Safety and Health Resource Guide

Health, Safety, and Radiation Protection (HSR) Division

Los Alamos
NATIONAL LABORATORY

LALP-04-020

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HSR Safety & Health Resource Guide

Introduction

Purpose The purpose of this Health and Safety (HSR-5) Safety Guide is to provide a single-source document for addressing your safety questions.

The guide is not intended to be a compliance document, but rather a resource document. The guide does not set policy and therefore, does not contain policies pertaining to human resources, safety or emergency procedures.

In some cases, HSR-5 policies may be restated or summarized, but all who use this guide must read the referenced controlled document or source document for additional details

Scope Responsibilities for safety are outlined in the individual documents referenced within the text of each section of this guide. References include:

- Laboratory Implementation Requirements (LIRs) and Guidance (LIG) documents
- Occupational Safety and Health Administration (OSHA) standards
- National Fire Protection Administration (NFPA) guidance
- National Electrical Code (NEC) guidance
- American National Standards Institute (ANSI) recommendations

Additionally, where applicable, Laboratory training requirements are listed.

Who to Contact HSR-5 at 667-5231.

Confined Space

Introduction

A confined space is any space that meets the following criteria:

- is large enough and is configured so that a person can bodily enter and perform assigned work,
- has limited access or exit, and
- is not designed for continuous occupancy.

If all three criteria are not present, the space is not a confined space.

Requirements

After a space is identified as a confined space, it must be classified as either a nonpermit or permit-required confined space. See Table 2.

Table 2. Confined Space Definitions

Type of Confined Space	Definition
NonPermit-Required	A confined space that does not contain or have the reasonable potential to contain any hazard capable of preventing self-rescue or causing death or serious physical harm. **NOTE:** If a new hazard is introduced during the course of work, a nonpermit-confined space can become a permit-required confined space.
Permit-Required	A confined space has the following inherent or introduced primary hazard characteristics: • contains or has the potential to contain a hazardous atmosphere; • contains a material that has the potential to engulf the entrant; • has an internal configuration that could entrap or asphyxiate an entrant; or • contains any other recognized serious safety or health hazard.

Confined Space (continued)

Entry Requirements

Any time a confined space is entered, an authorized worker must obtain the confined space evaluation report for the space to be entered and ensure that the evaluation is accurate. The HSR-5 and other Health and Safety Professionals are authorized to evaluate confined spaces. All authorized employees must receive the required training. See Table 3.

Table 3. Confined Space Requirements

Confined Space Entry	Requirements
NonPermit-Required	A copy of the confined space evaluation must be available at the point of entry and the atmosphere should be monitored before anyone enters the space.HSR-5 and other Health and Safety professionals can conduct air monitoring.
Permit-Required	• A permit must be completed by an authorized worker and signed by the entry supervisor. • The atmosphere must be monitored before entry and throughout the entry. • An attendant must be posted outside the space and maintain communications with the entrant. The attendant must also have a means to communicate with emergency services. • Nonentry rescue equipment must be used unless it increases the overall risk of entry. • If an onsite rescue team is not available LAFD must be notified.

References

Document Number	Title
CFR 1910.146	Permit-Required Confined Spaces
LIR402-810-01	Confined Spaces

Cranes, Hoists, Lifting Devices, and Rigging

Introduction

Using cranes, hoists, lifting devices, and rigging can be hazardous. If this equipment is improperly used or maintained, property and equipment can be damaged and personnel can be seriously injured. The hazards associated with the use of lifting devices can be minimized through operator training and certification, routine inspections, and proper maintenance.

Requirements

- Only trained and qualified personnel who have received a formal, documented review of proficiency training are permitted to operate general-purpose installed lifting devices (GPILDs). The GPILDs are defined as cranes and hoists that were installed as part of the original building construction, or commercially available cranes and hoists that are permanently attached to the building or other structure.
- The GPILDs must be load-tested and certified.
- The GPILDS must have a current annual inspection as identified by a dated gray tag (Form 1594) posted on the lifting device. Evidence of mechanical and electrical preventative maintenance may also be posted; however, the gray tag indicates the required annual inspection.
- The GPILDs must be operated within established guidelines in accordance with manufacturer's specifications.
- Equipment that is unsafe or defective must be locked and tagged out-of-service.
- Documentation of maintenance, repairs, inspections, and certifications must be current and available for audit.

Cranes, Hoists, Lifting Devices, and Rigging (continued)

Inspections

Inspections are required before operation, monthly, and annually. See Table 4.

Table 4. Inspection Requirements

Period	Description
Pre-operational	Inspect cranes and hoists before each use or shift. Document this inspection on Form 1489.
Monthly	• Inspect cranes and hoists during the first week of each month. Document this inspection on the appropriate form for the type of crane/hoist. • Conduct a monthly inspection before these units are returned to service. The units must have a current annual inspection. Document this inspection on Form 1588 through 1592.
Annual	• This inspection is conducted by the Laboratory support services contractor or another vendor. • The inspection must be documented on Form 1594 (gray card), which must be affixed to the lifting equipment. • All equipment must have an annual inspection to be used.

Cranes, Hoists, Lifting Devices, and Rigging (continued)

Rigging Equipment

- Rigging equipment is defined as wire rope slings, synthetic or nylon web slings, shackles, eyebolts, and special devices such as spreader bars or fixtures that are used as the final means of attaching a load to a crane or hoist.
- Rigging equipment used for critical lifts must have a certificate-of-proof test.
- All other rigging equipment must have a certificate of conformance.
- Laboratory-made rigging equipment must have a design engineering analysis and a certified load test certificate.
- Rated capacities must be conspicuously attached to all rigging equipment.
- Rigging equipment must be visually inspected before each use.
- Rigging equipment must be inspected annually. The annual inspection must be documented.
- Rigging must be stored in a manner that prevents damage.
- Damaged rigging equipment must be removed from service.

High-Consequence (Critical) Lifts

A person-in-charge (PIC), who is a qualified crane operator, must be appointed. The PIC must prepare a detailed procedure (minimum requirements are listed in LIR 402-1120-01, Cranes, Hoists, Lifting Devices, and Rigging) and receive approval from the supervisor and HSR-5, Industrial Hygiene and Safety, at 5-8503 for each critical lift. A generic procedure may be developed for repetitive type lifts.

Cranes, Hoists, Lifting Devices, and Rigging (continued)

A high-consequence lift is any lifting operation that if dropped, upset, or involved in a collision could:

- cause an unacceptable operational or programmatic impact;
- cause undetectable damage resulting in future operational or safety problems of a facility;
- release significant amounts of hazardous materials to the environment; and
- present a significant risk for personal injury or property damage.

The following lifts are also considered high-consequence:

- any lift exceeding 75% of the rated capacity of the crane or hoist;
- an item that requires exceptional care in handling because of size, weight, installation tolerances, or other unusual factors; and
- an item, although noncritical, that requires care in handling because it is lifted above critical or expensive items.

Cranes, Hoists, Lifting Devices, and Rigging (continued)

Required Records

The following forms can be found at:
http://enterprise.lanl.gov/esh.htm

Form Number	Title
1489	Preoperational Inspection Record for Overhead Cranes and Hoists
1588	Monthly Inspection Record for Overhead Bridge and Gantry Cranes
1589	Monthly Inspection Record for Shop Cranes
1590	Monthly Inspection Record for Monorail Overhead Underhung Hoists
1591	Monthly Inspection Record for Fixed Hoists
1592	Monthly Inspection Record for Manually Lever-Operated Hoists
1594 (gray card)	Annual Inspection Document

References

Document Number	Title
LIR 402-1120-01	Cranes, Hoists, Lifting Devices, and Rigging

Electrical Safety

Introduction

Electricity is one of the most commonly encountered hazards at the Laboratory. Under normal conditions, the inherent safety features of the equipment being used provide protection from electrical shock. However, accidental contact with live components for equipment failure can result in shock, flash burns, thermal burns, or blast and can cause serious injury or death.

LANL uses LIR402-600-01, Electrical Safety, to define the Electrical Safety Program. This document:

- provides basic requirements for safely performing electrical work;
- require that only qualified workers perform electrical installations or repairs; and
- provide a plan for approval of LANL unlisted electrical equipment.

The sections that follow describe

- the requirements for safely performing electrical work, and
- the requirements for maintaining a workplace free of electrical hazards.

Electrical Safety (continued)

Operation of Equipment
Use of equipment that is Underwriters Laboratory (UL)- or other Nationally Recognized Testing Laboratory (NRTL)-listed or operating below the 50 volt (V), 1kilowatt (kW), 5 milliampere (mA), or 10 Joules (J) hazard thresholds does not require additional electrical training.
Examples: Use of office equipment, a flashlight, or badge reader. Use of equipment in a manner not consistent with its listing requires additional electrical training.

Use of equipment operating above the hazard threshold, and unlisted or unapproved, requires all users to have additional electrical worker training. A worker who has been qualified to perform a process through a work authorization document such as, HCP, has sufficient training to operate that equipment, providing that the work authorization document does not require additional electrical training.
NOTE: Any electrical work outside the scope of the work authorization document is not allowed.

Other Electrical Work
Working on or near exposed, hazardous, or energized electrical parts and fabrication or assembly of potentially hazardous electrical equipment requires additional electrical training. Guidelines for this training can be found in LIG402-600-01. *Electrical Safety Implementation Guide*, Attachments B and C, and LIR402-600-01 *Electrical Safety*, Attachment E. Line Management ensures employees are trained and qualified to perform electrical work and documents the training and qualification.

Electrical Safety (continued)

Requirements for Safety Performing Electrical Work

- Qualified workers must clearly define any electric or electronic equipment (or system) work and include the work location, a summary of the work to be done, and the equipment (or systems) to be worked on.
- An approved safety document such as a Special Electrical Work Permit (SEWP) for work on energized electrical systems, and an HCP may be required, based on the hazard level involved (see the requirements in the LIR402-600-01, Attachment D tables).
- Qualified workers must ensure that protective equipment (such as insulated gloves, mats, shorting hooks, and associated cable, clamps, and resistors) is in good condition and is stored and used properly.

Some reminders

- The hierarchy for hazard controls is
  - deenergize the circuit and verify the de-energized condition,
  - implement engineered controls,
  - implement administrative controls, and
  - use personal protective equipment.
- When an electrical hazard exists, qualified workers must positively de-energize exposed circuit parts before beginning work, unless there is a compelling reason to do the work on an energized circuit.
- Expediency, cost, ease of operation, or *it's always been done this way* are not considered compelling reasons.

Electrical Safety (continued)

Actions to Take When Performing Electrical Work

Step	Action
1	A qualified worker must analyze the electrical hazards present and determine the controls required for them. The controls must include the work practices required when personnel work on or near exposed electrical conductors or circuit parts that are energized or that could become energized.
2	When an unknown electrical hazard may exist (for example, the work involves penetrations or excavations into walls, ceilings, floors, masonry surfaces, slabs, ground surfaces, or other structures), qualified workers must determine the presence of energized electrical conductors using the process in LIR402-600-01, *Electrical Safety*, as a part of the hazard evaluation.
3	Following the hazard analysis, qualified workers must implement controls to bring the risks to acceptable levels.
4	An Electrical Safety Officer can approve unlisted equipment for use if the unlisted equipment meets the requirements of Section 7.6 of LIR402-600-01.
5	To perform electrical work, personnel must: • be qualified as defined in LIR 402-600-01; • follow the requirements of LIR 402-600-01; and • follow the requirements of this manual including, but not limited to, integrated safety management, change control, and work release.

Electrical Safety (continued)

Requirements for Electrical Equipment

The following requirements apply to electrical equipment, power disconnects, and circuit breakers and are performed by qualified workers.

Actions to Take When Working with Circuit Breakers

Step	Action
1	Authorized personnel may reset a tripped single-pole electrical panel breaker **once**.
2	Ensure that there are no unguarded openings, exposed wires, broken receptacles, or missing cover plates; open conduits, or openings in electrical equipment.
3	Maintain guarding and closures for electrical services that are located in travel paths for equipment or personnel.
4	Ensure that receptacles that are outdoors or in areas that are routinely wet have ground fault circuit interrupters.

Requirements for Minimizing Electrical Hazards in the Workplace

Reminder: None of the following instructions require that you to do electrical work.

Prejob Inspection Walkthrough

Step	Action
1	Notify your supervisor of any shock hazard or other electrical hazard that is associated with any piece of equipment. **Do not** use the equipment until it has been repaired and checked out.
2	**Do not** reset circuit breakers that are locked and tagged unless the originator removes the lockout.

Electrical Safety (continued)

Prejob Inspection Walkthrough (continued)

Step	Action
3	When turning or adjusting settings of electrical controls, avoid contact with good conducting grounds, such as *wet* floors or bare metal pipes.
4	Ensure that cord-connected equipment is listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories Inc. (UL) *Reminder:* An electrically unqualified worker can only use unlisted equipment only if approved by an Electrical Safety Officer (LIR402-600-01, *Electrical Safety*).
5	Ensure that connections are secure, are not cracked, have insulation intact, and have appropriate ground prongs.
6	Ensure that cords are not spliced and that terminations (for example, strain relief grommets) are in good condition and secure.
7	Use extension cords and multiple outlet strips for only short-term usage or in mobile situations. Ensure that 3-wire heavy-duty (or higher rated) extension cords are used.
a	Ensure that rated capacities are appropriate with actual use and that cords are not brittle or warm to the touch.
b	Avoid more than one extension cord in a circuit (daisy chain).
c	Protect cords from abrasion and pinching.
d	Multiple outlet strips and similar power distribution equipment with built-in surge protection, designed for personal computer installations, may be used for such systems, provided they are not damaged or overloaded.

Electrical Safety (continued)

Prejob Inspection Walkthrough (continued)

Step	Action
8	Ensure that 30 inches of space is clear in front of breaker panels. *Reminder:* You can request an electrical safety walkthrough with the Group or Division Electrical Safety Officer or an Electrical Inspector from the inspection team of the HSR-5 Chief Electrical Safety Office.

References

Document Number	Title
LIG402-600-01	Electrical Safety Implementation Guide
LIR402-600-01	Electrical Safety

Ergonomics

Introduction

In general terms, ergonomics is the study of fitting the workplace to the human. The goals of ergonomics range from making the workplace safe (reducing injuries) and humane to increasing efficiency.

Ergonomics is used to properly fit the workstation to the person performing the work in order to reduce injuries associated with cumulative trauma disorders (CTDs). The three risk factors associated with CTDs are posture, force, and repetition. The amount of time spent at a task and the frequency of rest breaks have direct effects on overall risk.

Actions to Take

For instructions on setting up a workstation and a standing workstation, see Tables 5 and 6, respectively.

Table 5. How to Set Up Your Workstation

Component	Configuration
Display-table	The table should be adjustable and set between 23 to 33 inches. If the table is not adjustable, 31 inches should be the maximum height.
Display	The display should be between 33 to 43 inches from the center of the screen to the floor. The gaze angle should be 10 degrees to 20 degrees below horizontal (the top of the screen should be approximately 15 degrees below the worker's eye level).
Keyboard table	The table should be adjustable and set between 23 to 31 inches. If the table is not adjustable, 25 to 26 inches is recommended.
Document holders	Holders should be at the same height as the display.
Viewing distance	The distance should be approximately 18 to 20 inches from eyes to the display.

Ergonomics (continued)

Table 5. How to Set Up Your Workstation(continued)

Component	Configuration
Keyboard angle	The angle should be tilted forward about 20 degrees to 15 degrees.
Vertical knee room	A minimum of 24 inches, measured from the floor to the underside of the table.
Horizontal knee room	A minimum of 16 inches of horizontal knee room.
Chair	A chair with adjustable seat height, pan angle, and backrest angle is recommended. The backrest should provide lumbar support.
Wrist rest	If a wrist rest is used, it should be the length of the keyboard, about 2 inches wide and have rounded edges.
Foot rest	People who must raise their chair to reach the work surface may need a footrest if they cannot reach the floor. The footrest should slope forward from 4 to 5 inches to 1 to $1^1/_2$ inches.

Table 6. How to Set Up a Standing Workstation

Item	Configuration
Items and controls	Should be positioned to eliminate excessive reaching, stooping or bending, and twisting of the body.
Comfort	The worker should not have to lean, stretch, or stoop frequently or for extended periods of time.
Height	**Heavy** work-should be 4 inches below elbow height **Precision** work-should be 4 inches above elbow height, with supported elbows.
Foot and knee clearances	Needed for standing workers.
Floor mats	Should be provided in the workplace to reduce discomfort. **NOTE:** If floor mats cannot be used because of safety considerations, wear shoes with cushioned soles.

Ergonomics (continued)

Table 6. How to Set Up a Standing Workstation (continued)

Item	Configuration
Provisions for sitting	Make provisions for sitting during down time.
Platforms	When personnel are working in gloveboxes and the working level cannot be adjusted, provide platforms to elevate shorter workers.

Rest Breaks

Frequent, short rest breaks can significantly reduce the likelihood of ergonomic injuries and illnesses.

Lifting Guidelines

- Use mechanical lifting devices when possible.
- Get help from a second person when necessary.
- Use handling aids when possible.
- Get a good grip on the load before lifting.
- Keep the load close to your body.
- Bend with your knees, not your back.
- Do not twist the back or bend sideways.
- Do not lift or lower with your arms extended.

Formula for Injury

Force + Repetition + Posture + No Rest = Cumulative Trauma Disorders

References

Document Number	Title
LIR 402-870-01	Ergonomics
Plog, B. A., Ed.	Fundamentals of Industrial Hygiene, 4th Edition, National Safety Council, 1996

For Additional Information or an Ergonomic evaluation Contact the HSR-5 Group Office at **667-5231** or **665-2135**.

Excavations

Introduction
An excavation is any soil disturbance or ground breaking using hand tools or powered machinery.

Requirements
- Excavation permit
- Minimal personal protective equipment within excavation sites:
  - hard hat,
  - safety shoes, and
  - safety glasses with side shields.
- If a jackhammer or asphalt/concrete saw is required near buried electrical lines, dielectric boots and gloves are required.
- Personnel working near the edge of an excavation 6 feet or deeper must be protected from falling into the excavation.
- All excavations 4 feet or deeper must be provided with safe access every 25 feet. A straight or extension ladder is a safe form of access.
- For excavation work 5 feet or deeper, an approved protective system is required.
- Individuals are not permitted within 5 feet of the swing radius of a backhoe nor within 5 feet of other parts of the backhoe.
- A backhoe is not permitted within 18 inches of a utility line that is not fully exposed. A backhoe is allowed to be used adjacent to a fully exposed utility line as long as the line has a protective barrier between it and the backhoe.
- Spoils piles are not permitted within 2 feet of the excavation cut.

Excavations (continued)

Actions to Take

Step	Action
1	Before performing excavation work, obtain an excavation permit. The permit must include the entire area to be disturbed as well as locations of the spoils piles. The permit is generated by the Project Coordinator and expires 6 months after its issuance.
2	Before excavation, visually identify all known and unknown utility lines on the ground. A walkdown with all parties involved is required to identify the marked lines.
3	Pot hole all known and unknown utility lines to confirm type, location, and depth.
4	Ensure that a competent person in excavation work is present during all active periods of excavation work.
5	Inspect all excavations 4 feet or deeper daily before entry, with documentation kept onsite by the competent person.
6	Evaluate excavations close to structures for potential exhaust contaminants entering the structure.
7	Prevent soil erosion from spoils piles.

References

Document Number	Title
29 CFR 1926.651	Excavations
LIR402-880-01	Excavation/Soil Disturbance Permit Process

Eye and Face Protection

Introduction

The preface to ANSI Standard Z87.1, *Practice for Occupational and Educational Eye and Face Protection* (a principal reference for OSHA personal protective equipment standards) states:

> Protective devices do not provide unlimited protection. In the occupational and school environment, eye and face protective devices are not substitutes for machine guards and other engineering controls. Personal eye and face protective devices alone should not be relied on to provide complete protection against hazards, but should be used in conjunction with machine guards, engineering controls, and sound manufacturing practices. Every effort should be made to eliminate eye and face hazards in occupational and educational settings.

Eye and Face Protectors

There are two categories of eye and face protectors, primary and secondary. See Table 7.

Table 7. Eye and Face Protectors

Protectors	Description
Primary	Devices that may be worn alone or in conjunction with a secondary protector. Spectacles, for instance, are primary protectors with regard to protection against impact and optical radiation hazards.
Secondary	Devices that are worn only in combination with a primary protector. Examples include faceshields and welding helmets, either of which should always be used in conjunction with appropriate eyewear.

Eye and Face Protection (continued)

Protector Selection Criteria

Table 8 is summarized from the protector selection chart in ANSI Z87.1.

Table 8. Protector Selection Chart

Hazard Category	Hazard Assessment	Recommended Protectors	Comments
Impact: chipping, grinding, machining, masonry work, riveting, and sanding	Flying fragments, objects, chips, particles, sand, dirt, etc.	Spectacles,* goggles, faceshields	Restricted ventilation of goggles may cause fogging
Heat: furnace operations, pouring, casting, hot dipping, gas cutting, and welding	Sparks, molten metal splashes, high-temperature exposure	Faceshields, goggles, spectacles, faceshields over goggles, screen and reflective face shields, etc.	Avoid protectors that do not provide side exposure protection
Chemical: acid and chemicals handling, degreasing, plating	Splashes, irritating mists or dusts, vapors	Goggles, eyecup and cover types; add face shield if needed	Restricted ventilation of goggles may cause fogging
Dust: woodworking, buffing, general dusty conditions	Nuisance dust	Goggles, eyecup and cover types	Restricted ventilation of goggles may cause fogging
*Sideshields (permanent, clip-on, or slide-on) are strongly encouraged wherever practical.			

Eye and Face Protection (continued)

Table 8. Protector Selection Chart (continued)

Hazard Category	Hazard Assessment	Recommended Protectors	Comments
Optical Radiation: welding (electrical arc, gas, cutting, brazing, soldering), glare	Infrared radiation, reduction in visual acuity	Welding helmets, goggles, spectacles, face shield, with optically dense lens	Select darkest optical density that still allows adequate task performance

References

Document Number	Title
ANSI Z87.1	Practice for Occupational and Educational Eye and Face Protection, 1989
29 CFR 1910.132	Personal Protective Equipment: General Requirements
29 CFR 1910.133	Eye and Face Protection
LIR 402-1000-01	Personal Protective Equipment

Emergency Eyewash and Shower Equipment

Introduction

Emergency eyewash and shower units include emergency shower, eyewash equipment, eye/face wash equipment, hand-held drench hoses, and combination shower and eyewash or eye/face wash equipment. These units may be self-contained or plumbed. The Laboratory has engineering standards that are applicable to the installation of emergency eyewash and shower equipment.

NOTE: Hand-held drench hoses may be used to **supplement**, **but not replace**, emergency shower and eyewash units.

Requirements for Safety Showers

- Units must be within 10 seconds to reach at the same location as the hazard.
- Areas must be well-marked and well-lit.
- Path of travel must be free of obstructions that may inhibit immediate use.
- If an enclosure is provided, it must have a minimum unobstructed area 34 inches in diameter.
- The unit must be capable of delivering at least 20 gallons per minute (gpm) for 15 minutes.
- Operating valves should be large enough to be easily located and operated by the user.
- Plumbed supply lines with shutoff valves must be protected against unauthorized shut off.
- Valves and construction materials must be resistant to corrosion by the flushing fluid.
- Shower units must be inspected annually to ensure conformance with ANSI Z358.1, *Emergency Eye Wash and Shower Equipment*. Follow the manufacturer's instructions for *self-contained* units.

Emergency Eyewash and Shower Equipment (continued)

Requirements for Safety Showers (continued)

- Eyewash nozzles must be protected from airborne contaminants; caps, or other protective means must not require separate motion by the operator when activat ing the unit.
- Delivery of flushing fluid from nozzles must be balanced in accordance with ANSI Z358.1.
- Units should be positioned in a way that poses no hazard to the user.
- Flushing fluids must be delivered at not less than 0.4 gpm for 15 minutes.
- Plumbed supply lines with shutoff valves must be protected against unauthorized shut off.
- Inspect eyewash units monthly to ensure conformance with LANL Criterion 407. Follow the manufacturer's instructions for self-contained units.

Testing

The Laboratory currently follows ANSI Z358.1 for emergency eyewash and shower equipment except for the following:

- Showers are activated yearly [unless otherwise stated in the facility authorization documents.
- Plumbed eyewash units should be activated monthly (3 minute duration).

NOTE: *Recommended* good practices suggests *bump* testing eyewash units weekly but this is only a recommendation.

References

Document Number	Title
ANSI Z358.1-1998	Emergency Eye Wash and Shower Equipment

Fall Protection

Introduction
Two OSHA standards address fall protection.

- 29 CFR 1910 Subpart D, Walking –Working Surfaces, applies to general industry.
- 29 CFR 1926 Subpart M, Fall Protection, applies to the construction industry.

Summaries of the two requirements are provided below.

General Industry Standard
The fall protection requirement does not apply to work on ladders or scaffolds, which are covered by other sections of Subpart D.

In general, fall protection is required any time an employee is **working 4 ft or more above the floor or ground level**. Fall protection can be provided by:

- Standard guardrail systems (including toe boards if pedestrian traffic is possible below)
- Floor opening covers of standard strength and construction
- Work platforms with standard guardrails
- Personal fall arrest systems

Construction Industry Standard
This section applies to construction work such as, personnel working under a subcontractor work package. However, the provisions of this subpart do not apply when personnel are inspecting, investigating, or assessing workplace conditions before the actual start of construction work or after all construction work has been completed.

Fall Protection (continued)

Construction Industry Standard (continued)
This standard also does not apply to work on ladders, scaffolds, or cranes; and derricks, steel erection, or construction of electric transmission and distribution lines. These types of work are covered in separate subparts of 29 CFR 1926.

Generally, fall protection is required any time personnel are exposed to a fall of 6 feet or more. Fall protection can be provided by:

- Standard guardrail systems (including toe boards if pedestrian traffic is possible below)
- Work platforms with standard guardrails
- Safety net systems
- Personal fall arrest systems

If it can be demonstrated that it is infeasible or creates a greater hazard to use one of these systems, the employer may develop and implement a job-specific fall protection plan.

Areas where objects could fall must be barricaded to prohibit personnel from entering the area.

References

Document Number	Title
29 CFR 1910, Subpart D	Walking–Working Surfaces
29 CFR 1926, Subpart M	Fall Protection

Forklifts and Powered Industrial Trucks

Introduction

The use of forklifts and powered industrial trucks involves certain hazards that cannot be eliminated by mechanical means but only by exercising intelligence, care, and common sense; therefore, only competent and careful operators who are physically and mentally fit and who are thoroughly trained are permitted to operate the equipment and handle the loads.

Requirements

- Only authorized and trained personnel who have a current operator license may operate forklifts and powered industrial trucks.
- Equipment must have a current and documented annual inspection to be used.
- Equipment may not be modified in manner that would change the rated capacity without the manufacturer's approval.
- Capacity, operation, and maintenance instruction plates must be maintained in a legible condition.
- To prevent unauthorized use, forklifts and powered industrial trucks must be controlled either administra tively or physically.
- The correct class of equipment must be used; i.e., vehicles with internal combustion engines must not be used indoors.
- A Laboratory placard must be displayed on the left-hand side of the vehicle. The placard must contain the following information:
  - Assigned organization, group, facility management group
  - Equipment point of contact
  - Inspection/maintenance coordinator
  - Annual inspection status
  - Special instructions

Forklifts and Powered Industrial Trucks (continued)

Operator Requirements

Step	Action
1	Operate only the types of equipment for which they are trained and authorized.
2	Perform a preoperational inspection before each shift that the truck will be used and document the inspection on Form 1568.
3	Follow the manufacturer's instructions for use.
4	Use seat belts if they are provided.

Inspection/Maintenance Coordinator Requirements

Step	Action
1	Maintain an inventory list of equipment.
2	Coordinate required maintenance.
3	Inspect forklifts and powered industrial trucks: • before each vehicle is first used, • when each vehicle is reassigned, and • after each vehicle is repaired.

Group Leader Requirements

Step	Action
1	Maintain a current inventory list of all forklifts and powered industrial trucks, along with records on all maintenance, inspections, and modifications.
2	Devise an administrative system to control and track usage of equipment by licensed and authorized personnel.
3	Appoint inspection/maintenance coordinators.
4	Authorize candidates to be operators.

Forklifts and Powered Industrial Trucks (continued)

Required Records

Form Number	Title
1568	Inspection Checklist for Forklifts and Powered Industrial Trucks

References

Document Number	Title
LIR402-1110-01	Forklifts and Powered Industrial Trucks

Gas Cylinders

Introduction

Compressed gases must be handled and used only by properly trained personnel.

General Requirements

- Become familiar with the properties and inherent hazards of the specific gases used.
- Secure gas cylinders to prevent them from falling while they are in service and in storage.
- Ensure that valve protection caps are on cylinders at all times except when they are secured and connected to dispensing equipment.
- Use and store cylinders in a well-ventilated area.
- Do not alter or remove stamped markings or labels.
- Do not modify, tamper with, obstruct, remove, or repair any part of a gas cylinder.
- To avoid corrosion to cylinders, avoid their prolonged exposure to damp environments.
- Do not use gas cylinders as rollers, supports, or for any other purpose than designed.
- Do not place gas cylinders where they might become a part of an electrical circuit.
- Ensure that gas cylinders are not subjected to temperature extremes.
- Ensure that the equipment used with oxygen is free from oil and grease.

Handling

- To move cylinders, use a suitable hand truck, forklift, or similar material-handling device, with the cylinder properly secured.
- Never lift cylinders by the container cap or with magnets.

Gas Cylinders (continued)

Storage

- Store empty cylinders separately from full ones.
- Separate oxidizers and flammable gases by 20 feet or a 5-ft-high noncombustible barrier with a 1/2-hour fire rating.
- Separate toxic gases from oxidizers and flammable gases by 20 feet or a 5-ft-high noncombustible barrier with a 1/2-hour fire rating.
- Do not store gas cylinders in direct sun light or in areas where the temperature exceeds 125 ºF.
- Ensure that storage areas for oxidizers and flammable gases are posted **NO SMOKING**.
- Do not store cylinders near elevators, walkways, unprotected platform edges, or in locations where heavy moving objects may strike or fall on them.
- Ensure that portable fire extinguishers (carbon dioxide or dry chemical) are available at storage locations where oxidizers or flammable gases are stored.

References

Document Number	Title
CGA P-1-1991, NFPA 55	Compressed Gas Association Pamphlet
LIG 402-1200-01	Compressed Gases
LIG 402-1200-03	Gaseous and Liquid Hydrogen
LIR402-508-01	Cryogenic Fluids or Cryogens
LIR402-1200-01	Pressure, Vacuum, and Cryogenic Systems

Glove Selection

Introduction
When selecting the proper chemically resistant glove for a job, it is important to remember that there is no ideal chemically resistant glove that will work for all chemicals. Although some flexible laminate gloves are available, such as Silver Shield or 4H, they have the limitations of diminished dexterity, tactile sensitivity, ability to grip when wet, and resistance to tears and punctures.

When selecting a chemically resistant glove, the permeability of the glove to the specific chemical it will be exposed to is the most important characteristic to consider. Permeability information is available from glove manufacturers, usually in the form of permeability tables or computer software. It is important to note that gloves made of the same material but by different manufacturers may have different permeation rates. Abrasion resistance tables are also available from glove manufacturers.

General information on glove selection is provided below.

Actions to Take
Factors to consider when selecting chemically resistant gloves:

- Chemical resistance guides vary by manufacturer.
- Chemicals can permeate gloves without causing visible change.
- All gloves are permeable. The permeation time depends on the chemical handled, length of time the chemical is handled, glove thickness, and condition of the glove.
- Gloves should be inspected for defects before use.
- There is no ideal chemically resistant glove. Sometimes the *ideal* glove is two gloves worn together. Wearing one pair of gloves, such as reusable nitrile, latex, neoprene etc., over a flexible laminate combines the advantages of both.

Glove Selection (continued)

Actions to Take (continued)

- Gloves used for radiological protection will not always protect the worker from the chemical hazards involved.
- Good personal hygiene is always important whenever chemicals are used. Immediately remove spills and splashes with soap and water.

For information on general glove material, see Table 9.

Table 9. General Information on Glove Material

Material	Characteristic
Viton	Provides resistance to chlorinated and aromatic solvents.
Butyl	A good choice for aldehydes, ketones, and esters.
Neoprene	Provides resistance to a wide range of solvents, acids, caustics, and alcohols; offers tactility and dexterity without compromising chemical protection.
Nitrile	Affords a wide range of applications along with resistance to punctures and abrasions.
Natural rubber (Latex)	Resists acids and bases. Often combined with other polymers for a broader range of applications. **CAUTION**: Workers may develop a latex allergy.
NA-PA Surgeons Gloves	Nitrile/rubber/neoprene blend from Fisher Scientific
Polyvinyl chloride	Resists acids but not petroleum solvents.

References

Document Number/ Author	Title
LIR402-510-01	Chemical Management
LIR402-1000-01	Personal Protective Equipment
Plog, B. A., Ed.	*Fundamentals of Industrial Hygiene*, 4th Edition, National Safety Council, 1996

Hand Care and Dermatitis

Introduction

We use our hands for just about every task that we perform. In fact, our hands are frequently closer to a specific hazard than any other part of the body. The most common occupational skin disorder is dermatitis, or inflammation of the skin for any reason.

Common symptoms of dermatitis follow.

- Itching
- Dryness
- Cracking
- Boils
- Blisters
- Bumps
- De-pigmentation
- Redness
- Rashes

Dermatitis can also affect exposures to toxic materials by compromising the natural protective ability of skin and allowing better absorption and uptake of those materials through the skin. See Table 10.

Table 10. Agents that Affect the Skin

Agent	Description
Chemicals	Can cause dermatitis either by direct contact, such as acids or bases, or by allergy or sensitization to a specific chemical. Latex gloves can cause dermatitis. Chemicals that sensitize easily are usually fat-soluble and reactive with tissue proteins. Allergic contact dermatitis usually requires an incubation period of up to a week or more, after which the skin may show signs of dermatitis within 24 hours after contact.
Mechanical	Causes, including friction and pressure, can result in calluses, blisters, abrasions, bony projections, skin atrophy, and dead skin tissue.

Hand Care and Dermatitis (continued)

Table 10. Agents that Affect the Skin (continued)

Agent	Description
Physical	Agents such as heat, cold, and radiation (both ultra-violet and ionizing) can either promote dermatitis or cause it directly, with results that include frostbite, skin overgrowth, burns, photosensitivity, and skin cancer.
Biological	Include viruses, bacteria, fungus, and other parasites that may attach the skin and sometimes produce whole-body disease as well. Unbroken skin provides the best protection from most parasites and bacteria; however, cuts or abrasions provide easier access to deeper layers of the skin.
Botanical	Include many plants and trees; poison ivy and oak are the most common. The allergen or irritant agent may be present in any part of the plant and, in some instances, may be capable of being airborne through burning.

Requirements

- When using gloves, make sure they are properly selected, changed as needed, and protected from damage; use them in a manner that prevents materials from entering through the glove cuff.
- Use available facilities for hand washing, and keep hands in good condition by moisturizers.

Hand Care and Dermatitis (continued)

Actions to Take

Use the following checklist as a general guide for maintaining healthy hands:

- Avoid washing your hands with solvents, harsh soaps, or abrasives.
- Clean and bandage all cuts and abrasions.
- Immediately remove any imbedded foreign materials.
- Wash immediately after using any chemical.
- Wear clean, dry undertaker gloves (remember to match the glove material to the solvent).
- Pay attention to skin rashes—get an immediate medical evaluation.
- Wear cotton gloves under rubber gloves to reduce sweating.

References

Document Number/ Author	Title
Neuffer, M.	"Chemicals Aren't Your Only Concern: Hand Care," *Industrial Safety & Hygiene News*, August, 2000
Plog, B. A., Ed.	*Fundamentals of Industrial Hygiene*, 4th Edition, National Safety Council, 1996

Hazardous Chemicals

Introduction
This section identifies most physical and health hazards associated with hazardous chemicals typically found at LANL. The controls listed here reduce the risk associated with hazardous material work to an acceptable level. Following these guidelines ensures a formal and consistent approach to hazardous material protection.
NOTE: Specific hazards associated with materials are shown in Table 11.

Requirements
Lab coats and safety glasses are minimum requirements for working with hazardous chemicals. For all operations requiring a fume hood or the equivalent ventilation device, *if this is not practical*, respirators must be worn to meet the requirement. Requirements (controls) for specific hazards are shown in Table 11.

Exemptions
Chemicals that are packaged in primary containers and that are not regulated do not constitute a hazard to workers or the public, or have no significant costs associated with disposal are exempt from this guideline. Several of these chemicals are listed in Table 13.

The following volumes and amounts of material are exempt from this guideline:

- Less than 2 liters of any cryogen
- Less than 5 liters of any inert cryogen
- Less than 100 mg of any hazardous material unless it is a Category I chemical
- Less than 10 mg of any Category I chemical
- Less than enough material with a physical hazard for the hazard to be realized

Hazardous Chemicals (continued)

Exemptions (continued)
This program does not cover articles (for example, consumer products), ionizing radiation hazards, or materials that personnel bring into the workplace for personal use.

Actions to Take
Once hazards have been identified, it is important to use equipment, methods, or procedures that prevent exposure to the hazards as much as possible. These controls should be designed to prevent exposure from everyday routine uses of chemicals and exposures that could occur in foreseeable emergencies.

Control of hazardous materials is an ongoing process that starts during the design phase of a process or facility and continues through the performance of routine procedures. Hazardous materials are controlled in a variety of ways. These methods fall into one of five categories. These categories, ranked in order preference, follow.

- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal protective equipment (PPE)

Hazardous Chemicals (continued)

References

Document Number	Title
LIR402-550-01	Explosives
LIR402-560-01	Beryllium Use
LIR402-570-01	Asbestos
LIR402-1000-01	Personal Protective Equipment
LIR402-510-01	Chemical Management
LIR402-580-01	Cryogenic Fluid or Cryogens
LIR404-00-06	Managing Polychlorinated Biphenyls
LIR404-10-01	Air Quality Reviews
LPR402-00-00	Worker Health and Safety (Appendix 2; Chemical and Hazardous Material Handling; Appendix 8, Explosive Safety; Appendix 18, Pressurized Systems and Cryogens)
LPR404-00-00	Environmental Protection (Appendix 2: Air Quality, Appendix 4, Waste Minimization and Pollution Prevention)

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Asbestos or asbestos-containing materials	Asbestos and asbestos-containing materials have crystals that form long thin fibers that cause major lung damage including asbestosis and cancer.	**Administrative Controls** Take 8661: Asbestos Awareness. Take 14727: Refresher Asbestos Awareness, as required. Follow the requirements of the Asbestos Management Program.
Beryllium	Beryllium in solid form is virtually harmless. However, processes that generate beryllium particles cause major lung damage including berylliosis, and chemical pneumonia.	**Administrative Controls** Take 725: Beryllium Health Hazards (as determined by supervisor). Take 21784: Beryllium Health Hazards Facility-Specific (as determined by supervisor) Follow the control measures listed in the training guide.
Carcinogens	Those chemicals that have been identified as carcinogens by the IARC (A1, A2), NTP, or OSHA and that have concentration equal to or greater than 0.1%. See the ESH-5 Industrial Hygiene and Safety Group home page for a list of these compounds. These substances do or may cause cancer.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** • Do not breath fumes and avoid contact with skin, eyes, and clothing. • Carcinogen Management Program • Regulated area • Decontamination procedure **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Category I Chemicals	A Laboratory designation identifying specific chemicals that are regulated at the Laboratory and that require the user to follow special provisions. Category I chemicals are known human carcinogens, high acute toxicity chemicals, high chronic toxicity chemicals, and known human reproductive toxins. See the Industrial Hygiene and Safety Group home page for a list of these compounds.	**Engineering Controls** Fume hood (or the equivalent ventilation device) **Administrative Controls** • Do not breath fumes and avoid contact with skin, eyes, and clothing. • Category I Chemical Evaluation • Designated area • Decontamination procedure **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required
Chemical asphyxiant	All materials that react with components of the respiratory system to block or inactivate the body's ability to use oxygen.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** Do not breath fumes and avoid contact with skin, eyes, and clothing. Oxygen monitors, if used, must be inspected calibrated, and undergo periodic testing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Compressed gas	All gases stored and used at pressures greater than nominal atmospheric pressure. These materials are stored-energy hazards.	**Engineering Controls** • Relief values • Safety chains **Administrative Controls** • Take 769: Pressure Safety Orientation • Take 11459: Intermediate and High Pressure Safety • Take 9518: Gas Cylinder Safety **Personal Protective Equipment** • Foot protection
Corrosive	All materials that have pH less than 2 or greater than 12 or causes visible destruction of or irreversible alteration in living tissue at the point of contact.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** Do not breath fumes and avoid contact with skin, eyes, and clothing. • Use secondary containment for perchlorate solution made of nonorganic material. • Use secondary containment for hydrofluoric acid solutions made of nonglass material. • Purchase corrosive liquids packaged in plastic bottles, when given the option. • Carry a tube of **Calcium Gluconate Gel** at all times if working with hydrofluoric acid. • **Never** sit when handling corrosive liquids.

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Corrosive (continued)	All materials that have pH less than 2 or greater than 12 or cause visible destruction of or irreversible alteration in living tissue at the point of contact.	**Personal Protective Equipment** • Nitrile rubber gloves or an equivalent required • Safety goggles or the equivalent required • Face shield or the equivalent when working with over 10 milliliters of corrosive liquids or any amount of hydrofluoric acid • Rubber aprons or the equivalent when working with over 10 milliliters of corrosive liquids or any amount of hydrofluoric acid Rubber boots and mid-arm length PVC gloves (or the equivalent) with any amount of hydrofluoric acid
Cryogen	All materials that exist only in the vapor-phase above –73 °C (-99 °F) at one atmosphere pressure and that are handled, stored, and used in the liquid state at temperatures at or below –73 °C (-99 °F) while at any pressure. These materials have several hazards associated with them, including stored energy, asphyxiation, and eye and skin injuries.	**Engineering Controls** Pressure relief values **Administrative Controls** • Take 769: Pressure Safety Orientation • Take 11459: Intermediate and High Pressure Safety • Take 8876: Cryogen Safety • If oxygen monitors are used they must be maintained, calibrated, and tested. **Personal Protective Equipment** • Insulated gloves required • Face shield • Rubber Apron

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Epoxy	Epoxies are multi-component resin systems that begin with a plastic material that is cured or hardened after application. Any or all of the components of the resin system, or the products generated when these components react, may be toxic, sensitizers, and irritants.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** Do not breath fumes and avoid contact with skin, eyes, and clothing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required
Explosive	All materials that produce a sudden, almost instantaneous release of pressure, gas, and heat and heat when subjected to abrupt shock, pressure, or high temperature. These materials are stored-energy hazards.	**Engineering Controls** • Material shape • Blast shields **Administrative Controls** Explosive Management Program (LIR402-550-01, *Explosives*) **Personal Protective Equipment** Ballistic gear

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Flammable	All material with the ability to ignite spontaneously from an elevated temperature or from a spark or flame.	**Engineering Controls** • Fume hood • Storage containers and cabinets (NFPA Standard No. 45 or 55) • Material shape **Administrative Controls** • Store flammable materials separated from acids, bases, toxins, and oxidizers. • Keep flammable materials away from sources of ignitions.
Irritant	All materials that cause a reversible inflammatory effect on living tissue at the point of contact.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** Do not breath fumes and avoid contact with skin, eyes, and clothing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Lead	Lead is a Category I Chemical because it is both highly toxic (chronic) and a known reproductive toxin	**Elimination** • Replace lead shielding with bismuth **Substitution** • Replace uncoated lead shielding with coated lead shielding. **Administrative Controls** • Take 4426: Lead Awareness. • Take 15331: Refresher: Lead Awareness. • Use HSR-5 certified HEPA vacuums for clean-up of Lead contamination. Follow the requirements of the Lead Management Program.
Oxidizer	All material, other than a blasting agent or explosive, that starts or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.	**Administrative Controls** • Store oxidizers separate from flammable or combustible materials.

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Peroxide-former	Substances that form peroxides or hydroperoxides when standing or when in contact with air. These materials have the hazards associated with low powered explosives (stored energy).	**Engineering Controls** • Store in an inert atmosphere. **Administrative Controls** • For chemicals with a severe peroxide hazard on storage with exposure to air, check for exposure to air or discard within 3 months. • For chemicals with a peroxide hazard on concentration, do not distill or evaporate without first testing for the presence of peroxides. Discard or test for peroxides after 6 months. • For chemicals with a hazard of rapid polymerization initiated by internally formed peroxides, discard or test for peroxides after 6 months.
Poisons	Substances that are hazardous to health when inhaled, ingested, or absorbed through the skin. There is danger of lethal damage to health by short (acute) or prolonged (chronic) exposure.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** • Do not breath fumes and avoid contact with skin, eyes, and clothing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Pyrophoric	A chemical that will ignite spontaneously in air at a temperature of 130 °F or below.	**Engineering Controls** • Store in an inert atmosphere • Secondary containment for liquids **Administrative Controls** • Store reactive materials separated from everything else • Only open in an inert atmosphere.
Reactive	All materials or mixtures that will vigorously polymerize, decompose, condense, or become self-reactive because of shock, pressure, or temperature. These materials are stored-energy hazards.	**Engineering Controls** • Store in an inert atmosphere • Secondary containment for liquids **Administrative Controls** • Store reactive materials separated from everything else • Do not open expired container without supervisor approval.
Reproductive toxin	Substances that are known to have lethal effects on the fertilized egg, developing embryo, or fetus or teratogenic (malformation) effects in the fetus. In addition, certain reproductive toxins may cause infertility in males or females.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** • Do not breath fumes and avoid contact with skin, eyes, and clothing. • Reproductive Toxin Management program **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Sensitizer	A chemical that causes a substantial proportion of exposed people to develop an allergic reaction to tissue after repeated exposure.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** • Do not breath fumes and avoid contact with skin, eyes, and clothing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required
Sharps	Sharps include such instruments as needles, syringes with and without needles, broken glass, glass slides, razors, and scalpels. Sharps are a form of infectious waste which present a risk to humans	**Engineering Controls** • Syringe holders • Puncture-resistant boxes **Administrative Controls** • Sharps are clearly labeled using the universal biohazard symbol. • Take 7292: Bloodborne Pathogens. • Take 11776: Refresher Bloodborne Pathogens (Self-Study). **Personal Protective Equipment** Puncture-resistant gloves are recommended.

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Skin hazard	A notation for substances that can be absorbed sufficiently through the skin as to cause possible toxic effects.	**Engineering Controls** • Secondary containment for liquids **Administrative Controls** • Do not allow contact with skin, eyes, or clothing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required
Stench-producing materials	Substances that have or generate foul odors.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** • Do not breath fumes and avoid contact with skin and eyes. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Target organ effects	The following list is a target organ categorization of effects that may occur, examples of effects, and chemicals that cause them. • Blood or hematopoietic system toxins – blood damage • Hepatotoxins – liver damage • Lung toxins – agents that act on the lungs, irritate, or damage pulmonary tissue • Nephrotoxins – kidney damage • Neurotoxins – central nervous system impairment	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** • Do not breath fumes and avoid contact with skin, eyes, and clothing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required
Toxic agents	Substances that are hazardous to health when breathed, swallowed, or in contact with the skin. There is danger of serious damage to health by short (acute) or prolonged (chronic) exposure.	**Engineering Controls** • Fume hood (or the equivalent ventilation device) • Secondary containment for liquids **Administrative Controls** • Do not breath fumes and avoid contact with skin, eyes, and clothing. **Personal Protective Equipment** • Nitrile rubber gloves or the equivalent required • Safety goggles or the equivalent required

Table 11. List of Hazards from Materials and Adequate Controls		
Hazard	**Description**	**Controls**
Water-reactive materials	All materials that react violently with water or when mixed with water; a material that generates toxic gases, vapors, or fumes in sufficient quantity to present a danger to human health or the environment.	**Administrative Controls** • Store water-reactive materials away from possible contact with water.

Table 12. Training Plans for Specific Hazards Associated with Materials

Hazardous material workers and their supervisors complete the following training plan before working with the following materials.

Item	Materials	Courses
1	any hazardous material	2398: Hazard Communication Introduction
2	any amount of asbestos	• 8661: Asbestos Awareness • 14727: Refresher Asbestos Awareness
3	any amount of beryllium:	• 725 or NMT 21426: Beryllium Health Hazards • 21784: Beryllium Health Hazards Refresher
4	any amount of lead outside a glove box	• 4426: Lead Awareness • 15331: Refresher: Lead Awareness
5	lead used as shielding inside a glove box	4426: Lead Awareness
6	over 10 milliliters of organic solvent	9894: Organic Solvent Safety
7	any amount of materials listed as explosives	3574: First Aid: Standard
8	any amount of hydrogen	8724: Hydrogen Gas Safety
9	any amount of tritium	11952: Tritium Safety
10	any amount of plutonium:	11579: Plutonium Safety
11	any amount of depleted uranium	12323: Depleted Uranium Safety
12	amount of uranium except depleted:	12324: Uranium Safety
13	gas cylinders	• 769: Pressure Safety Orientation • 9518: Gas Cylinder Safety • 11459: Intermediate and High-Pressure Safety
14	sharps (includes needles, syringes, broken glass, glass slides, razors, and scalpels)	• 7292: Bloodborne Pathogens • 11776: Refresher Bloodborne Pathogens (Self-Study)
15	with cryogens	• 769: Pressure Safety Orientation • 11459: Intermediate and High Pressure Safety • 8876: Cryogen Safety

Table 13. Nonhazardous Materials

No.	Material	CAS No.	Reference	NFPA H	F	R	S
1	Deionized water	7732-18-5	Orion: 205534-001	0	0	0	0
2	Sodium Chloride	7647-14-5	Orion: 205534-001	0	0	0	0
3	Potassium Chloride	7447-40-7	Orion: 205538-001	0	0	0	0
4	Potassium Chloride	7447-40-7	Orion: 205538-001	0	0	0	0
5	Glycerin	56-81-5	Orion: 205433-001	0	1	0	0
6	Sand	14808-60-7	LIR 402-510-01	1	0	0	0
7	Process Oil 2440 (San Joaquin)	64741-53-3	EH&S Data Element Table	1	1	0	0
8	Process Oil 750 (San Joaquin)	64741-53-3	EH&S Data Element Table	1	1	0	0
9	Heavy Naphthenic Vacuum Distillate	64741-53-3	EH&S Data Element Table	1	1	0	0
10	Carbowax 300	25322-68-3	EH&S Data Element Table	1	1	0	0
11	Magnesium Oxide	1309-48-4	Spill-X-A Data Sheet	1	0	0	0
12	SF-2 3M Brand Secondary Fluid	86508-42-1	EH&S Data Element Table	1	0	0	0
13	Apiezon N Grease	12704-92-6	EH&S Data Element Table	1	1	0	0
14	FC-77 Fluorinert	86508-42-1	EH&S Data Element Table	1	1	0	0
15	Gallium	7440-55-3	EH&S Data Element Table	1	0	0	0
16	Magic Sorb		EH&S Data Element Table	1	0	0	0
17	Micro(R)-90	64-02-8	EH&S Data Element Table	2	1	0	0
18	Quin-CIP Oil ISO-68	64741-88-4	EH&S Data Element Table	1	1	0	0
19	Trichlorotrifluoroethane	76-13-1	EH&S Data Element Table	0	1	0	0
20	Welch Pump Oil	647426-50-0	EH&S Data Element Table	1	1	0	0

Heat Stressors

Introduction

Environmental conditions (a combination of ambient temperature, relative humidity, radiant heat, and air speed) have the capability to result in heat strain in workers. Heat strain is the manifestation of physiological disorders in the form of injury or illness.

Heat Stress: The Degrees of Danger

Recognizing the early signs of heat-related illness and acting quickly can prevent a mild reaction from becoming a fatal response.

Accordingly, it is often difficult to predict who will be affected and when. The goal of heat stress management is to maintain resultant strain below the elastic limit, i.e., avoid permanent impairment. Table 14 identifies types of heat stress, their symptoms, and treatment.

Table 14. Types of Heat Stress

Type of Heat Stress	Symptoms	Treatment
Heat Fatigue	Impaired motor skills, *mental* capabilities.	• Move the person to the shade or cool area.
Heat Rash	*Prickly heat*; reddish rash in areas of restrictive clothing.	• Move the person to the shade or cool area and remove restrictive clothing.
Heat Collapse	Individuals may lose consciousness (onset of heat collapse is rapid and unpredictable).	• To prevent heat collapse, the worker should gradually become acclimatized to the hot environment. • Move the person to the shade or cool area.

Heat Stressors (continued)

Table 14. Types of Heat Stress (continued)

Type of Heat Stress	Symptoms	Treatment
Heat Cramps	Painful muscle spasms, sweaty skin.	• Move person to a reclining position in the shade or cool area. • Give the person fluid replacement. (Electrolyte imbalance: too little or too much salt.) • Stretching muscles may help. **Do not massage.**
Heat Exhaustion	Headache, nausea, clammy or pale skin, rapid pulse, weakness, thirst and giddiness.	• Move person to a reclining position in the shade or cool area. • Call Facility 911. • Give the person fluid replacement. • Encourage the person to get adequate rest.
Heat Stroke	Unconsciousness (or, if conscious, confused, staggered walk, agitated), hot dry skin or (rarely) sweating, rapid pulse, body temperature of 105 ℉ or higher.	• Move person to a reclining position in the shade or cool area. • Call Facility 911. • If a person is conscious, offer sips of cool water. • Fan the person and apply cool towels. • Seek **immediate** medical attention.

Heat Stressors (continued)

Table 15, sets the **maximum** stay-time limits to be used in the absence of monitoring. Stay-time starts when the respirator or hood is donned and stops when the worker exits the work area.

Monitoring of biological signs (weight loss, heart rate, temperature) may be used in consultation with a safety professional and can result in longer stay times. Real-time biological monitoring used according to directions allows the lifting of all stay-time restrictions.

Recommended Work/Rest Break Schedules

Table 15. Work/Rest Break Schedule

Work	Level 1 Plus Respirator	Impermeable Clothing	Special Cases
Swagelok inspection and tightening	2 hours (30 min)	2 hours (30 min)	Consult with safety professional
Maintenance (bagouts, glove changes, window changes)	2 hours (30 min)	2 hours (30 min)	Consult with safety professional
Decontamination	2 hours (30 to 60 min)	1.5 hours (30 to 60 min)	Consult with safety professional
Pump room maintenance	1.5 hours (30 to 60 min)	1.5 hours (30 to 60 min)	Consult with safety professional
Decommissioning and decontamination (removing piping or gloveboxes)	Consult with safety professional	1.5 hours (30 to 60 min)	Consult with safety professional

Heat Stressors (continued)

References

Document Number/ Author	Title
LIR402-820-01	Noise and Temperature Stresses
Plog, B. A., Ed.	Fundamentals of Industrial Hygiene, 4th Edition. National Safety Council, Chicago, IL. 1996.

Laboratory Practices

Introduction

Many operations involve research quantities of materials that are used either in the pursuit of basic materials research or analytical chemistry supporting a variety of operations. The range of hazards arising from those activities can include:

- Hazardous chemicals
- Highly toxic materials
- Radioactive materials
- Flammable and combustible materials
- Compressed gases
- Nonionizing radiation (ultraviolet, radio frequency, and microwave sources)
- Electrically-powered commercial and homebrew equipment
- Elevated temperatures and pressures

Laboratory Practices (continued)

Requirements

The Laboratory has certain requirements relevant to work with hazardous materials within a laboratory environment. Much of what is contained in those requirements regarding exposures to chemicals follows.

Make sure that all chemicals are entered in to the ChemLog Inventory and removed from ChemLog when used or disposed of as chemical waste.

Step	Action
1	• Minimize all chemical exposure. • Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals. • Avoid skin contact with chemicals.
2	• Avoid underestimation of risk. • Even for substance of no known significant hazard, minimize exposure. • For work with substances that present special hazards, take special precautions. • Assume that any mixture will be more toxic than its most toxic component, and that all substances of unknown toxicity are toxic.
3	• Provide adequate ventilation. • The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices.
4	Institute a Chemical Hygiene Program. A mandatory chemical hygiene program designed to minimize exposures is needed. It should be a regular, continuing effort, not merely a standby or short-term activity.

Laboratory Practices (continued)

Requirements (continued)

Step	Action
5	• Observe occupational exposure limits including the Permissible Exposure Limits (PELs) of OSHA and Threshold Limit Values (TLVs) and the American Conference of Governmental Industrial Hygienists (ACGIH). • Do not exceed these limits. • Follow the Chemical Management LIR and HAZ-COM.

References

Document Number	Title
—	"A Closer Look at Laboratory Safety," *Industrial Safety and Hygiene News*, August 2000
LIR 402-510.01.1	Chemical Management

Job Planning and Prejob Reminders for Respirator Jobs

All jobs that require respirators or supplied air have the potential for heat-related problems. This essential information should be incorporated into job planning. See Table 16.

Table 16. Respirator/Supplied Air Heat-Related Problems

Issue	Action
1	All workers who will be wearing respirators or using supplied air must be trained in heat stress according to LIR402-820-01, *Noise and Temperature Stresses*.
2	Job planning must address the work and rest cycle. The chart on that is located in the section on heat stress sets maximum stay-time limits to be used in the absence of monitoring. • Stay time starts when the respirator or hood is donned and stops when the worker exits the work area. • Breaks before returning should be at least half as long (for strenuous labor) or one-quarter to one-half as long (for light labor) as the stay time that was spent and should include drinking noncaffeinated liquids.
3	Job planning should include the acclimatization of the workers to this type of work and plan rotation if appropriate.
4	Each work should be assigned a buddy, whose responsibilities include formally checking for heat-stress symptoms at defined intervals; for instance, every 15 minutes. After 30 minutes of the stay time, some people may experience symptoms of heat stress; at this point, buddies should start to check with each other.

Job Planning and Prejob Reminders for Respirator Jobs (continued)

Table 16. Respirator/Supplied Air Heat-Related Problems (continued)

Issue	Action
5	Job planning for jobs that require more than one work/rest cycle must include planning for fluid replacement. (It is estimated that workers at risk for heat stress require 5 to 7 ounces of liquid every 20 minutes.)
6	Monitoring of biological signs (weight loss, heart rate, temperature) may be used in consultation with a safety professional and can result in longer stay times. Real-time biological monitoring that is used according to directions allows the lifting of all stay-time restrictions. This equipment is available through HSR-5.

Prejob Briefing for Respirator Jobs

Date:	Job:

Your ability to work under the conditions required for respirator work depends on the ability of your body to cope with the buildup of heat. Under normal conditions of health and fitness, your body will use sweating to dissipate the heat. However, your protective clothing inhibits the effectiveness of sweating. The following factors may have an effect on your stay time.

- Work in respirators in the last 24 hours
- Less than usual fluid intake
- Recent consumption of diuretic drugs, caffeine, or alcohol
- Recent respiratory infections or allergies
- Other work (including fitness workouts) that generated profuse sweating
- Recent illness
- Emotional or mental stress

If these factors are present, or if you have any other factors that you think may affect you, notify your supervisor or buddy that they should re-evaluate you at the minimum stay time.

- Scope of the job
- Hazards associated with the job
- Mitigations prescribed
- Verification that mitigations are in place
- Solicit questions/concerns from the group
- Sign this document or the appropriate work document to indicate that a briefing was conducted.
- Attach a copy to the work document.
- Other:

Name	Organization

Laser Safety

Introduction

A laser is a device capable or producing an intense, directional, and coherent beam of visible or invisible light. Laser is an acronym for light amplification by stimulated emission of radiation. Lasers may be continuous or pulsed. Pulsed lasers are generally more dangerous than continuous systems because the energy is concentrated in a short time period. The uncontrolled use of lasers can result in skin burns, eye damage, and fire.

Requirements

- Laser operations at the Laboratory must comply with ANSI Z136.1, *American National Standard for Safe Use of Lasers*, LIG402-400-01, *Safe Use of Lasers*, and LIR402-400-01, Lasers.
- Group leaders must authorize personnel who work with Class 3b or Class 4 lasers.
- Class 3b and 4 laser operations require a Hazard Control Plan (HCP) and a laser hazard evaluation conducted with a LSO. A current list of operating personnel is also required.
- Class 3b and 4 laser operations require the approval of a LSO.
- Personnel who operate class 3b and 4 lasers must have a medical evaluation through HSR-2, Occupational Medicine.
- Personnel who work in laser control areas must have current laser safety training appropriate to their needs.
- Laser control areas shall meet the requirements of ANSI Z136.1.
- Access to laser operations must be controlled. Addition ally, operations with a class 4 laser require a Labora tory standard access control light panel (for details, see LIG402-400-01, *Safe Use of Lasers*).

Laser Safety (continued)

Requirements (continued)

- Control measures must be established to reduce the possibility of exposing personnel to hazards associated with lasers and laser systems during operation, maintenance, and service.
  NOTE: ANSI Z136.1 specifies the minimum control measures that must be applied for each laser classifica tion. Control measures must include engineering, administrative, and personal protective equipment controls. Certain situations also require special controls as determined by the LSO, such as: outdoor laser operations, laser demonstrations for the general public, very high-power or high-energy lasers, invisible lasers, and laser robotic installations.
- Physical barriers that limit the risk of beam exposure to workers must be used as appropriate.
- The correct laser protective eyewear must be available and kept in good condition.
- Nonbeam hazards, such as electrical, chemical, pressure, etc., associated with laser operations must be controlled.

References

Document Number	Title
ANSI Z136.1	American National Standard for Safe Use of Lasers
LIG402-400-01	Safe Use of Lasers
LIR402-400-01	Lasers

Life Safety Requirements

Introduction

The focus of life safety requirements is to ensure that personnel can safely enter and exit buildings.

Requirements

Exit and entry requirements are described in Table 17.

Table 17. Exit and Entry Requirements

Requirement	Description
Ceiling height	The minimum ceiling height in an occupied building is 7 feet-6 inches. Projections from the ceiling, such as ventilation ducts can further reduce this space to 6 feet-8 inches.
Levels of *exit*	Changes in levels in exit areas more than 21 inches must be by a stairs or ramp.
Means of *exit*	Exits must be free of obstructions that would prevent their use such as, snow/ice, furniture, decorations, construction or renovation debris, and poor housekeeping.
Door widths	Door widths must be a minimum of 28 inches in existing buildings and 32 inches in new construction.
Exit widths	The minimum width of any exit corridor or exit passageway must be 44 inches.
Aisle width	• The *minimum* width of any aisle within a business occupancy is 28 inches. The 28 inches can be further reduced within cubicles to 18 inches if the 10-inch obstruction is movable furniture. • The *maximum* height of that obstruction can be 38 inches.
Travel distance	The travel distance within a reduced *exit* area, such as a cubicle, must be less than 50 feet.

Life Safety Requirements (continued)

Requirements (continued)

Table 17. Exit and Entry Requirements (continued)

Requirement	Description
Passageway width	The minimal width within corridors and passageways is 28 inches (36 inches in new buildings) but may be reduced to • 18 inches with swing-open metal cabinets and • 36 inches for opening file cabinets.
Illumination	Illumination must be provided throughout the means of *exit* including emergency lighting when there is a power failure. Exits must be lit and have emergency lighting.
Exit signs	Exit signs must be visible from all directions of exit access and exit corridors.

References

Document Number	Title
NFPA 101	Life Safety Code

Lightning

Introduction

During lightning storms:

- Temperatures can approach 50,000 °F.
- Speeds of lightning bolts can approach one-third the speed of light.
- New Mexico is second in highest lightning activity. (Florida is first.)

Personal Lightning Safety: the Short Version

When you first see lightning or hear thunder, suspend activities and go to shelter. A metal vehicle or a substantial building is a safe place. Wait until 30 minutes after the last observed lightning or thunder before resuming activities.

Personal Safety Guidelines

The seemingly random nature of thunderstorms cannot guarantee absolute protection from lightning strikes; however, following proven lightning safety guides can greatly reduce the risk of injury or death.

Step	Action
1	Avoid open fields, metal fences, isolated trees, unprotected gazebos, picnic shelters, communications towers, flagpoles, bleachers (metal or wood), convertibles, golf carts, water.
2	Avoid using telephones, taking a shower, washing your hands, doing dishes, or physically contacting conductive surfaces with exposure to the outside, such as metal door or window frames, electrical wiring, telephone wiring, cable TV wiring, plumbing, etc.
3	If outdoors, seek shelter. In general, fully enclosed metal vehicles such as cars with windows rolled up provide good shelter from lightning. Avoid contact with metal or conducting surfaces.

Lightning (continued)

Warnings and Risk
If you can see lightning and/or hear thunder, you are at risk. Louder or more frequent lightning indicates that lightning is approaching, increasing the risk for injury or death. If the time delay between seeing the flash and hearing the bang is less than 30 seconds, you should be in, or seek, a safe location.

High winds, rainfall, and cloud cover often act as precursors to actual cloud-to-ground strikes, which are indications that individuals should take action. Many lightning casualties occur in the beginning, as the storm approaches, because people ignore these precursors. Also, many lightning casualties occur after the perceived threat has passed.

The lightning threat diminishes with time after the last sound of thunder, but may persist for more than 30 minutes. When thunderstorms are in the area but not overhead, the lightning threat may exist even when it is sunny, not raining, or when clear sky is visible.

Actions to Take When You Are Outside
If lightning is striking nearby when you are outside:

- **Crouch down.** Put feet together. There should not be two points of contact with the ground, so do not touch the ground with your hands or knees.
- Place hands over ears to minimize hearing damage.
- **Avoid proximity** (minimum of 15 ft.) to other people.

NOTE: If a person is struck by lightning, the injured person does not carry an electrical charge and can be handled safely.

References
National Lightning Safety Institute Safety Guidelines

Lockout/Tagout Procedures

Introduction
The Laboratory has two procedures that deal with locking and tagging of processes and equipment. You use these procedures under certain conditions (see Table 18) and with appropriate training.

Requirements
Line management must designate authorized workers.

Actions to Take
Reminder: Disciplinary action will result for:

- Failure to use these procedures when appropriate

or

- Violation of them (for example, unauthorized removal of a lock or tag).

Table 18. Lockout/Tagout Conditions

Document Number	Title	Purpose	Lock Color	Tag Color
LIR402-860-01	Lockout/ Tagout for Personal Safety	To prevent accidental startup of equipment or machines during service, maintenance, or modification where the startup could harm personnel.	Red	Red
LIR402-860-02	Locking and Tagging Equipment, Machinery, and Systems	To provide personnel safety and protection for the environment.	Orange	Orange

Noise

Introduction
Noise is any unwanted sound that may cause annoyance, interference with speech or communication, and/or hearing loss. Noisy environments may lead to increased anxiety, hypertension, and fatigue. Occupational noise sources within LANL include machinery or equipment, such as, ventilation blowers, compressors, and operation of heavy machinery, rollers, presses, grinders, and lathes.

Ultimately, noise-induced hearing loss (NIHL) is classified by a slow progressive hearing loss that results from exposure to continuous noise over a long period of time.

At LANL, personal noise monitoring levels of 82 **dBA** for an 8-hour time-weighted average or 50% dose of the permissible exposure level of 85 dBA places an individual worker in the hearing conservation program. Inclusion in the hearing conservation program consists of audiometric testing from HSR-2, training from PS-13, and the use of hearing protection.

Requirements
Hearing loss can be prevented with the proper use of hearing-protection devices (ear plugs or ear muffs). These devices provide a barrier between the sound and the ear, and absorb sound waves before they enter the ear.

Hearing-protection devices maybe considered prudent if you:

- Work in noisy conditions that have an 8-hour time-weighted average decibel levels greater than 82 dBA (and you are in a hearing conservation program).

Noise (continued)

Requirements (continued)

- Have to shout to speak to your coworker to be heard.
- Experience *ringing* in the ears after being in a noisy area.
- Are bothered, nervous, or anxious after being in a noisy area.
- Want to increase your comfort.
- Are unusually fatigued after working in noisy area.
- Doctor recommends hearing protection devices.

Limitations of Hearing Protection Devices

When wearing hearing protection consider the following limitations:

- Improperly worn hearing protection may not reduce the noise levels to within acceptable levels and may cause a false sense of security.
- Always throw away dirty disposable plugs. Dirty plugs or muffs can cause serious skin irritation or ear infection.
- The maximum permissible exposure to impact or impulse noise without hearing protection is 140 decibels (dB).
- Impact or impulse noise exceeding 160 dB requires double hearing protection to be worn.

References

Document Number/ Author	Title
LIR402-820-01	Noise and Temperature Stresses
Plog, B. A., Ed.	Fundamentals of Industrial Hygiene, 4th Edition. National Safety Council, Chicago, IL. 1996.

Penetrations of Ceiling, Wall, Floor, and Concrete Surfaces

Introduction

Follow the instructions in this section to ensure that ceiling, wall, floor, and concrete surfaces are penetrated safely. Guidelines are also provided to ensure that penetrations done indoors are sealed properly.

Requirements

- Visual inspection
- Penetration Permit on HCP

Actions to Take

Step	Action
1	Before conducting penetrations of ceilings, walls, floor, and concrete surfaces, visually inspect the areas to determine hazards present.
2	Prepare an HCP or Penetration permit for ceiling, wall, floor, and concrete surfaces.
3	Check the areas behind walls, under floors, and above false ceilings to ensure that no utilities are present.
4	If the penetration interferes with known utilities, find an alternate location.
5	Use ground fault circuit interrupters (GFCIs) for electric, nonbattery-operated hand tools.
6	When penetrating drywall or other easily penetrated surfaces, make the penetration with a blunt instrument having an electrically insulated handle. Make the first penetration and then check for any interfering utilities by looking into the hole with a flashlight.
7	Use drill stops or mark equipment to limit the depth of penetration.

Penetrations of Ceiling, Wall, Floor, and Concrete Surfaces (continued)

Step	Action
8	When conducting demolition or remodeling activities or when removing entire wall sections, lock out/tag out all circuits within the room.
9	Solid wall penetrations require the assistance of facility management. Drawings and engineering plan review are required. If the supervisor cannot positively verify that there are no hidden hazards at the point of penetration, nondestructive evaluation is required. Authorized nondestructive evaluation equipment is required.

References

Document Number	Title
29 CFR 1910.301	Electrical
29 CFR 1926.401	Installation Safety Requirements
LIR 402-880-02	Penetrations

Portable Ladder Safety

Introduction

According to OSHA, a stairway or ladder must be provided at all personnel points of access where there is a break in elevation of 19 inches or more, and where no ramp, runway, sloped embankment, or personnel hoist is provided.

General Requirements

- Follow the manufacturer's instructions for use.
- Always face the ladder when climbing and descending.
- Do not carry objects so that both hands can be used to hold the ladder. Keep tools in a tool belt or use a bucket to hoist them up and lower them down.
- Never use a metal ladder when working with or near electrical current.
- Ensure the ladder's feet are level.
- Avoid excessive stretching or leaning.
- Do not use a ladder for unintended purposes, such as in place of scaffolding.
- Wear slip resistant footwear.
- Do not position a ladder by a door or walkway unless the door can be locked and posted or the walkway can be barricaded to prevent collisions.

Straight Ladders

- Ensure the ladder is equipped with safety feet.
- Position the later so that the ladder base is 1 foot away from the wall for every 4 feet of height.
- Ensure that the ladder is positioned so that at least 3 feet of the ladder (generally 3 rungs) extend above the support point.
- Secure the ladder close to the support point.
- Do not let the trunk of your body extend past the side of the ladder.

Portable Ladder Safety (continued)

Step Ladders

- Ensure the spreaders are functional and locked in place.
- Never stand on the top two rungs.
- Do not overreach; reposition the ladder to avoid leaning over the base support.

References

Document Number	Title
29 CFR 1910.25	Portable Wood Ladders
29 CFR 1910.26	Portable Metal Ladders
Course 12985	Ladder Safety Training in White Rock

Personal Protective Equipment

Introduction

Estimates place approximately 30% of the 1.8 million disabling injuries per year involve injuries to the head, eyes, face, hands, or feet. Given this information, the overall emphasis is on worker safety, *yours* and *mine*, within the NMT Division.

Personal protective equipment includes:

- eye and face protection;
- head;
- foot;
- extremities;
- respiratory protection (covered under respiratory protection); and
- protective clothing; shields, and barriers.

It is LANL to provide personnel (management, staff, students, contractors, etc.) with the personal protective equipment that is needed to prevent injuries or illness, and to protect personal clothing.

Personal Protective Equipment (continued)

Requirements

- Personal protective equipment (PPE) is a secondary control measure that should be used only to supplement engineering and administrative controls when they are not sufficient to reduce hazards to an acceptable level or when a potential for an accidental release exists. *However, PPE is a very important part of the control scheme*. It is often the only defense against exposure to a hazard.
- Health and Safety personnel must perform hazard assessments of new operations and review current operations, in part, to ensure that the appropriate PPE is selected and used properly.

Actions to Take

Choose the right type of PPE and be sure to inspect it before each use.

Action	Description
Choice	Based on a number of factors, including: • Chemical to be used • Chemical's inherent properties • Chemical concentration • Potential route of entry of the chemical • Amount of time a worker is exposed to the chemical
Inspection	Inspect all PPE before each use. Pinholes, cracks, tears, or imperfect seams could decrease the effectiveness of the PPE.

WARNING

No single material protects against every chemical; take care when choosing protective clothing.

Personal Protective Equipment (continued)

Protective Clothing
Protective clothing is designed to protect your clothes and your body from exposure to hazardous materials. By keeping hazardous materials out of your clothing there is less likelihood that they will be taken out of the workplace and create a hazard for family and friends.

Some types of protective clothing available include lab coats, coveralls, aprons, and chemical-resistant suits. This protective clothing is available in a variety of materials that provide protection from different hazardous materials.

Eye and Face Protection
In regards to hazardous materials, eye and face protection protects the face and eyes from splash hazards and dust or mist hazards. The three basic types of eye and face protection follow in Table 19.

Table 19. Types of Eye and Face Protection

Protection	Description
Safety glasses	Safety glasses protect the eyes only from flying hazards.
Safety goggles	Safety goggles fit snugly to the face and prevent chemical exposure caused by a splash. Some styles may also prevent exposure from vapors or mist.
Face shields	Face shields are designed to protect the face from direct chemical splashes. They are not full eye protection and should never be used in place of glasses or goggles, but in addition to them.

Personal Protective Equipment (continued)

Foot Protection
Foot protection protects your feet from crushing injuries, punctures or chemical exposures. When working with or around hazardous materials, materials spill may on your feet. Therefore, it is important to always wear completely enclosed shoes. This type of shoe protects your skin from the chemical.
NOTE: Enclosed shoes are required; open-toed shoes or sneakers are **not** allowed.

Head Protection
Head protection protects your head from contact with chemicals. Of the three main types of head protection: hard hats, bump caps, and skull caps; only skullcaps minimize the danger of radiological contamination to the head and hair.

Hand Protection
The hands are the parts of the body that come into the most contact with hazardous chemicals. This contact can cause any number of localized and delayed problems. See Table 20 and LIR 402-1000-01, Personal Protective Equipment, Attachment F.

Personal Protective Equipment (continued)

Table 20. Hand Protection

Protection	Description
Gloves	The proper selection and use of gloves will minimize the risk of hand injury. Choosing gloves is a task that can be daunting. Factors to consider when choosing gloves include properties of the chemical and length of contact time. No single glove material is a barrier to all chemicals, so some consideration must be taken when choosing gloves. The glove type should be decided by consulting the material safety data sheet (MSDS), a glove chart, your supervisor, or an industrial hygienist. **Caution:** Latex gloves offer virtually no protection from hazardous materials. Additionally, many people are allergic to them. Before using them, consult your supervisor or industrial hygienist. Hazardous materials will eventually pass through all gloves, so change your gloves as necessary. Lastly, **never reuse disposable gloves**.
Barrier creams	A number of barrier creams can reduce the likelihood of chemicals being absorbed. For example, beeswax or petroleum is used to prevent contact with water-soluble chemicals like acids. These creams are the least effective method of control and should be used in addition to other forms of PPE, not in place of them.

Personal Protective Equipment (continued)

Respiratory Protection
The use of some hazardous materials may require respiratory protection. If you feel that respiratory protection may be necessary, contact your supervisor to have your workplace monitored. If respiratory protection is required, you need to be in the Laboratory Respiratory Protection Program (call **7-3560)**.
Contact HSR-5 for all Respiratory Protection Questions/ Issues.

References

Document Number	Title
LIR402-1000-01	Personal Protective Equipment

Respiratory Protection

Introduction
Concerned with the potential of airborne hazards in your work place?
By law, employers must provide respiratory protection to employees who are exposed to concentrations of potentially harmful substances exceeding established Permissible Exposure Limits (PELs).

Normally, engineering and administrative controls can provide sufficient protection. Within LANL, engineering controls can include measures such as increasing ventilation or installing a fume hood; administrative controls involve changes in work procedures. The law requires that these controls be considered before personnel are issued respirators. If engineering and administrative controls are infeasible or will not provide adequate protection, respirators can be assigned.

Respiratory Protection (continued)

HSR-5 and other deployed/divested health and safety professionals work with your group/team to analyze the work environment and decide which protective measures are necessary (e.g., how to reduce hazards to acceptable levels through engineering or administrative controls).

Requirements

As an worker enrolled in the Respiratory Protection Program, your responsibilities include:

- Returning to HSR-5 Respiratory Protection (call **7-3560**) for annual fit test.
- Use of the respirator only for the assigned hazard, clean, and maintain the respirator as trained.
- Notify your supervisor of any new or changed workplace hazard.

General Facts About Respirators

- Engineering and administrative controls are always preferable to the use of a respirator.
- Respirators should only be considered if no other solutions are viable, since the possibility for human error makes the respirator less reliable than the other controls.
- Men must be clean-shaven to wear a respirator. Most respirators will not provide the necessary tight seal over a beard.
- Never borrow or lend a respirator. Each respirator has been specifically fitted to the person designated to wear it. An ill-fitting respirator is dangerous.
- Do not wear a respirator into a situation that has not been evaluated by the Health and Safety Professionals. Different environments may require a change in assigned cartridges or respirators. There is no one cartridge respirator that is good for all situations.

Respiratory Protection (continued)

Types of Respirators

Table 21 identifies types of air purifying respirators.
Table 22 identifies supplied-air respirators.

Table 21. Air Purifying Respirators

Type	Description
Half-Face or Full-Face Respirators	Used with interchangeable filter cartridges, this form of respiratory protection can provide protection, against certain contaminants up to a limited concentration, for the respiratory system from hazardous dusts, fumes, mists, etc. Protection is only *gained* if there is a proper seal of the respirator face piece. Thus this type of respirator requires fit testing prior to respirator assignment and a fit check prior to each use.
Powered Air Purifying Respirators (PAPR)	Full-face, helmet or hood type PAPRs operate under positive pressure inside the face-piece using a battery operated motor blower assembly. This unit forces air through a filter cartridge into the worker's breathing zone.

Respiratory Protection (continued)

Table 21. Air Purifying Respirators (continued)

Type	Description
Disposable Dust Masks	For authorized use within LANL, Health and Safety personnel must determine that no significant hazard exists. A *significant hazard* is defined to mean that either of the following conditions exists: • Oxygen level below 19.5%, or • Uncontrolled air contaminant exposure exceeding a short-term exposure limit (STEL) or long-term exposure limit (usually 8 hours) established by ACGIH, the National Institute of Occupational Safety and Health (NIOSH), or OSHA. This information may be found on the material safety data sheets. If the worker chooses to use dust masks as protection against nuisance dust, they accept full responsibility for their proper use. Contact HSR-5 for disposable dust masks. **NOTE**: Paper dust masks may **never** be used in place of required respiratory protection.

Respiratory Protection (continued)

Table 22. Supplied-Air Respirators

Type	Description
Airline Respirators	Airline respirators are designed to deliver breathing air from either a compressor or a compressed air cylinder through a small diameter hose. This type of respirator operates in three modes: demand, pressure demand, and continuous flow. Lack of mobility is a limiting factor for this type of respirator.
Self-Contained Breathing Apparatus (SCBA)	SCBA respirators provide protection against gases, vapors, particles, and an oxygen deficient atmosphere. The user is more mobile than with an airline respirator but is limited by the amount of air that is supplied by a single tank (20 to 60 minutes). Primarily used for emergency response or rescue work, these units must be thoroughly inspected on a monthly basis and written records must be kept of all inspections, operator training, etc.

References

Document Number/ Author	Title
Plog, B. A, Ed.	*Fundamentals of Industrial Hygiene*, 4th Edition. National Safety Council, Chicago, IL. 1996.

Scaffolding

Introduction

All users of scaffolding must be aware of the hazards associated with the types of scaffolds being used and understand the procedures to control or minimize those hazards.

- Scaffolds are categorized as light duty, medium duty, and heavy duty.
  - Light duty has a maximum of 25 pounds per square foot,
  - medium duty has a maximum of 50 pounds per square foot,
  - heavy duty has a maximum of 75 pounds per square foot.

Actions to Take

Step	Action
1	Scaffolding is posted with a daily inspection log that indicates **Ready for use** or **Do not use**. If the log is not signed off **Ready for use** when you need to use it, do not climb it.
2	Do not carry equipment while climbing. Have someone hand the equipment to you or use ropes.
3	While working below someone on a scaffold, wear a hard hat.
4	To access a scaffold platform when more than 2 feet above or below a point of access, use a fixed ladder or straight ladder. Bottom rung must be within 24 inches of lower level.
5	Ensure that the ladder extends 3 feet beyond the level of the platform. Proper climbing angle is required for straight ladders.
6	Clear access is required at the top and bottom of the ladder.

Scaffolding (continued)

Actions to Take (continued)

Step	Action
7	Ensure that the platform is fully planked.
8	When the platform is more than 10 inches above the ground, install toeboards.
9	When scaffolding reaches a height of 10 feet, a midrail and guardrail is required at the platform level. **Exception**: If the scaffolding is up against a wall, equipment, secured piping, etc., that act as a barrier from falling.
10	Do not erect, use, dismantle, alter, or move scaffolding within 3 feet of <300 volt power cords and 10 feet of 50 kilovolt lines.
11	Do not allow trash and debris to accumulate on scaffolds.
12	Reaching outside of the railings beyond the ability to keep both feet on the platform is not permitted. **Jumping on/off of scaffolding is not permitted.**
13	Never modify or remove components of a scaffold structure.

References

Document Number	Title
29 CFR 1926.451	Scaffolding

Ventilation

Introduction
Ventilation is, basically, the *supply* and *exhaust* of air with respect to an area. Many processes, operations, and activities generate airborne contaminants that are harmful to workers and in some cases the product being manufactured. Laboratory fume hoods (California, welding fume, etc.) are ventilated working surfaces designed to provide uniform exhaust air throughout its interior. By design, these ventilated enclosures protect users from inhaling chemicals by constantly pulling air into the hood, away from the user, and exhausting it out of the building.

Requirements
Use laboratory fume hoods in the following situations:

- When handling chemicals that could result in inhalation of toxic gases, vapors, or powders;
- When handling dispersible radioactive materials;
- When handling chemicals with high vapor pressures;
- When chemical vapors could create a fire hazard; and
- When working with compounds that could have an offensive odor.

Hood Certifications
All laboratory fume hoods that are relied on to protect workers from exposures are certified once a year. All hoods that have been certified have a yellow label attached to them with the date of the certification, the initials of the person who conducted the certification, and operating conditions (for example, maximum sash height).

Flow Indicators
In addition to being certified annually, fume hoods also are required to have flow indicators. These indicators can be magnehelics that indicate the static pressure in the hood. You can find airflow indicators used at LANL at http://int.lanl.gov/safety/lihsm/toolbox.shtml

Ventilation (continued)

Actions to Take

WARNING
Before using a hood, always verify that the hood is on and that air is being drawn into the hood. Please refer to Appendix A in LIR-402-830-01.0 Local Ventilation for Contaminant Control.

Step	Action
10	*Avoid* working in areas where there is turbulence (e.g., along outer walls, close to doors that are opened and closed frequently.
11	Never adjust dampers – contact Facility Management.

References

Document Number	Title
	American Industrial Hygiene Association Engineering Reference Manual, Second Edition, 1999
	US Berkley EHS, Fact Sheet on Fume Hoods
LIR-402-830-01.0	Local Ventilation for Contaminant Control
Chapter	Laboratory Industrial Hygiene and Safety Manual – Chemical Lab Fume Hood Testing

Working Alone

Introduction
This checklist may be used to document evaluation of potential working-alone situations, and the means chosen to protect personnel from specific hazards that may be associated with the work tasks, activities, or environment.

Working alone is not permitted for work involving:

- Certain energized electrical equipment (see LIR402-600-01, *Electrical Safety*)
- Personnel entry into limited egress/confined spaces (see LIR402-810-01, *Confined Spaces*)
- Activities requiring the use of supplied air or self-contained breathing apparatus
- Explosives activities

Working Alone (continued)

Checklist

Date:	Group:	Manager (sign)
Location:		
Description of operation:		
Affected personnel:		
Does the operation require: o Working with hazardous materials inside or outside of a glovebox o Inserting hands into potentially contaminated gloveboxes o Maintaining potentially contaminated systems o Hazard Control Plan, or Radiological Work Permit (if so, is working alone specifically authorized)		
Other requirements performing *hazardous* operations: o Is another person within earshot in the area? o Is another person within sight if the work is conducted in high-noise areas? o Are laboratory doors unlocked when the area is occupied? o Are occupants visible within the occupied area? o Is the operation conducted outside of normal hours? If so, another individual must be in the immediate area. o Is the operation or activity covered by an approved hazard control plan? o Have case-by-case exceptions been documented by a group leader or deputy group leader?		
Notes/Comments:		

References

Document Number	Title
LIR 402-550-01	Explosives
LIR402-600-01	Electrical Safety
LIR402-810-01	Confined Spaces
AR 1-8	Working Alone

Appendix A
Acronyms and Abbreviations

Acronym or Abbreviation	Definition
A	ampere
ACGIH	American Conference of Governmental Industrial Hygienists
AP	administrative procedure
AWC	area work coordinator
CTD	cumulative trauma disorder
dB	decibel
dBA	
ANSI	American National Standards Institute
BIO	Basis for Interim Operations
BST	Behavior Science Technologies
ESH	environment, safety, and health
HSR-1	Health Physics
HSR-2	Occupational Medicine
HSR-5	Industrial Hygiene and Safety
PS-13	Environment, Safety, and Health Training
ESO	electrical safety officer
FSAR	Final Safety Analysis Report
GFCI	ground fault circuit interrupter
GPILD	general-purpose installed lifting devices
gpm	gallons per minute
HCP	hazard control plan
ISM	Integrated Safety Management
J	joule
kW	kilowatt
LIG	Laboratory Implementation Guideline
LIR	Laboratory Implementation Requirement
LPR	Laboratory Performance Requirement
LSO	laser safety officer
mA	milliampere
mg	milligram
MSDS	material safety data sheet
NEC	National Electrical Code
NFPA	National Fire Protection Administration
NIHL	noise-induced hearing loss
NIOSH	National Institute of Occupational Safety and Health

Appendix A
Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
NRTL	Nationally Recognized Testing Laboratory
OSHA	Occupational Safety and Health Administration
PAPR	Powered Air Purifying Respirators
PEL	permissible exposure limits
PIC	person-in-charge
PPE	personal protective equipment
PVC	polyvinyl chloride
RCT	radiological control technician
RWP	radiological work permit
SCBA	self-contained breathing apparatus
SEWP	special electrical permit
SOP	safe operating procedure
STEL	short-term exposure limit
TLV	threshold limit value
UL	Underwriter's Laboratory