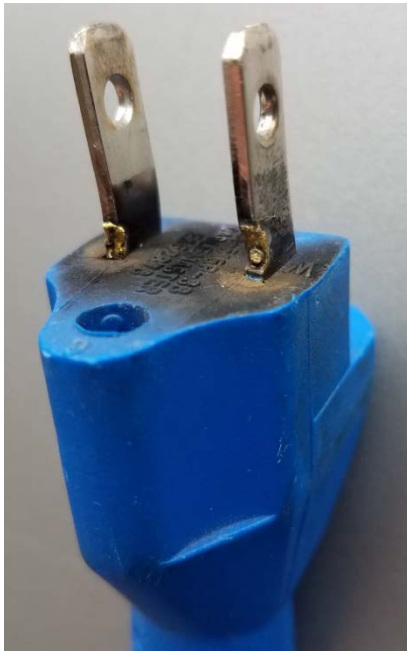
G_001 - General Laboratory Safety

What is wrong in these pictures?



Douglas Jacobs-Perkins
LLE Chief Safety Officer

Emergency phone numbers

	University phones	ATT or Verizon cell phone	All other phones
LLE Receptionist (West lobby)	5-5101	(585) 275-5101	
UR Public Safety	13	#413	(585) 275-3333
Local emergency services (Fire, Police, Ambulance)	9-911	911	
Blood exposure hotline	5-1164	(585) 275-1164	

Campus blue phones connect directly to UR Public Safety.

Add emergency numbers to your cell phone contacts now!

This presentation has two parts

Note: G_005 – "Safety Training for Guest Workers at LLE" is generally recommended for Guest Workers, and satisfies the training requirements to obtain badge access to LLE. It is *NOT* necessary to complete both G_001 and G_005.

- **Part I is mandatory for all persons who have "badge access" to LLE**
  - **Part I is sufficient for persons who have infrequent (~1x/year) need to *visit* laboratories as an *escorted observer***
- **Part II is required for persons who**
  - **Work in or enter LLE laboratories without an escort (including facility mechanics, cleaning staff)**
  - **Supervise laboratory activity (e.g., faculty who supervise lab research)**

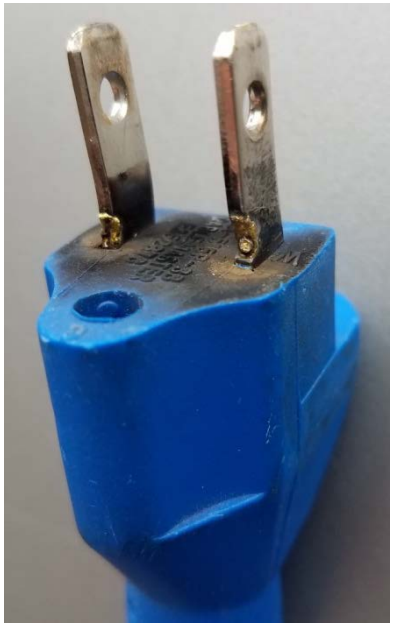
Part I - Summary

Safety is everyone's responsibility

- **Hazards exist throughout the workplace and change over time**
- **Restrict your activities to those for which you are trained, qualified, and Authorized**
- **Stop Work if an abnormal event occurs or if an activity seems unsafe**
- **Report safety deficiencies or events promptly**
- **Be Prepared. Know how to respond in an emergency**
- **Prevent Unauthorized Access to LLE**
- **Understand Computer and Network Safety guidelines**

What is wrong in these pictures?

1



2

3

1. **The cover-plate screw is missing** (*note: this photo was staged*)
2. **The ground conductor is missing, the connector blades are burned**
3. **The top outlet is broken**

Why does it matter?
Refer to Incident Report (IR) 253 – Electrical outlet fault

What happened?

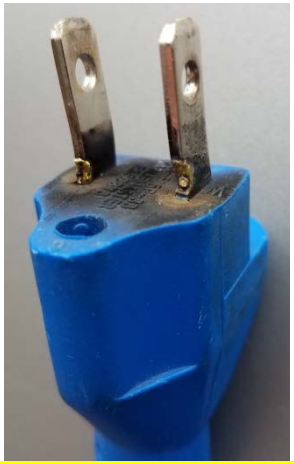
The missing screw allowed the cover to fall onto the plug and cause arcing. The circuit breaker did not trip; arcing continued until the appliance was unplugged. No one was injured, but the worker was alarmed.

What was the cause?

The cover had apparently fallen off and been replaced (speculation – label text was upside down); no one reported the screw was missing. When the plug was inserted, the plate fell.

IR 253 Findings

- The plate fell onto the plug because the screw was missing
- The missing ground pin created two shock hazards:
  - The appliance was not grounded
  - Power polarity was reversed; shutting off the appliance power switch did not disconnect power from the appliance
- The outlet was installed with the live contacts facing up (permitted by code; preferred orientation is with the ground pin up)
- The broken outlet indicates mishandling of appliance plugs (e.g., forceful “wiggling” to remove them)



Broken

Preferred orientation:
Ground pin up

Inspect equipment each time you use it, and use it properly.
Never knowingly use defective equipment.

Outline

Part I – General Safety

- **Overview**
- **Medical emergencies**
- **Fire safety**
- **Laboratory access and visitors**
- **Computer and network safety**
- **Ergonomics**

Part II – Laboratory Safety

- **Buddy system**
- **Personal Protective Equipment (PPE)**
- **Lockout/Tagout**
- **Incident reporting and investigation**
- **Contractors & guests**
- **Safe work practices**

Part I – General Safety

LLE has a proactive safety program to ensure the safety of personnel and protection of equipment

- **Everyone must *actively participate* in making LLE a safe workplace**
- ***Training*, *procedures*, and *qualification* are critical elements of LLE's safety program**
- ***Compliance* with safety procedures and manufacturers' recommended operating procedures is mandatory**
- ***Incidents* are investigated and actions taken to prevent recurrence**
- **Laboratories are *inspected* every 6 months**
- **LLE's "Safety Zone" web site contains the latest training information**

Hazards are present in all aspects of daily life

- A **hazard** is a condition that poses a threat to life, health, property, or environment. Most hazards are dormant, with a finite probability of causing harm
- The probability of a hazard causing harm increases with:
  - carelessness, ignorance, or failure to follow procedures
  - defective equipment
  - equipment or techniques unsuitable for a specific task
  - unforeseen circumstances
- Hazards that are **not adequately mitigated** cause unsafe conditions
  - never undertake a job that appears unsafe
- Hazards can be mitigated only when they are identified **and their full implications are understood**

Effective **hazard mitigation requires specialized knowledge**

Employers and employees both have responsibilities to keep the workplace safe

The Occupational Safety and Health (OSH) Act of 1970[1] states:

(a) Each employer

(1) shall furnish … a place of employment which is free from recognized hazards that are … likely to cause death or serious physical harm to employees;

(2) shall comply with occupational safety and health standards promulgated under this Act.

(b) Each employee shall comply with occupational safety and health standards and all rules, regulations, … applicable to his own actions

1) Excerpted from Occupational Safety and Health Act of 1970, General Duty Clause, Section 5

Workers need to be aware of work area hazards

- Each work area is dynamic and presents unique hazards
- LLE management informs workers of hazards by training, signs, and other communications
- Some of the hazards that may be present at LLE include:
  - Electromagnetic radiation (laser, x-ray, …)
  - Radioactive sources (neutron, beta, electron, …)
  - High-pressure gas and large volume vacuum systems
  - Cryogenic fluids
  - Chemicals, beryllium, silica dust
  - High voltage
  - Working aloft (e.g., ladders, lifts, platforms)
  - Rotating machinery
  - Rigging operations

You must restrict your activities to those for which you are trained, qualified, and authorized

Everyone has the right and RESPONSIBILITY to "Stop Work" if they perceive an imminent danger

- An imminent danger is a hazard or unsafe practice that presents an unacceptable risk of injury, environmental impairment, or property damage
- STOP, get the right people involved to resolve the problem:
  - Experienced co-workers, supervisors, Shot Directors, Safety Officers, and/or the Laser Facility Managers
- Provide feedback to the Safety Officers and peers to
  - reduce future risks and
  - improve planning

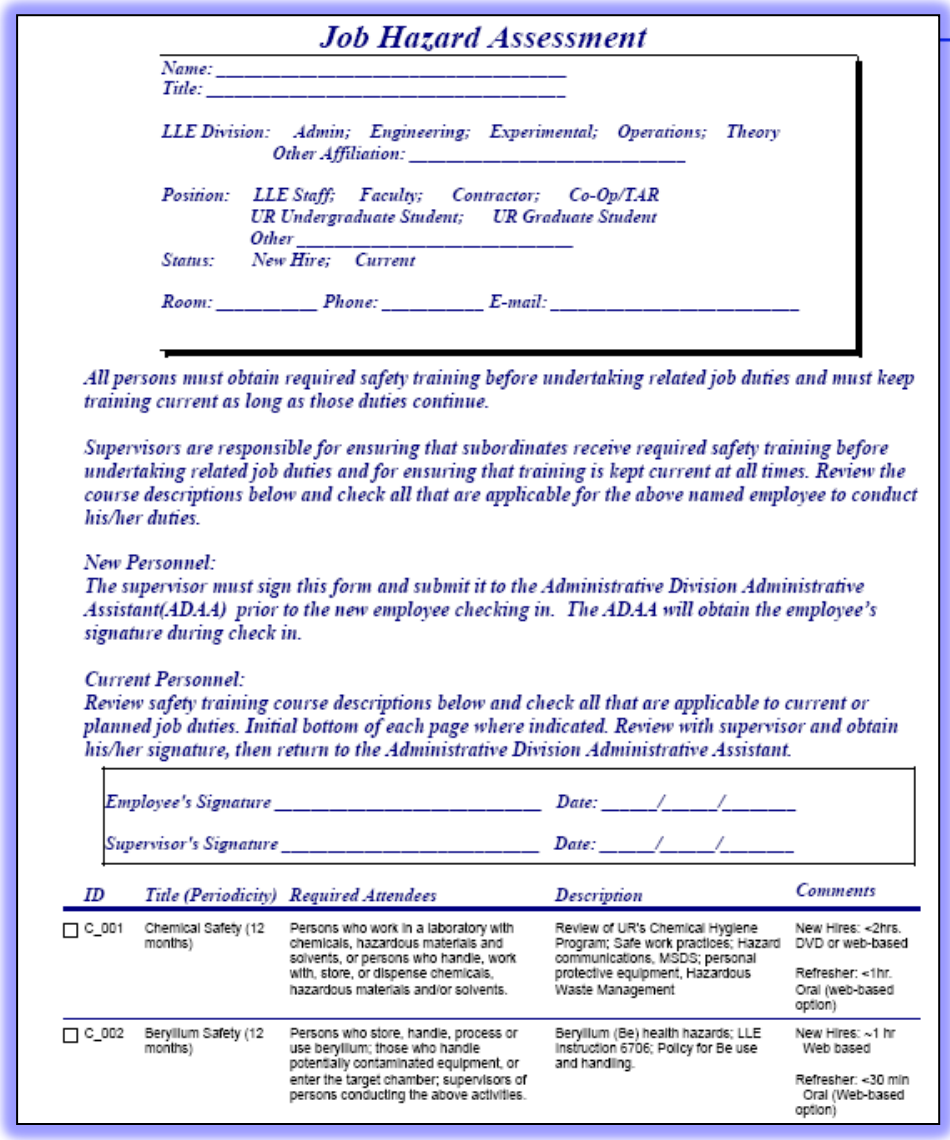
No one is expected *OR PERMITTED* to undertake a job until having received instructions on how to do it properly, and authorization to perform it

Report safety concerns immediately

- **Bring safety concerns to the attention of persons with the ***knowledge and authority*** to rectify the situation**
- **Witnesses who observe an event that (could have) caused injury or harm shall promptly report the event/concern to a supervisor, a Safety Officer and/or the Chief Safety Officer**
- **A supervisor who learns of an event must ensure that proper follow-up is initiated:**
  - **Medical evaluation/treatment for injured workers**
  - **Incident investigation**
- **If you believe a safety issue is not being addressed, inform the Chief Safety Officer**

An employer may not take unfavorable personnel action for reporting a workplace safety deficiency when the complaint is made in good faith

Your Job Hazard Assessment (JHA) is the first element of your safety training



Job Hazard Assessment

Name: _____
Title: _____

LLE Division: Admin; Engineering; Experimental; Operations; Theory
Other Affiliation: _____

Position: LLE Staff; Faculty; Contractor; Co-Op/TAR
UR Undergraduate Student; UR Graduate Student
Other _____
Status: New Hire; Current

Room: _____ Phone: _____ E-mail: _____

All persons must obtain required safety training before undertaking related job duties and must keep training current as long as those duties continue.

Supervisors are responsible for ensuring that subordinates receive required safety training before undertaking related job duties and for ensuring that training is kept current at all times. Review the course descriptions below and check all that are applicable for the above named employee to conduct his/her duties.

New Personnel:
The supervisor must sign this form and submit it to the Administrative Division Administrative Assistant(ADAA) prior to the new employee checking in. The ADAA will obtain the employee's signature during check in.

Current Personnel:
Review safety training course descriptions below and check all that are applicable to current or planned job duties. Initial bottom of each page where indicated. Review with supervisor and obtain his/her signature, then return to the Administrative Division Administrative Assistant.

Employee's Signature _____ Date: _____/_____/_____

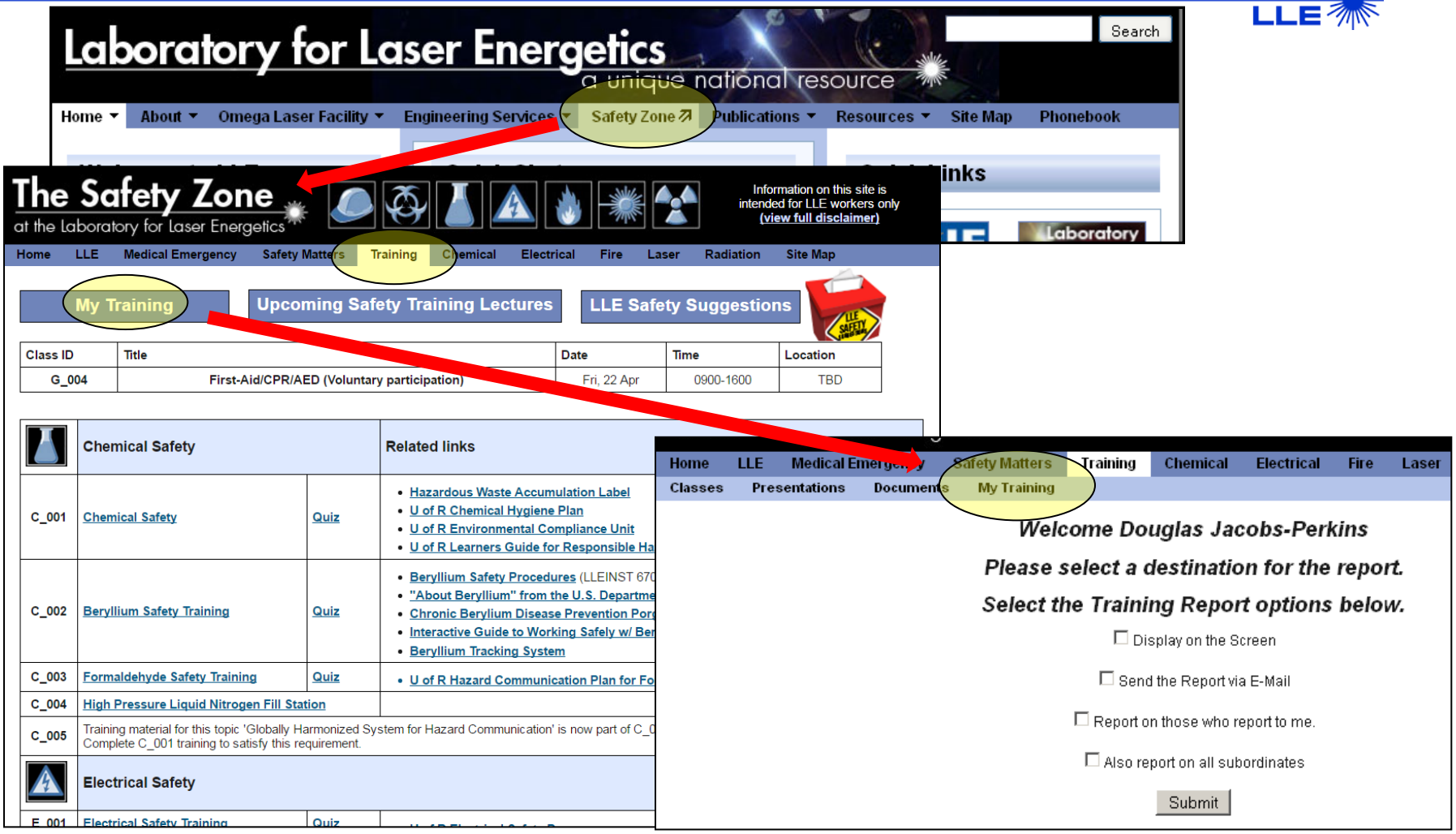
Supervisor's Signature _____ Date: _____/_____/_____

ID	Title (Periodicity)	Required Attendees	Description	Comments
☐ C_001	Chemical Safety (12 months)	Persons who work in a laboratory with chemicals, hazardous materials and solvents, or persons who handle, work with, store, or dispense chemicals, hazardous materials and/or solvents.	Review of UR's Chemical Hygiene Program; Safe work practices; Hazard communications, MSDS; personal protective equipment, Hazardous Waste Management	New Hires: <2hrs. DVD or web-based Refresher: <1hr. Oral (web-based option)
☐ C_002	Beryllium Safety (12 months)	Persons who store, handle, process or use beryllium; those who handle potentially contaminated equipment, or enter the target chamber; supervisors of persons conducting the above activities.	Beryllium (Be) health hazards; LLE instruction 6706; Policy for Be use and handling.	New Hires: ~1 hr Web based Refresher: <30 min Oral (Web-based option)

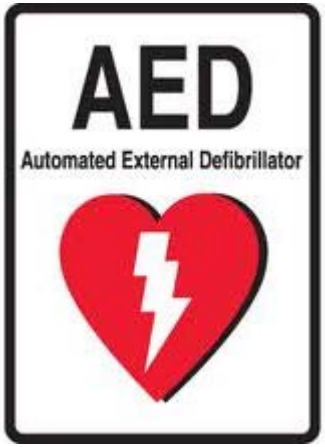
- The JHA defines
  - **risks** associated with your work, and
  - required **training**
- The JHA must be **updated** with input from you and your supervisor
  - annually
  - when job duties change

JHA changes must be approved by your supervisor

Safety training presentations, quizzes, and status reports are available on-line



Know where to find emergency equipment and learn how to use it



Notify a Safety Officer after depleting first-aid supplies, or if safety equipment is missing or deficient

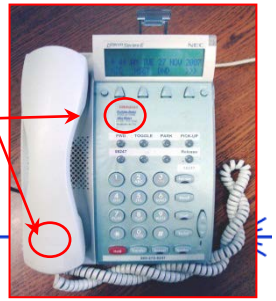
Medical emergencies require a rapid response

- **Secure area hazards or move the patient to a safe location**
- **Avoid exposing yourself to hazards such as fire, laser beams, radiation, electricity, chemicals, or body fluids**
- **Wear PPE. First-aid cabinets in bathrooms and public areas contain items to treat minor injuries, and gloves, face mask, goggles, and a resuscitation mask to protect the care givers**
- **Wash thoroughly. If you contact body fluids ("anything wet or sticky", blood, saliva, …), promptly call the Occupational & Environmental Medicine (OEM) Blood Exposure Hotline 585-275-1164**

Cleanroom garments are *NOT* required when responding to emergencies, but don't ignore hazards such as lasers, machinery, high voltage, …

Medical emergencies require a rapid response

Emergency Numbers
During working hours:
55101
After hours:
13 (UR Public Safety)
If no response, dial 9-911



- **During working hours (M-F, 8:30am – 5:30pm)**
  - **Call an LLE receptionist and state "MEDICAL EMERGENCY". Receptionist will notify the Medical Emergency Response Team**
    - **If no response, call UR Public Safety**
- **Off-hours (nights, weekends)**
  - **Call UR Public Safety, or use any "Blue" phone outside**
  - **If no response, call Local Emergency Services (9-911)**
- **Inform the receptionist when the situation is stable, or if further assistance has been summoned (e.g., defibrillator, ambulance, etc..)**
- **Once an ambulance is called, have a bystander notify UR Public Safety**

If a first-responder determines that advanced medical assistance is required, immediately call 911 and remain with the patient. Remain on the phone to provide situational information and obtain instructions. Other responders can keep the receptionist appraised of the situation.

Remain calm when seeking emergency assistance

Provide detailed information to avoid delays:

- **Your exact location (e.g., “OMEGA Target Bay, top deck, South-West side”)**
- **Your phone number**
- **Description of the emergency (e.g., hand injury, breathing difficulty, chest pain, …)**

- **Enlist help; give simple, clear instructions, e.g.,**

  “Amy – notify the receptionist”, “Joe – get a first-aid kit”
- **Stay with the injured person until more qualified help takes over**
- **Begin first-aid if you know how**

Medical emergency follow-up

- **If in doubt about a patient's safety, or if a patient exhibits any of the following, call for an ambulance:**
  - **Altered mental status**
  - **Potential threat to self or others**
  - **Unable to verbalize rational reasons for refusing care**
- **Encourage the patient to seek medical evaluation and treatment**
  - **The patient may refuse medical treatment if he/she is mentally competent**
- **Report all workplace injuries* to LLE Human Resources (HR); (Dave VanWey, Steve Stagnitto)**
  - **HR will prepare and submit a UR Employee Incident Report**

*** see UR Policy 271 – Workers' Compensation Insurance**

Failure to promptly report a workplace injury can jeopardize the patient's right to receive Worker's Compensation

Prepare for the unexpected – what to do if you observe, or are the victim of a robbery or an assault

- **STAY AWARE of your surroundings. Keeping alert is your best defense**
- **TRAVEL WITH OTHERS. There is safety in numbers**
- **LIMIT use of personal electronic devices when out in public**
- **DO NOT ARGUE with a suspect or force a confrontation**
- **STAY CALM and observe everything taking place**
- **NOTE the suspect's direction and means of travel; do not chase or follow!**
- **HAVE A PLAN! what you might do - think about alternatives**
- **As soon as it is safe to do so, call UR Public Safety from a Blue Light Emergency Phone (x13 on campus phones). Off campus, call 911**

LET IT GO! Property can be replaced, but you are one of a kind

Respond immediately to fire alarms

Evacuate via the most direct, safe route

- **close windows and doors while exiting, if safe to do so**
- **use stairs, not elevators**
- **move at least 50 feet from the building and emergency equipment**
- **don't re-enter the building until alarms are silenced and beacons are off**
- **LLE hosts are responsible for their guests during an emergency**

After getting to safety, notify (phone, email, text message…) a RESPONSIBLE Individual (Supervisor, Group Leader, Division Director) before leaving (e.g., lunch, class, home, etc..)

The UR Advancement Center is LLE's assigned meeting location during an emergency evacuation

If an emergency evacuation prevents reentry into LLE, walk to the Larry & Cindy Bloch Alumni and Advancement Center at 300 E. River Road.

Follow instructions from the Emergency Response Coordinator (ERC), and do not leave until authorized by the ERC.

Fire Safety

Do:

- **Use *only* electromagnetic safety latches to hold fire doors open**
- **Never obstruct a sprinkler head**
- **Keep combustible materials 18” below fire sprinkler heads**
- **Maintain clear access**
  - **≥ 48” through hallways, around doors**
  - **≥ 36” around electrical panels, fire extinguishers, and fire alarm pull stations**
- **Minimize storage of flammable materials**
- **Inform a Safety Officer of faulty safety equipment (exit light, fire extinguisher, etc..)**

These boxes are too close to a sprinkler, will restrict water distribution, and limit effective coverage. Items that are too close to the ceiling will not be protected.

Fire Safety

Do not:

- **Prop fire doors open**
- **Place items on electrical raceways**
- **Attach items to, or drape items over, fire sprinklers or pipes**
- **Bring personal appliances to LLE (heaters, toasters, coffee makers, refrigerators, microwave ovens, halogen lamps, decorative lights, etc..)**
- **Park within 15 feet of a fire hydrant**

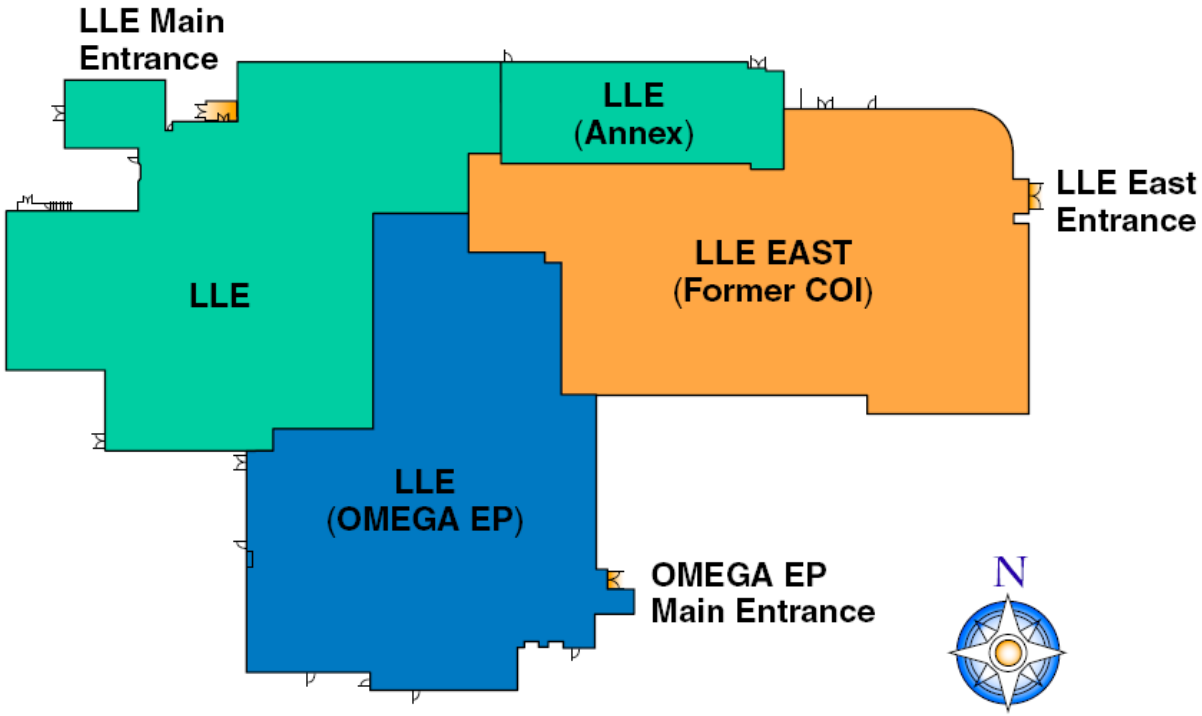
Mag. Latch OK

Door prop NOT OK

Raceway storage NOT OK

LLE has three fire alarm zones

- **Alarms *may* not sound in all zones**
- **Fire doors automatically isolate each zone when an alarm sounds**



You may move into an area that is not in an alarm state, only if it is along your most direct egress route

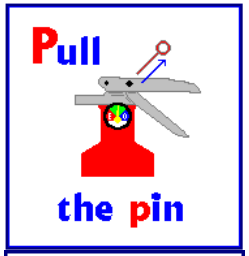
UR has designated LLE as a “Fight Building”

- **LLE personnel are ***NOT*** required to fight a fire**

- ***Trained*** **personnel ***MAY*** fight a fire after:**
  - **Activating the building fire alarm**
  - **Assisting persons in immediate danger**
  - **Assessing the risks *(follow your instincts!)***
    - **Is there heavy smoke or strong odor?**
    - **Is fire small and contained?**
    - **Is there an unobstructed exit?**

- **Evacuate immediately if:**
  - **the fire spreads beyond the point of origin**
  - **the fire could block your exit**
  - **one fire extinguisher is insufficient**

Learn how to use a fire extinguisher



Pull the pin.
This will allow you to discharge the extinguisher.

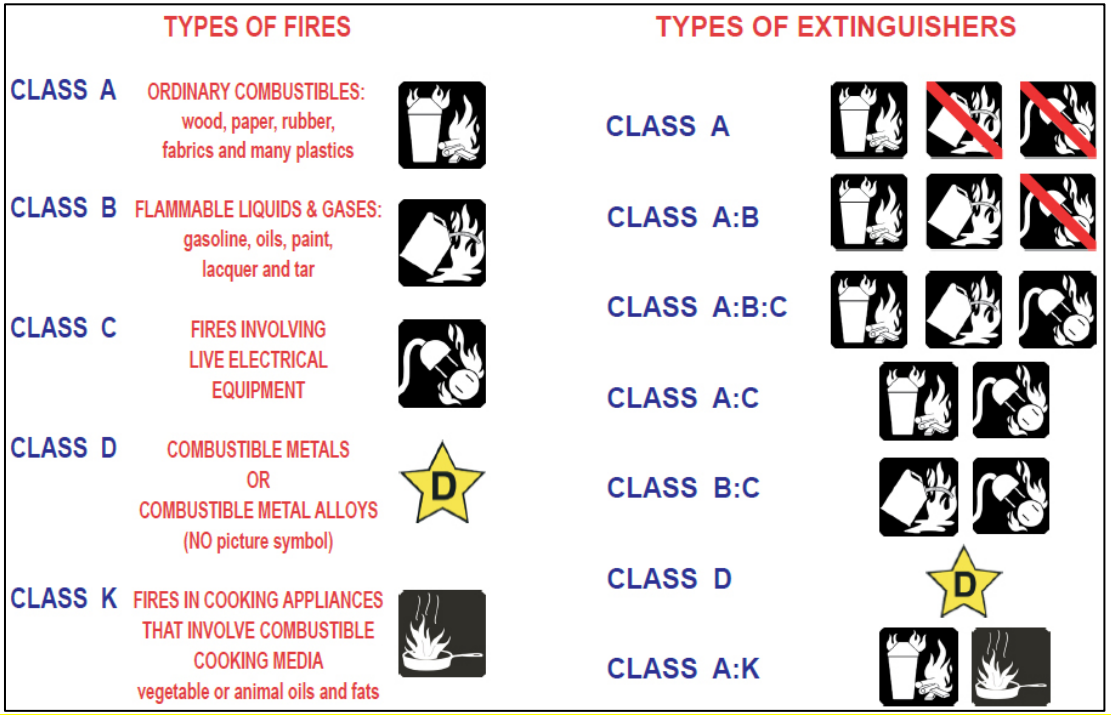
Aim at the base of the fire.
You must hit the fuel, not the flames

Squeeze the top handle or lever
Start using the extinguisher from a safe distance, then move forward.

Sweep from side to side
Once the fire is out, monitor the area in case it re-ignites.

Source: http://ehs.okstate.edu

Source: http://www.fireservicepro.com

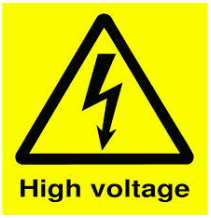


LLE has type B:C (Carbon Dioxide, CO_2) fire extinguishers in laboratories because of the electronics and optics. When used on ordinary combustibles (e.g. paper), use caution; CO_2 may scatter burning materials, causing the fire to spread.

LLE building infrastructure policies

- **LLE facility personnel, under direction of John Sawyer, are responsible for installation, modifications, maintenance, and repair of**
  - **Electrical power distribution and permanent fixtures**
  - **Water, chilled water, and house gas (compressed air & nitrogen) distribution**
  - **Permanent infrastructure, including walls, doors, floors, fume hoods, etc..**
- **LLE staff (other than facility personnel) are NOT permitted to**
  - **Modify any laboratory infrastructure**
  - **Open circuit panels or enable/reset/disable circuit breakers, except when part of written and approved procedures**

LLE electrical safety policies



- **High-voltage definition: 50 volts or greater**
- **Extension cord safety:**
  - **Don’t exceed the manufacturer’s load rating**
  - **Don’t “daisy-chain” cords (connect in series)**
- **Equipment used at LLE must be Underwriters Laboratory (UL) certified, or approved by the Electrical Safety Officer**
- **Do not repair any high-voltage equipment. Contact an Electrician or the LLE Electronics shop if repairs are needed**
- **Orange outlets provide “clean” power for instruments. Don’t connect pumps, motors, etc..**
- **High-voltage diagnostics Lockout/Tagout guidelines are documented in S-SA-M-060**

Access to LLE is restricted to provide physical and personal security

- **Building access is controlled by card readers and receptionists**
- **Everyone must visibly display (e.g., above the waist) their UR/LLE ID or visitors pass while in the building**
- **Visitors must sign in with a receptionist and wait for an LLE staff member to escort them to their destination**
- **Never allow people to enter LLE to use the phone, bathroom, get a drink, etc.. unless they are personally known to you and escorted by you.**
- **Before you leave the building, make sure the path to your vehicle is safe. Wait inside the building if you observe unusual vehicles or suspicious activities. Call UR Public Safety and ask an officer to investigate or provide an escort if there are concerns**

Please be observant

Do not allow unfamiliar people to enter LLE when the receptionist desk is not staffed.

If someone you do not recognize tries to follow you inside, ask to see their ID showing their affiliation with LLE, or who they are here to see. Refuse entry if they can't provide this information.

If you grant entry to someone who is here for a legitimate purpose, *YOU are responsible* for staying with them until you hand them off to the person they came to see.

Since the UR Medicine Outpatient Imaging Center opened at 200 East River Road, many patients have come to LLE mistakenly. Redirect people to the Imaging Center when appropriate.

Report instances of unauthorized building entry to Jean Steve.

All persons are required to wear UR/LLE issued ID or visitors badge, where it is readily visible, while in the building

Guest and Visitor access

- **Non-US citizen visitors must be preapproved by the Director's office (see LLE Instruction 5100)**
  - **LLE host must contact J. Steve 60 days before planned visit**
  - **This rule applies to vendors and contractors**
  - **UR faculty or UR students are exempt from this rule**
- **Tours of >3-4 people must be scheduled with the Director's office (J. Steve)**
- **Photos are allowed in viewing galleries**
- **Visitors must be escorted in technical areas (labs, cleanrooms, shops, OMEGA facility)**
  - **The Responsible Supervisor must authorize visitor access**
  - **No photos are allowed in technical areas**
- **LLE Employees, and students with LLE badge access, may bring family members into LLE viewing galleries on evenings & weekends (technical areas are prohibited)**
- **The LLE host is responsible for their guests at all times**

Questions? Contact Jean Steve

Carefully control information you have access to, and items assigned by LLE/UR

- University ID badge
  - If you misplace your ID badge, report it immediately to Jean Steve (275-5286) and the ID Card office (273-2000)
- Computer accounts & passwords
- Confidential information
- Radiation badges
- Keys
- Mobile devices

The University enforces strict policies regarding handling of confidential information. University IT Policies are found here, including:

- Data Security Classifications Policy
- Mobile Computing Device Security Standards

Individuals are personally responsible for appropriate use of these things. Improper use may result in termination.

Computer and Network Safety

Computer safety and security policies play an integral role in operations at the Laboratory. Like all safety rules and guidelines, the overriding principal is “think before you act”. A compromised system or misconfigured network device can easily have a broad impact on operations, data integrity, and/or cause extensive downtime and lost productivity.

Computer and Network Safety: 10 things you should know

LLE's Computer Support Group (CSG) has identified the key things you should know about accessing or using computer or network resources:

1. **Never connect or disconnect cables from a computer or network device without assistance or explicit permission from CSG. Limit your activities to specific cables, devices, and network ports you are authorized to work on.**
2. **Do not change the network settings on any LLE network device w/o CSG approval.**
3. **Laptops that connect to ANY University network must be kept up to date with all relevant security patches and have University approved anti-virus protection.**
4. **Treat all email as suspicious until proven otherwise. Don't click links or open attachments unless you recognize the sender and understand why they sent you a link / attachment.**

Computer and Network Safety: 10 things you should know (cont.)

5. **Do not power off a desktop computer without contacting CSG.**
6. **Save important LLE files on network shares, not on your computer.**
7. **Mobile devices (phones, tablets, laptops, etc..) that access any LLE resources (mail, files, etc..) must be password protected.**
8. **Use randomly generated passwords for everything. CSG recommends the use of a password manager/vault, such as: LastPass, KeePass, PasswordSafe, 1Password, etc....**
9. **Never open a computer chassis without assistance from CSG.**
10. **Log off or lock your computer when you are away from your desk (or lock your door if you have your own office).**

If you have any questions about ANY of these rules, contact CSG for answers and/or clarification

The UR Ergonomics Program reduces the incidence of work-related musculoskeletal disorders

- **Musculoskeletal Disorders (MSDs) are injuries involving muscles, nerves, tendons, ligaments, cartilage, joints and spinal disk**
- **MSDs can be caused or aggravated by**
  - **Repetitive motion**
  - **Poor posture & inadequate back support**
  - **Improper lifting techniques**
- **The UR Environmental Health & Safety Occupational Safety group will assist with**
  - **Worksite evaluations**
  - **Employee and supervisor training**
  - **Implementation of ergonomic control strategies**

For more information, visit:
http://www.safety.rochester.edu/ih/ergonomic/ergonomics.html

AlertUR emergency notification system disseminates critical safety information to the University community

What is considered critical?

- **In-progress police emergencies on University property and/or an imminent danger to the community**
- **Civil disturbances, acts of terrorism, fires that impact operations, release of hazardous materials and medical emergencies, which pose a severe threat to personal safety and/or cause a major disruption to University operations**
- **Warnings about natural disasters, health emergencies, and other dangerous occurrences connected to the University**

To register, or change notification options, go to:
https://alert.rochester.edu

Do you have a suggestion to make LLE a safer work place?

- **Click this image to open the LLE Safety Suggestion form (Also available from LLE Safety Zone web site)**
- **Anonymous suggestions allowed**
  - **No personally identifiable information will be collected, unless you specifically provide it**
- **Submissions will be copied to LLE Safety Officers for resolution**
- **After submission, you will get a link that can be used to edit your submission, track the response, and provide anonymous feedback**

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Safety is everyone's responsibility

- **Hazards exist throughout the workplace and change over time**
- **Restrict your activities to those for which you are trained, qualified, and authorized**
- **Stop Work if an abnormal event occurs or if an activity seems unsafe**
- **Report safety deficiencies or events promptly**
- **Be prepared. Know how to respond in an emergency**
- **Prevent unauthorized access to LLE**
- **Understand Computer and Network Safety guidelines**

This is the last slide of Part I

- **If you work in any LLE laboratory area or supervise laboratory activity, proceed to the next slide**

- **If you visit laboratories infrequently and only with an escort, you do NOT need to complete Part II**

You must complete the G_001 quiz to satisfy your training requirement

Part II – Laboratory Safety

Persons who perform or supervise laboratory work MUST understand and comply with the information presented in the following section

Outline

Part I – General Safety

- **Overview**
- **Medical emergencies**
- **Fire safety**
- **Laboratory access and visitors**
- **Computer and network safety**
- **Ergonomics**

Part II – Laboratory Safety

- **Buddy system**
- **Personal Protective Equipment (PPE)**
- **Lockout/Tagout**
- **Incident reporting and investigation**
- **Contractors & Guests**
- **Safe work practices**

Part II Summary

- **The Buddy System must be used when working in potentially hazardous situations**
- **Understand the limitations of PPE. Know what PPE is required for the tasks assigned to you, and for the areas in which you work**
- **Summaries of several incident reports are presented to highlight lessons learned**
- **Guest workers are only permitted to perform pre-approved tasks**
- **Lockout/Tagout protects workers from unexpected hazardous energy release**
- **Incident investigations prevent recurrent problems**
- **Housekeeping can help mitigate hazards and prevent the spread of contamination**
- **Permits are required to perform energized work, hot work, or to enter a confined space**

Ensure that new and existing equipment is both safe to operate and operated safely

- **No equipment or diagnostic will be operated until requirements set forth in LLE Instruction 7700 are satisfied**
- **Only qualified operators may operate Omega facility equipment, with authorization from the appropriate Shot Director or Laser Facility Manager**
- **Equipment will be installed by qualified personnel only, with authorization and coordination from the Laser Facility Manager, Engineering Group Leaders, and Facilities Engineering**

Anything, no matter how carefully designed and built, can be operated in a manner that renders it unsafe

Consider safety risks at all times

- **Good design practices identify and eliminate hazards where possible, then minimize remaining hazards to an acceptable level (e.g., use a Class 3R or lower laser power for alignment)**
- **Failure Mode and Effects Analysis (FMEA) Is process used to assess the causes and consequences of possible failure mechanisms. It is applicable to systems, software and procedures. When done properly, an FMEA can help define requirements that improve both safety and reliability.**
- **Risks are mitigated to the maximum extent practical by:**
  - **Engineering controls (interlocks, guards, pressure relief devices, …)**
  - **Procedures and training**
  - **Administrative controls (restrict access, buddy system, …)**
  - **Personal protective equipment (PPE)**
- **Never alter, remove, or defeat Safety Features without review and approval from the relevant safety officer; examples include software and hardware interlocks, guards on moving machinery, electrical and laser enclosures**
- **Keep procedures accurate**
  - **Stop and correct procedures that are unclear or inaccurate**
  - **Obtain authorization before deviating from procedures**

LLE requires use of the Buddy System

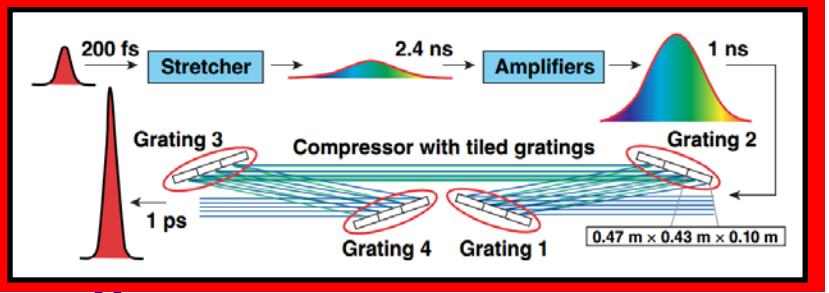
- "Buddy System" means working with a partner when
  - Using potentially hazardous equipment or processes or
  - Working in a potentially hazardous environment
- Buddies are responsible for
  - Being available to assist in an emergency
  - Verifying that safe work practices are used
  - Remaining in contact with partner, and knowing he/she is OK
- Workers must review plans for off-hours laboratory work with their Supervisor and obtain approval prior to starting. Review:
  - Planned work hours
  - Activities being performed
  - Worker training and qualification
  - Buddy System implementation
- Sign in/out at the receptionist desk when working off-hours

Introduction to Personal Protective Equipment (PPE)

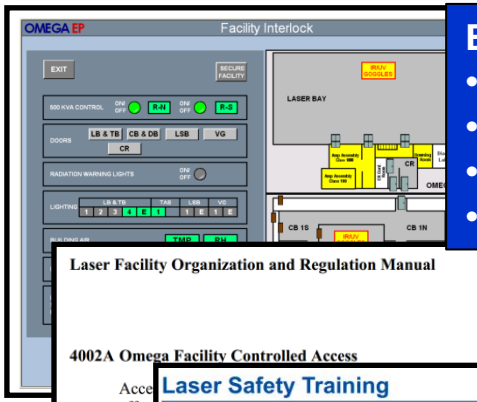
Training about the proper use of PPE is covered in other training modules

Redundant safety barriers reduce the probability of accidents

Potential Hazard



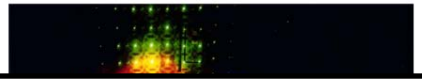
Engineered safety
- Structures
- Interlocks
- Guards
- Software



Laser Facility Organization and Regulation Manual
LFORM
LLEINST 3000M
1 February 2013

4002A Omega Facility Controlled Access

Laser Safety Training



LLE INST6200F
24 February 2006

SUBJECT: LASER OPERATOR QUALIFICATION CARD

REFERENCES: a. *LLE Instruction 3000 (LFORM)*
b. *American National Standard for the Safe Use of Lasers*

Vol. VIII – System Shot Operations Manual
Chapter 2 – Laser Sources
S-AB-P-120 Rev. V
August 16, 2013

LST PROPAGATING SHOT CHECKLIST

Prerequisite: *LST Shot Preparation Checklist, S-AB-P-092.*

Administrative
- Policies
- Access Control
- Buddy System

Education
- Training
- Qualification
- Procedures

Warnings
- Signs
- Voice
- Alarms

Diminishing effectiveness

PPE *NEVER* prevents an accident; it *may* reduce the severity of injuries

PPE is your LAST form of protection

- **When safety barriers fail, PPE is critical**
- **PPE is effective only when properly maintained and used**
- **Wear PPE correctly**
- **Many types of PPE are designed to withstand a single catastrophic event (e.g., hard hats, impact-resistant eyewear, fall arresters)**
  - **If such an event occurs, or if the PPE appears to be damaged, remove it from service immediately!**
- **Some PPE is designed for single-use to prevent spread of contamination (e.g., disposable gloves, mask, lab coat, ear plugs)**
  - **Discard single-use PPE after use**

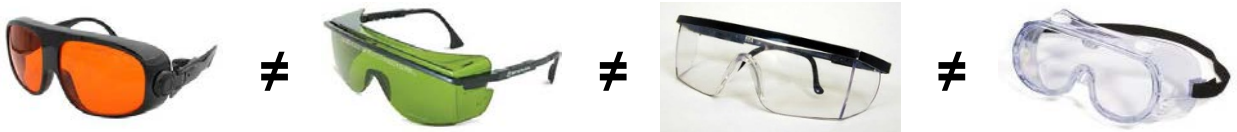
Know the capabilities and limitations of the PPE you use, and use it accordingly

PPE is provided by LLE

- **Some areas within LLE require workers to wear PPE. Many rooms have signs indicating the specific type of PPE required.**
- **Each worker must know/understand what PPE is required *prior to starting* a task. Contact the work-area supervisor or a Safety Officer if there is any question about what PPE is needed**
- **Types of PPE include**
  - **Safety eyewear. Laser, chemical, and mechanical eyewear must meet ANSI Z87.1 impact resistance standard**
  - **Face shield (must be used with safety eyewear)**
  - **Hardhat**
  - **Respiratory protection**
  - **Gloves, lab coat**
  - **Safety shoes (required when moving items ≥ 50 lbs = 22 kg)**
  - **Hearing protection**
  - **Fall protection**

The user is responsible inspecting PPE before *every* use

- **Keep PPE clean and in good working order**
- **Verify the PPE selected affords the required protection**
- **Inspect PPE for wear and damage before each use**
- **Immediately remove damaged PPE from service; return it to the work area supervisor who will dispose of it and replace it**
- **Return PPE to the point of origin. Do NOT transfer PPE from one laboratory to another**
  - **For example: do not "upgrade" your laser safety eyewear from another lab, the wavelengths may not be compatible**



Not all safety eyewear is interchangeable!
Laser eyewear ≠ Mechanical eyewear ≠ Chemical eyewear

OSHA specifies conditions requiring safety eyewear and/or face protection

"… when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation" OSHA 1910.133(a)(1)

LLE requires safety eyewear in the following situations:

- **When required by signs or by the work area supervisor**
- **At <u>all times</u> in the following areas:**
  - **Omega Facility areas (e.g., Laser Bays, Target Bays, LaCave)**
  - **Any room where Class 3B or Class 4 lasers with free-space beam propagation are in operation**
  - **Machine shop, all Chemistry labs and LLE Mechanical rooms**
- **All persons working or passing within 20 feet of:**
  - **Activities that can generate particulate, debris, or projectiles**
  - **Chemical processes areas**
  - **Compressed gas and vacuum system operation**

All safety eyewear used at LLE must have side protectors and satisfy ANSI Z87.1 impact resistance standards

LLE Safety Footwear Policy

- LLE personnel who lift and/or move items weighing more than 50 pounds are required to wear protective footwear while doing so (see M_001 - General Mechanical Safety training, slide 9)
- Protective footwear must meet ASTM F2413-11 standards for Impact and Compression Resistance.
- Personnel who are not wearing safety footwear are prohibited from lifting or moving items weighing more than 50 pounds.
- Supervisors are responsible for ensuring that their staff are aware of, and abide by this rule.
- Supervisors must determine which staff members are required to move heavy items, and purchase safety footwear using funds from their department's operating budget (typical cost ~$160/pair)
- All LLE funded safety footwear purchases are to be coordinated through the LLE Purchasing office (Bill Byrne).

LLE Instruction 6300 describes LLE's Lockout /Tagout policy for the entire lab*

Lockout /Tagout (LOTO) is used to ensure the safety of personnel who could be injured by the unexpected operation of equipment or release of energy while servicing or maintaining equipment

LLE's LOTO policy dictates:

- **Locks shall be used to secure energy-isolating devices, unless it is infeasible, in which case a tag may be used**
- **The person who installs a LOTO device must also remove it**
- **How to transfer responsibility for a LOTO device**
- **Who the LOTO supervisor is for each LLE work area**

See: LLE Instruction 6300

* Updated August 2018

Authorized Workers who perform lockout/tagout operations must complete G_011 - LLE LOTO training

Lockout/Tagout (cont.)

- Never use equipment that has a known or suspected safety deficiency
  - Stop using it immediately and contact the area supervisor or a Safety Officer to lock it out
  - Have it professionally repaired before returning it to service
- The LOTO must remain in place until
  - Repairs are complete and/or the equipment is deemed safe to operate
  - Or, a qualified individual is assigned to perform troubleshooting
- If equipment that you need is LOTO, contact the LOTO supervisor to determine the proper course of action to return an item to service
- Do not perform repairs for which you are not specifically trained and authorized

If a LOTO device is removed by someone other than the installer, the Chief Safety Officer must be informed

An example of unacceptable practices (#1)

A belt guard was on the floor beside a vacuum pump during a safety inspection. No one was present, so the guard was reinstalled. On a follow up visit, the guard was on the floor again. Student's explanation: "The motor doesn't start, so we spin the pulley by hand to start it"

The student knew that the equipment was defective. Rather than having it repaired, he used it with safety guards removed. What should have occurred?

1. **Stop using the equipment immediately**
2. **Lockout the defective item**
3. **Contact a supervisor or a Safety Officer to arrange repairs**
4. **Replace the item or have it professionally serviced**
5. **The Safety Officer who replaced the guard should have locked out the equipment, then followed up with the user.**

LLE's Electrically Energized Work policy

Definitions

High-voltage: ≥ 50V potential relative to earth ground

Electrically Energized: High-voltage conductors are exposed

- **Work on Electrically Energized equipment is permitted *only when essential*:**
  - **If disabling power will affect critical safety systems**
  - **When necessary to evaluate operation of electrical equipment**
  - **In all other situations, high voltage equipment MUST be LOTO before servicing**

LLE will apply DOE guidelines (DOE-HDBK-1092-2013) to establish criteria for electrically energized equipment safe work practices.

***ONLY* qualified electrical workers (see E_001 – Electrical Safety Training) may work on high-voltage equipment or perform Electrically Energized Work**

Hot Work requires a permit

Hot Work [1] **- Any operation that produces heat, sparks or flame**

- **Persons conducting hot work must complete G_006 – Hot Work Training**
- **Purpose-designed hot-work areas (e.g., welding stations) can be approved for long-term use**

1) **UR EH&S Policy FS010 "Hot work procedures". http://www.safety.rochester.edu/fire/pdf/policyprocedure/FS_HotWorkProcedures.pdf**

Incident Review and Reporting

LLE Instruction 6950 – Incident Review and Reporting describes when and how incident investigations are to be conducted.

***Definition*: An incident is any event that causes or could have caused personal injury resulting in hospital room treatment or lost time, significant equipment damage, exceeding environmental release limits for hazardous or radioactive material, or a significant loss of Omega system effectiveness or availability.**

When a safety incident occurs:

- **Immediately stop related activities**
- **Have qualified personnel secure affected equipment in a safe state (de-energize, and lockout/tagout)**
- **Report the event to the employee's supervisor and the work-area supervisor (Group Leader or higher authority)**

Past incident reports can be found here

Example - Incident Report 226: Electrical Shock event

This example demonstrates why it is important to promptly investigate a safety incident.

A worker received an electric shock while working on equipment that was under development

- **An incident investigation was NOT conducted at the time of the event**
- ***Nearly one year later*, the worker reported that the root-cause *still* had not been eliminated. A subsequent investigation identified other installations having the same deficiency.**

***PROMPTLY* report *and investigate* safety deficiencies and events; delaying an investigation leaves others at risk of a repeated event.**

Incident Review and Reporting - Responsibilities

- Management initiates incident investigations and assigns a lead investigator
- Investigator meets with all persons having first-hand knowledge to:
  - Establish an event timeline
  - Identify all causal factors
  - Identify and prioritize immediate corrective actions needed to resume normal operation, and permanent corrective actions
  - Develop a plan to ensure corrective actions are completed
  - Verify that corrective actions are completed in a timely manner
  - Publish an Incident Report
- Management shall ensure that:
  - The investigator is unbiased
  - Corrective actions effectively mitigate causal factors

Visitor and Contractor Safety

- An LLE escort must accompany visitors and short term contractors working in laboratories or technical areas, e.g.,
  - Repair/service technicians (e.g., laser, crane, …)
  - Vendors and other persons requiring access to laboratories
  - Instrument specialists & technicians
- Training is required for long term contractors
  - Contract employees are managed by the work area supervisor
  - Facilities contractors are managed by the Administrative Division
- LLE Host personnel are responsible for ensuring that guests:
  - receive site-specific safety training and supervision
  - follow LLE Safety and Access policies
  - are appropriately escorted/supervised

Contractor Safety (continued)

- **Contractors are hired for their knowledge and expertise**
- **LLE hosts are responsible for**
  - **ensuring contractors receive training of site-specific hazards and work-area protocol (managed by “Work Authorization Procedure”)**
  - **mitigating hazards to the maximum extent practical before allowing a contractor to begin work**

Example: A factory technician comes to service a laser in the Omega Target Bay. The technician must:

- **Receive Target Bay (TB) access training**
- **Be escorted while working in the bay**
- **Wear proper TB cleanroom garments and PPE**
- **Adhere to hazard mitigation defined in Work Authorization Procedure (e.g., how to operate safely with covers removed, interlocks defeated, etc..)**
- **Consult with the LLE host to obtain authorization prior to deviating from approved plans**

Guest Workers are NOT permitted to perform the activities listed below *

*** Exceptions must be approved by LLE management**

- **Act as Lead Worker for lockout/tagout (LOTO); They *MUST* participate in LOTO using group/gang locks when appropriate**
- **Service energized equipment**
- **Use ladders > 6 feet (1.8 m) tall, rolling stairs, aerial lifts, or perform activities requiring fall protection**
- **Operate hoists or cranes, or perform rigging operations**
- **Install permanent cables, fibers, hoses, etc..**
- **Use cryogens (e.g., liquid N_2)**
- **Chemical processes**
- **Modify, or authorize changes to equipment, software, or procedures**
- **Allow people to enter LLE buildings**
- **Activities requiring a respirator**
- **Hot work**
- **Fight fires (unless trained by home institution. Fire extinguisher only.)**
- **Machine shop work**

Good housekeeping can eliminate many hazards

- Clutter can result in
  - Trip/fall hazards
  - Fire hazards
  - Lost productivity (e.g., personnel injuries, searching for items)
- Good housekeeping minimizes the spread of contamination
  - Metal shavings
  - Beryllium dust
  - Tritium
  - Chemicals
- Discard outdated books, catalogs, papers, boxes, packing materials
- Salvage, repair or discard equipment that is no longer useable
- Properly dispose of outdated and unnecessary chemicals

Eliminate contamination at the source to prevent it from spreading

- **Areas near, and connected to, the target chamber (TC) (target bays, LaCave, TIMs, GCC, etc.) are the most likely areas to find Beryllium dust and tritium contamination**
- **Persons who handle items that have been exposed to the TC, or work in areas around the TC must:**
  - **be LLE qualified/authorized**
  - **treat items as if they are contaminated when removed from the TC**
  - **ensure items are below contamination limits before they are released to “general” work areas**
  - **wash hands after working in contaminated areas or after working with equipment that may have been contaminated**

Secondary exposure occurs when persons are indirectly exposed to contamination

Examples:

- **A worker opens a door while wearing contaminated gloves, transferring chemicals to the door handle. The worker is not affected, but people who touch the handle without gloves may be.**
- **The beryllium filter in a diagnostic is shattered during a target shot. The diagnostic is transferred to a workbench for repairs. Particulate dislodged during repairs may become airborne, or may be left behind on the workbench. Prevent spread of contamination:**
  - **Consider vacuuming or bagging the diagnostic prior to moving it from the TIM to a beryllium workstation**
  - **Clean the TIM before installing another diagnostic**
  - **Work in a Be hood to trap airborne particulate in the HEPA filter**
  - **Clean the interior of the Be hood after work is complete**

What should have been done differently? Excerpts from Incident Report 178

A student scratched his neck with a chemically-contaminated glove. He initially felt tingling; by the next day, he developed a first degree chemical burn.

Lessons learned

- **Promptly wash skin if contact with any contaminant is suspected**
- **Be aware of your surroundings, including activities of nearby workers**
- **When using gloves as a chemical barrier:**
  - **Rinse gloves before removing**
  - **Learn and use proper technique to remove gloves**
  - **Remove gloves before handling non-contaminated items**
  - **Properly dispose of single-use gloves**

General recommendations

- **Periodically review location and condition of eye wash stations, safety showers, first-aid kits, and emergency contact info on nearby telephones**
- **Separate contaminated and non-contaminated items**
- **Review emergency response procedures for your work area**

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You must complete the G_001 quiz to satisfy your training requirement