hair should be tied back, gloves should not be worn, and dupattas, scarves, loose sleeves, lanyards and jewellery should be kept clear.

4.3 Food and drink should not be consumed or stored where chemicals or samples are present.

4.4 Exits, corridors, fire doors, fire extinguishers, eye-wash stations, safety showers and electrical panels should be kept unobstructed. Fire doors should not be wedged open.

4.5 Every container, sample and waste container should be labelled with its contents, the name of the user and the date.

4.6 Hazardous work (for example, work with hydrofluoric acid, pyrophoric reagents or toxic gases, or live electrical work) should not be undertaken by a person working alone. Work outside normal hours should follow the rules of the laboratory concerned.

4.7 Equipment should be left running unattended only with the supervisor's agreement, and should carry a notice stating what it is doing, the name and telephone number of the person responsible, and how to make it safe. At the end of each working day, equipment that is not required should be switched off and gas cylinder valves closed.

4.8 Faulty equipment should be withdrawn from use, labelled "DO NOT USE", and reported to the laboratory in-charge.

5. Chemicals and chemical waste

5.1 Work with volatile, toxic, odorous or dust-generating materials should be carried out in a fume hood with the sash at its marked working height. Fume hoods should not be used for storage.

5.2 Chemicals should be stored by compatibility, not alphabetically: acids separated from bases, oxidisers separated from flammable and organic materials, and water-reactive materials kept away from water. Flammable liquids that require refrigeration should be kept only in refrigerators designed for flammable storage, never in domestic refrigerators.

5.3 Acid should always be added to water, never water to acid. Chemicals should never be mixed without a defined purpose: for example, hypochlorite (bleach) and acid release chlorine; acid and cyanide release hydrogen cyanide; and acid and sulphide release hydrogen sulphide.

5.4 Peroxide-forming solvents (for example diethyl ether, tetrahydrofuran and 1,4-dioxane) should be dated on opening and tested for peroxides before distillation or evaporation. A container with crystals around its cap should not be handled or opened, and should be reported to the laboratory in-charge immediately.

5.5 Hydrofluoric acid (HF), and fluoride salts in the presence of acid, cause deep and delayed burns that can be fatal. Such work should be undertaken only with the supervisor's approval, never alone, using plasticware rather than glassware, and with calcium gluconate gel, within its expiry date, at hand before work begins.

5.6 Alkali metals (such as lithium and sodium) and pyrophoric reagents react violently with water or air. They should be handled only in accordance with their SOP, and their residues should never be placed in general or solvent waste.

5.7 Piranha solution should be prepared fresh, in small volumes and in a fume hood. It should never be placed in a closed container or mixed with organic waste.

Chemical waste

5.8 Chemical waste should never be poured into drains or sinks.

5.9 IIT Kanpur collects chemical waste in three categories, chlorinated liquids, non-chlorinated liquids and solids, which are transferred to the Institute's chemical shed (IIT Kanpur Sustainability Report 2024-25). Waste should be collected by category in labelled, capped containers. Advice should be sought from the laboratory in-charge before generating any waste that falls outside these categories (for example, strong acids, heavy metals or mercury).

5.10 Waste containing oxidising acids (such as nitric acid or piranha solution) should never be mixed with organic waste.

5.11 Empty containers and liners contaminated with hazardous chemicals, and contaminated cleaning rags, are classified as hazardous waste and should not be placed in general waste.

6. Electrical equipment and batteries

6.1 Cables, plugs and casings should be inspected before use. Damaged equipment should not be used, and any tingling sensation from equipment should be treated as a serious fault.

6.2 Laboratory users should not alter, extend or repair the building's wiring, sockets or distribution boards; faults should be reported to the laboratory in-charge.

6.3 Extension boards should not be connected in series, multi-plug adaptors should not be used, and heaters, ovens and furnaces should not be powered from extension boards.

6.4 Earth connections, guards and interlocks should never be removed or bypassed.

6.5 Work on circuits, power electronics, battery banks or photovoltaic arrays should be carried out only as the laboratory's rules permit, and circuits should be isolated and proved dead before they are touched. Capacitors and batteries can remain charged after switch-off, and photovoltaic modules generate a voltage whenever they are illuminated.

6.6 Lithium batteries should be charged and cycled within the manufacturer's limits (for laboratory-made cells, the limits set in the SOP), on a non-combustible surface away from flammable materials. Swollen, damaged, leaking or overheating cells should be withdrawn from use immediately and reported to the laboratory in-charge.

6.7 Spent batteries and discarded electrical and electronic equipment should not be placed in general waste, and should be handed over through the laboratory in-charge.

7. Compressed gases and cryogenic liquids

7.1 Gas cylinders, regulators and gas lines should be handled only by persons trained by those responsible for them.

7.2 Cylinders must be adequately supported during handling. Cylinders of liquefiable gases must be kept upright and placed so that they cannot be knocked over, and cylinders used horizontally must be secured so that they cannot roll (Gas Cylinders Rules, 2016, rule 18). As good practice, every cylinder should be secured against falling.

7.3 Trolleys must be used, as far as possible, to move cylinders, and cylinders must not be slid, dropped or subjected to undue shock (rule 18).

7.4 Oil or similar lubricants must not be used on cylinder valves or fittings, and cylinders must not be exposed to high temperatures or to the sun (rule 15).

7.5 Smoking, open flames and any article capable of causing ignition, including matches and mobile phones, are prohibited near places where cylinders of flammable gases are stored or handled (rules 14 and 18).

7.6 **Each regulator should be appropriate to the gas,** and adaptors should not be used between incompatible fittings. Cylinder valves should be closed when gas is not in use. New connections should be leak-tested with leak-detection solution, never with a flame.

7.7 When liquid nitrogen is dispensed, cryogenic gloves and a face shield over safety glasses or goggles should be worn, and only vessels designed for cryogenic liquids should be used, in well-ventilated

rooms. No person should travel in a lift with a cryogenic Dewar; the Dewar should be sent unaccompanied, with a person waiting at the receiving floor.

8. Machinery, X-ray equipment and intense light sources

8.1 Machine tools should be used only after training and authorisation by the workshop in-charge. Guards should remain in place and safety glasses should be worn. Workpieces should be clamped, and machines should be stopped before measuring or clearing swarf.

8.2 X-ray diffractometers, X-ray fluorescence instruments and electron microscopes generate ionising radiation and are regulated by the Atomic Energy Regulatory Board (AERB) under the Atomic Energy (Radiation Protection) Rules. They should be operated only by persons trained and authorised by the facility in-charge, in accordance with their SOPs. Interlocks should never be defeated, and shielding should never be removed nor enclosures opened while the beam is on. Any interlock or shielding fault should be reported immediately to the facility in-charge, and the instrument should be withdrawn from use.

8.3 Users of ultraviolet lamps and solar simulators should never look into the beam and should protect their eyes and skin from ultraviolet radiation.

9. Incidents and near misses

9.1 **Every incident (including injury, fire, spill, electric shock or gas release) and every near miss should be reported to the laboratory in-charge and the supervisor on the same day.** Reports serve to prevent recurrence, not to assign blame.

10. Emergency procedures

10.1 Personal safety comes first: no person should put themselves at risk and become a second casualty.

10.2 The alarm should be raised by warning those nearby and calling the appropriate number in section 2.

10.3 A fire or spill should be tackled only if it is small, the person has been trained to do so, and a clear escape route is available.

10.4 On evacuation, experiments should be made safe only if this can be done within a few seconds (for example, by switching off heating or closing a cylinder valve). Occupants should leave by the nearest exit without collecting belongings, and should not use lifts. Once outside, they should go to the designated assembly point and inform the responders of anyone who may remain inside, and should not re-enter the building until the responders declare it safe.

10.5 The emergency quick reference on the final page summarises the immediate actions for specific emergencies and may be printed and displayed in each laboratory. First-aid measures cover the initial minutes only and are not a substitute for medical care.

References

- IIT Kanpur: Emergency Services page; Health Centre Emergency Services and Ambulance Protocol pages (consulted 3 October 2026); Sustainability Report 2024-25 (chemical waste).
- Gas Cylinders Rules, 2016, as amended.
- Atomic Energy (Radiation Protection) Rules, 2004; Atomic Energy Regulatory Board, e-LORA Guidelines for End-users of Electron and X-ray based Inspection Systems (September 2025).
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.
- National Research Council, Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards (National Academies Press, 2011), for recognised good laboratory practice.

Compiled by Sayan Kar.
Corrections, suggestions and comments to be sent to sayank@iitk.ac.in.

Emergency Quick Reference: SEE Laboratories

Protect yourself first. Warn those nearby. State the building, floor and room. Afterwards, inform the laboratory in-charge.

Health Centre, emergency and ambulance: 7777 (also 7666, 2222, 2228)

From a mobile: 0512-259-7777. Ambulance mobile: 87654 36535.

Security: 7999 (or 7994). From a mobile: 0512-259-7999.

Fire: 6777. From a mobile: call Security.

Situation	Immediate action
Fire or smoke	Shout "Fire" and raise the alarm. Use an extinguisher only if the fire is small, you are trained, and your escape route is clear: CO_2 for electrical and solvent fires; never water on these. Otherwise leave, closing doors behind you, go to the assembly point and call the Fire Service and Security. Do not re-enter.
Lithium-ion battery fire	Disconnect the charger if it is safe to do so. A single small cell: water or ABC (dry powder) extinguisher, then cool with plenty of water. Anything larger: evacuate, close the door and call the Fire Service.
Metal fire (lithium, sodium, lithium-metal cells)	Use only the Class D extinguisher or agent provided for that metal. Never use water, CO_2 or foam. If none is available, evacuate and call the Fire Service.
Unresponsive casualty, not breathing normally	Call the Health Centre. Begin chest compressions at once: hard and fast in the centre of the chest, 100 to 120 per minute. If not trained in rescue breaths, give compressions only. Send for a defibrillator (AED) if one is available. Continue until help takes over.
Electric shock	Do not touch the casualty until the supply is off: switch off or isolate first. At mains voltage only, if isolation is impossible, separate the casualty from the source with a dry, non-conducting object while standing on dry, non-conducting material. At higher voltage, do not approach until an authorised person has isolated the supply. Call the Health Centre. A medical check is always required.
Chemical on the skin	Remove contaminated clothing. Flush with running water for at least 15 minutes. Go to the Health Centre with the SDS.
Chemical in the eyes	Rinse at once with an eye-wash or gently running clean water, holding the eye open, for at least 15 minutes; remove contact lenses if this is easy. Then go to the Health Centre.
Hydrofluoric acid (HF) or fluoride on the skin	Flush with water for 5 minutes while removing contaminated clothing, then apply calcium gluconate gel with a gloved hand and continue applying it on the way to the Health Centre (if no gel is available, continue flushing). State that it is a fluoride burn. HF in the eyes: water only, for at least 15 minutes.
Inhalation	Move to fresh air only if it is safe to do so. Keep the casualty at rest. Go to the Health Centre, even if symptoms are absent.
Ingestion	Do not induce vomiting. Rinse the mouth. Go to the Health Centre at once with the SDS.
Minor spill (small, known chemical, trained person)	Wear gloves and goggles. Apply absorbent from the edges inward. Collect into labelled waste. Report the spill.
Major spill (large, toxic, flammable or unknown)	Do not attempt to clean up. Warn others, leave, close the door, keep people out and call Security. For a flammable spill, do not operate electrical switches.
Gas leak or gas alarm	Close the cylinder valve only if it can be reached safely. If the leak continues, leave at once, close the door and call Security. For a flammable gas, do not operate electrical switches.
Collapse where the air may be unsafe	Do not enter. Raise the alarm, call Security and the Health Centre, ventilate from outside if possible, and wait for equipped responders.
Thermal or electrical burn	Cool under clean running water for at least 20 minutes. Remove rings and watches near the burn. No ice or creams. Cover loosely. Go to the Health Centre.
Cryogenic (cold) burn	Do not rub. Rewarm gently with lukewarm water. Cover loosely. Go to the Health Centre.
Cuts	Apply firm pressure with a clean pad or cloth until the bleeding stops. Go to the Health Centre if bleeding continues or the cut is deep or contaminated.
Laser exposure to the eye	Stop the laser. Go to the Health Centre at once and state the wavelength and power.
X-ray interlock failure, or shielding open with the beam on	Switch off if it is safe to do so, leave the area, note the settings and the time, and inform the facility in-charge at once.