Information

Equipment (Lab Safety Manual)

Applicability

This policy applies to the University Community (administrators, faculty, staff, and students) and visitors.

Administrative Authority

Senior Associate Vice President for Operations

Responsible Unit

Environmental Health & Safety
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History

Revised Date(s):

Reviewed Date(s):

Categories

Statement:

Working in a laboratory requires the use of various types of equipment. Be familiar with the equipment before using it. Know:

- How it operates.
- Its safeguards.
- Its maintenance.

Checking the Equipment

Before beginning any experiment, be sure that each piece of equipment required is in proper working order.

If equipment does not operate properly or is in need of repair, immediately take it out of service so that it will not be used by other persons. Tag the equipment to indicate the deficiency and notify the PI or laboratory supervisor.

Checklist

Determine that all equipment:

- Has adequate controls and safeguards.
- Is installed in a safe location with adequate ventilation, if required.
- Is being used only for its designated purpose. When special adaptation is required, it should be done only with the assistance and direction of Biomedical Engineering or Physical Plant.
- Is not used in flammable or combustible atmospheres. Most pieces of laboratory equipment can be a potential source of ignition.

Introduction

Accidents involving glassware are a leading cause of laboratory injuries. These can be avoided by following a few simple procedures. In general, be certain that you have received proper instruction before using glass equipment designed for specialized tasks that involve unusual risks or potential injury. Listed below are some safety rules.

Safe Practices

Always:

- Handle and store glassware carefully so as not to damage it or yourself.
- Properly discard or repair damaged items.
- When inserting glass tubing into rubber stoppers or corks and when placing rubber tubing on glass hose connections:
    - Use adequate hand protection.
    - Lubricate tubing or stopper with water or glycerol and be sure that the ends of the glass tubing are fire-polished.
    - Hold hands close together to limit movement of glass should fracture occur.
- Substitute plastic or metal connections for glass ones whenever possible to decrease the risk of injury.
- For vacuum work, use only glassware designed for that purpose.
- When dealing with broken glass:
    - Wear hand protection when picking up the pieces.
    - Use a broom to sweep small pieces into a dustpan.
    - Package it in a rigid container (i.e. corrugated cardboard box) labeled "Broken Glass" and seal to protect housekeeping personnel from injury. Never attempt glass-blowing operations without proper facilities.

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Use

Laboratory refrigerators are appropriate equipment for the storage of materials that must be kept cold to preserve their function. These include:

- Biological specimens and preparations.
- Chemicals which are heat sensitive.

- Drugs.

Misuse

Unacceptable uses for laboratory refrigerators include:

- Routine storage of chemicals.
- Mixed storage of substances used for living systems with toxic and/or hazardous chemicals.
- Food storage, which is NEVER ACCEPTABLE in laboratory refrigerators. Lunches requiring refrigeration may only be stored in other refrigerators that are identified as acceptable for the storage of food and beverages. Such refrigerators must be located outside the laboratory.

Flammable Material

Flammable chemicals cannot be stored in conventional refrigerators. Electrical sparks from a conventional refrigerator can ignite the flammable vapors that build up inside. Unless a cold room is ventilated and has a fire suppression sprinkler system, do not store flammable liquids there. Two kinds of refrigerators are approved for storage of flammables:

1. Flammable Materials Refrigerator: These have no spark sources within the refrigerator cabinet. There are, however, spark sources outside the refrigerator cabinet from switches, motors, relays, etc. These spark sources can ignite flammable vapors present outside of the refrigerator. A bottle of flammable liquid dropped and broken near one of these refrigerators can easily be ignited by sparks.
2. Explosion-proof Refrigerators: These refrigerators have all spark sources completely sealed inside and are safe for flammable atmosphere both within and outside of the refrigerator cabinet.

Conventional refrigerators in laboratories and cold rooms that are not safe for flammable storage must be labeled "NO STORAGE OF FLAMMABLES".

Containers and Labeling

All materials stored in laboratory refrigerators must be in closed containers and labeled with the specific contents. If a refrigerator is used by multiple researchers, the individual refrigerator shelves should denote the name of the researcher or the individual materials should be labeled with the name of the responsible person. Seals should be vapor-tight and spill-proof in case the container is tipped over. Glass stoppers, aluminum foil caps and similar closures are not acceptable.

Laboratory refrigerators should be:

- Placed against fire-resistant walls.
- Equipped with heavy-duty electrical cords (explosion-proof refrigerators in Class 1, Division 1 locations require hard-wiring into the electrical system).
- Protected by a separate circuit breaker.

Defrosting a Freezer or Refrigerator

Occasionally it is necessary to defrost a laboratory freezer or refrigerator. One should exercise caution to prevent injury and/or contamination from items in the freezer or refrigerator during this process. If the unit is used to store biological, radioactive or hazardous materials, make sure that the inside of the unit is decontaminated before defrosting. After decontamination, placard the unit with a sign indicating that the unit was cleaned/disinfected by (name) on (date). This will show anyone who may need to use the freezer/refrigerator or make repairs to it that it is safe to use or repair.

Heating Devices

USE

Electrical devices that supply heat for reactions or separations are commonly used in laboratories. The use of Bunsen burners and other open flames is highly discouraged. If they are absolutely necessary, they must never be left on and unattended.

TYPES

Electrically heated devices include:

- Hotplates
- Heating mantles
- Oil baths
- Air baths
- Hot-tube furnaces
- Hot-air guns
- Ovens

HAZARDS

If used improperly, these devices can cause:

- Electrical hazards
- Fire hazards
- Burns to the user

Baths

If baths are required to be hot at the start of each day, they should be equipped with timers to turn them on and off at suitable hours.

Never use flammable or combustible solvents in a heated bath unless housed in a chemical hood.

Safe Practices

Before using any heating device:

- Check to see if the unit has an automatic shutoff in case of overheating.
- Note the condition of electrical cords and have them replaced as required.
- Make sure it has been maintained as required by the manufacturer.
- Before leaving an area for any extended period of time, check to see that all heating units in use without automatic shut-off have been turned off.

Open Flames in Biosafety Cabinets

Bunsen burners, alcohols burners, or other open flames may not be used inside biosafety cabinets. When deemed absolutely necessary, touch-plate microburners equipped with a pilot light to provide a flame on demand may be used. Internal cabinet air disturbance and heat buildup will be minimized. The burner must be

turned off when work is completed. Small electric 'furnaces' are available for decontaminating bacteriological loops and needles and are preferable to open flame inside the BSC. Disposable loops can also be used.

Safe Practices

Ultraviolet, visible, and near-infrared radiation from lamps and lasers in the laboratory can produce a number of hazards. Powerful arc lamps can cause eye damage and blindness within seconds. Some compounds, chlorine dioxide, for example, are explosively photosensitive.

Ultraviolet Lights in Biosafety Cabinets

UofL no longer supports use of UV germicidal lights in general use BSCs since they offer little to no value to product sterility, have resulted in hazardous exposures and result in expensive waste disposal (UV bulbs constitute hazardous waste and cannot be disposed of in regular trash).

More specifically, UV decontamination of BSCs has not been recommended for use since 1994. Refer to the Australian Standard AS 26471994. Installation of UV lamps in BSCs is not recommended because:

1. Personnel exposed to UV radiation may suffer eye damage and erythema.
2. The radiation is not penetrating and is ineffective on dry organisms.
3. Organism killing is dependent upon the stage of the growth cycle-organisms must be dividing.
4. Organism killing is dependent upon the relative permeability of the UV light; spores that have a thick, modified cell wall are not as permeable.
5. Radiation intensity decreases over time due to degradation and surface staining of the lamps.
6. UV radiation caused degradation of certain materials that may be used in cabinet construction such as the plastic.
7. The maximum life of the average UV lamp is six months due to solarization.
8. UV lights cannot use fluorescent glass, because it does not go through the glass. UV lights must be industrial quartz and a flux of 25 microwatts per square centimeter is required for any biocidal effec. A UV flux meter must be used to determine the radiation level is reached and maintained.

Hand-held Ultraviolet Lamps

Hand-held UV lamps require the user to wear long sleeves and gloves to prevent skin exposure and appropriate eye protection to prevent eye exposure. These lamps are designed to be used for a limited, short time period. One must ensure that the units are turned off after each use.

General Safety Rules

The following general precautions should be observed when using vacuum systems.

- Every laboratory vacuum pump must have a belt guard in place when it is in operation.
- The power cord and switch, if any, must be free of observable defects.
- Use a trap on the suction line to prevent liquids from being drawn into the pump.
- If vapors are being drawn through the pump, a cold trap should be inserted in the suction line to prevent contamination of the pump oil.
- Place a pan under the pump to catch any oil drips.
- Vacuum lines leading from an experimental procedure must always be equipped with traps to prevent contamination of vacuum equipment or house lines. The output of each pump should be vented to a properly functioning fume hood. Do not discharge into an enclosed space, such as a cabinet, as this may cause an explosion.

Particulates:
Determine size range being generated and choose capable filtration.

Aqueous non-volatile:
In most cases a filter flask at room temperature will prevent liquids from contaminating vacuum source.

Solvents or other volatile liquids:
A cold trap that is large enough and cold enough to condense vapors plus a filter flask large enough to hold all possible liquids that could be aspirated. Avoid using liquid nitrogen if at all possible. Liquid nitrogen should only be used in sealed or evacuated equipment and with extreme caution. Liquid oxygen can form if proper procedures are not followed. For most applications a slurry of dry ice and

isopropanol or ethanol can be used.

Corrosive, highly reactive, or toxic gases:
HEPA filters or a high efficiency scrubber system should be used to trap the contaminant.

Glassware

Glassware used for vacuum distillations or other uses at reduced pressure must be properly chosen for its ability to withstand the external pressure of the atmosphere.

- Only round-bottom vessels may be subjected to vacuum unless specially designed, such as Erlenmeyer-type filtration flasks.
- Each vessel must be carefully inspected for defects such as scratches or cracks prior to use.

Implosion

Implosion occurs when atmospheric pressure propels pieces inward creating small fragments that are then propelled outward with considerable force.

Because all vacuum equipment is subject to failure by implosion, vacuum operations must be enclosed by blast shielding or conducted in a chemical hood with lowered sash and blast shielding.

Dewar Flasks

Dewar vessels have a vacuum between the walls and some types can be dangerous when they fail.

- Glass types can propel glass into the eyes and should be wrapped from top to bottom with cloth tape such as electrician's friction tape. (Mylar tape can be used if transparency is needed.)
- Large Dewars encased in metal and stainless steel vacuum containers do not require wrapping.

Glass desiccators are often subjected to partial vacuum due to cooling of the contents. They have inherent strains due to glass thickness and the relatively flat

surface of the top and bottom. It is strongly recommended that you either:

- Obtain the available desiccator guard made of perforated metal; or
- Use a molded plastic desiccator, which is spherical and has high tensile strength.

Proper Instruction

Do not attempt to operate a centrifuge until you have received instruction in its specific operation.

- Read the operation manual.
- Ask an experienced colleague to demonstrate procedures. Ask questions about hazards and emergency action.

Responsibility

When operating a centrifuge, you are responsible for the condition of the machine and rotors both during and at the end of your procedure. This means:

- Proper loading.
- Controlling speed to safe levels.
- Safe stopping.
- Removal of materials.
- Cleanup.

Ultra Centrifuges

Ultra centrifuge rotors require special, cleaning procedures to prevent scratching of surfaces, which can lead to stress points and possible rotor failure during a run.

Potential Problems to Watch for:

An unbalanced load can cause damage to seals or other parts. Keep the lid closed during operations. Shut down and stop the rotor if you observe anything abnormal, such as noise or vibration. To avoid broken tubes examine tubes for signs of stress when loading the rotor and discard tubes that look suspicious.

Selection Criteria

In selecting a centrifuge, carefully consider location, type, and use. Other considerations include:

- Balance capability each time centrifuge is used.
- Adequate shielding against accidental "flyaways".
- Suction cups or heel brakes to prevent "walking".
- Accessibility of parts, particularly for rotor removal.
- Lid equipped with disconnect switch which shuts off rotor if the lid is opened.
- Safeguard for handling flammables and pathogens. This may include positive exhaust ventilation or a safe location.
- Positive locking of head.
- Electrical grounding.
- Locations where vibration will not cause bottles or equipment to fall off shelves.
- Knowledge of chamber entry during a power failure.

Proper Instruction

Do not attempt to operate an autoclave until you have received instruction in its specific operation.

- Read the operation manual.
- Ask an experienced colleague to demonstrate procedures. Ask questions about hazards and emergency action.

Preparing and Loading

- Inspect drain strainer daily - clean when blocked.
- Fill liquid containers no more than 50-75% full.
- Loosen caps or use vented closures on bottles. (NEVER tighten caps on non--vented bottles)
- Leave space between items to allow steam to circulate.
- NEVER use plastic bags, which are impervious to steam, unless the top of the bag is loosened to allow steam penetration.
- Autoclave reusable syringes and needles in a pan of disinfectant.
- Do NOT autoclave cellulose nitrate media due to decomposition hazard.
- Place the load in secondary containment. Special plastic bins (polypropylene) or stainless steel bins can be purchased for this purpose. Secondary containment will serve to contain the broken vessels or ruptured bags that sometimes result from routine autoclaving.

- Where a load to be decontaminated is comprised of largely dry materials in an autoclave bag, the addition of water to the bag may facilitate steam penetration, although it is important that caution be used so as not to create aerosols of infectious microorganisms.

Removing the Load

- Check that chamber pressure is zero prior to removing the load.
- Allow load to cool before opening the chamber. If the chamber must be opened before it has cooled, wear a lab coat, face protection (such as a face shield), heat-insulating gloves, and closed toe shoes to avoid steam exposures.
- Stand behind the door and open it slowly. BEWARE OF A RUSH OF STEAM.
- After slow exhaust cycle, open the door and allow liquids to cool before removing.

POTENTIAL HAZARDS

- Potential for generation of scalding jets of steam.
- Handling of superheated solids and liquids.
- Liquids can boil over if pressure is reduced too quickly or if removed too soon after cycle.
- Cellulose nitrate media, such as centrifuge tubes and nitrocellulose filters, can be highly reactive and can decompose explosively under the high heat and pressure conditions present in autoclaves.