Industrial Work Hazards at the LBTO

Rev. Date: 02-Dec-2020
Keep it Clean: Housekeeping, Storage, & Staging

• Work Areas
  • Storage and staging needs shall be coordinated with Manager on duty.
  • Leave areas clean, orderly, and weather-tight each night, including work areas and living quarters.
  • Store things so that they do not present a hazard to others.

• Best Practices
  • Clean as you go.
  • Any issues or conflicts let manager on duty know.

Make the safe choice...
Buddy System Requirement

• At LBT, You **must** work with a buddy (not alone) when:
  1. Working at height with fall protection gear
  2. Making large lifts or handling large equipment
  3. Working on exposed *energized* components over 50V (this requires Mountain Manager authorization and energy control plan), including in the machine shop
  4. As directed by procedure
  5. When not feeling well

• As a best practice, always work with a buddy and ensure (test) radio contact when in remote areas.

• Your buddy can:
  • Provide a helping hand and set of eyes to identify and control safety hazards.
  • Call for help and assist if you are injured or ill.

Make the safe choice...
Overview of LBTO Work Hazards

- Falls from heights (people), & falling materials (risk to people/equipment)
- Crush from moving parts (telescope, building, equipment)
- High voltage/high current electrical equipment
- Powered lifts and vehicles
- Overhead crane and heavy material handling
- Class IV Lasers
- Cuts/Punctures
- Ergonomic hazards and Slips, Trips, Falls
- Chemicals: Oils, mild irritants, flammables, glycol
- Cryogenic liquids (extreme low temperatures)
- Compressed gases and pressurized liquids
- Non-electrical hot work (welding, brazing, grinding, flame)

Make the safe choice...

Just to name a few...

Plan Ahead! Unsure? Ask...
Fall Protection

OSHA 29 CFR 1910.22 & 1910.140
LBTO Program: M004s00700/M004s00012

• 20% of all US work-related deaths in 2014 were from falls, 2nd only to transportation auto deaths.

• **4 Foot Rule.** Fall-heights over 4 feet require Fall Protection (OSHA rule).

• Training is required **before** using fall protection equipment. See the manager on duty.

• **Self Retracting Lifelines (SRL)** with double hooks only, no shock absorbing lanyards (more later).

• **Pre-Task Plan (PTP)** (M004s00021) must be completed before using fall protection, unless work is covered by an approved procedure.

• **LBT Manager Review** of PTP and Rescue Plans
  • Prior to work, all tie-off plans must be reviewed with and signed by the manager on duty.
  • Rescue requiring mechanical assist (R550 device) requires a Fall Rescue Plan be completed (M004s00702).

Make the safe choice...
Self-Retracting Lifelines (SRL) Allowed Only

- **SRL = Yes**
- **Non-Retracting = Do Not Use**

“Seat belt” style. Retracts inside housing. Must have 2 (double) for 100% tie-off. Require 6’ of fall clearance.

These types do not retract = not allowed because they require 18’ fall clearance.

Make the safe choice…

OSHA 29 CFR 1910.140
Working on the Roof @LBT

OSHA 29 CFR 1910.22
LBTO Doc. M004s00003 “Azimuth Lockout Procedure”
M004s90003 “Upper Roof & Level 9 Catwalk Access Requirements”

• Fall Protection required when less than 6 feet (2 meters) of the edge. No Exceptions.
• Prior Authorization from Manager IS ALWAYS required before going onto any roof.
• Lockout Hazardous Energies First, ALWAYS.
  • High-Bay Roof
    • Must lockout Azimuth Rotation on level 5 before going onto roof.
  • Upper Roof
    • Must lock out shutter door multiplexer drives on level 9 before going onto roof and/or on Level 9 Catwalks.

Make the safe choice...

Plan Ahead! Unsure? Ask...
Approved upper roof tie-off

OSHA 29 CFR 1910.22

- D-rings on top posts are the only approved fall arrest tie-off point on the upper roof.
- They run the length of the shutter, left and right sides.
- Mechanical Rescue Devices required (R550). Complete a PTP and Rescue Plan first, being sure to stage the rescue gear in the work area.

Make the safe choice...

Plan Ahead! Unsure? Ask...
Upper roof railings

OSHA 29 CFR 1910.22

- Otherwise, stay more than 6’ from the edge, or behind a railing.

Make the safe choice...

Plan Ahead! Unsure? Ask...
Lockout/Tagout & Controlling Hazardous Energy

OSHA 29 CFR 1910.147

• Hazardous energies inside equipment:
  • Before installing, servicing, or repairing the equipment, it must be:
    1. Turned off
    2. De-energized and verified zero energy, and
    3. Locked closed with your lock

• Just turning off valves or switches is not legal in the US. You must also apply a lock that only you have the key for.

• Each person working on the equipment must have their own lock.

• You are required to complete a separate lockout/tagout training.

Make the safe choice…
Types of Hazardous Energy Requiring Lockout/Tagout

- **Electrical** (Voltage over 30V, current >25 amps [any voltage], 240 VA, static electricity)
- **Chemical** (Explosion, pressure, extreme heat, fire, corrosion, reaction, oxidation, toxicity)
- **Pressure** (CDA, > 1 atm, 14.69 psi pneumatic, hydraulic)
- **Vacuum** (<1 atm; 14.69 psi)
- **Mechanical** (Crushing, pinching, cutting, snagging, striking, motion)
- **Thermal** (hotter than 140F, colder than 32F, surface; hot liquids, steam, cryogens)
- **Radiation** (> 2mRem/hr, UV, IR, RF/Microwave, Laser, Magnetic Fields)
- **Potential or stored energy** (Flywheels, springs, difference in elevation, elevated parts that could drop, capacitors, batteries - UPS)

Make the safe choice...
Electrical Safety

• Both **Shock Hazard** & **Arc Hazard** exist in energized equipment. Injury or death can occur from contact with (shock) or proximity to (arc) energized equipment.

• Always work on equipment *de-energized*.
  • LOCKOUT/TAGOUT is a **Must**
  • Double-check you have the correct volt meter and verify!

• **Never** open cabinets containing >50 V
  • Contact LBT Manager to open cabinets. Only certain LBT staff are authorized to open power, equipment and control cabinets.
  • Exception: Visiting Teams who are commissioning/servicing PI instruments are authorized to open their cabinets.

Make the safe choice…

Plan Ahead! Unsure? Ask...
Liquid Nitrogen & Cryogenics

• Liquid Nitrogen is a cryogenic
  • Cryogenic Liquids are extremely cold and can produce a severe burn comparable to frostbite, or worse.
  • Very small amounts of liquid are converted to large volumes of gas that can create asphyxiation and/or pressure hazards.
  • Cryogenic liquids may only be used by persons trained in the safe use of gases.
  • Pressure of liquid systems is 22-50 psi.
  • PPE Required are cryogen gloves, face shield, and safety glasses.

Make the safe choice...
Nitrogen Asphyxiation

• Release of nitrogen in confined areas could cause asphyxiation (suffocation).

• Elevator Transport of Liquid Nitrogen
  • No one allowed to ride in elevator with nitrogen dewers.
  • Transport will be pre-announced over radio.
  • If you see Danger Tape and dewers in the elevator, do not enter the elevator.

• Oxygen Sensors are in place in Clean Room and Lab 116.
  • Read instructions posted on doors to each of the rooms.
  • If alarm goes off in this room, leave room immediately and contact a manager.

Make the safe choice...
Ladder Safety

29 CFR 1926.1053
LBTO Doc. M004s00701

• All Ladders
  • Inspect before use
  • Good flat, sturdy surface
  • Belt buckle rule
  • 3 points of contact, don’t climb with tools in hand
  • Tether tools when working on ladders
  • Use ropes/buckets or other to bring up equipment
  • Don’t stand on top or top rung (next one down)
  • Store horizontally
  • 4’ Rule for Fall Protection Applies if climbing off a ladder.

• Straight Ladders
  • Tie off straight ladders to structure. Have someone hold base.

• A-frame ladders only to be used as a-frame, no leaning

Make the safe choice...
# Ladder Safety

<table>
<thead>
<tr>
<th>Location</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Cap</td>
<td>Do Not Stand or Sit</td>
</tr>
<tr>
<td>1st Rung (step)</td>
<td>Do Not Stand or Sit</td>
</tr>
<tr>
<td>2nd Rung (step)</td>
<td>Must maintain 3 points of contact at all times</td>
</tr>
<tr>
<td>3rd Rung (step)</td>
<td>Can work safely off the ladder as long as 2 points of contact are maintained</td>
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</tbody>
</table>

Make the safe choice...

Plan Ahead! Unsure? Ask...
Powered Lifts

29 CFR 1910.67 & 1910.178

• You must be **pre-trained and certified** to **operate** powered trucks and lifts.
  • e.g. scissor/boom lifts, fork lifts
  • Proof of training must be given to LBT Safety **before start of work**. Contact Safety for Info.
  • Remember prior authorization is also required for equipment use.
  • **Note: No training is required for SCISSOR lift passengers.**

• Inspect equipment before use
• Barricade areas below if needed.

• **Fall Protection**
  • Scissor lift = Fall Protection not required if you stay inside railings with feet on the floor.
  • Boom lift = Fall Protection required whenever in the basket.

• Never climb out of lifts without fall protection.

**Make the safe choice...**

Separate Training
Plan Ahead! Unsure? Ask...
Hand Carts

29 CFR 1910.67 & 1910.178

- There are a number of different carts on site.
- Always read instructions and labels before using hand carts.
- Always verify safety chains and restraints are in place prior to use.

- **If you are not comfortable or experienced in using carts, ask someone to help you out.**
- Safety with hand carts is the responsibility of the user.
- Not all carts have specific training, so get acquainted before you use one.
Overhead Cranes

- Never operate cranes unless you have been trained and authorized by LBT.
- Contact Mountain Manager prior to arriving on site to request crane assistance for your job.

Beware with Cranes

- Hard hats are required for crane use – Look for Signs at point of entry
- No walking under suspended loads.
- Special rigging fixtures may be required.
Chemicals

Safety Data Sheets (SDSs) are required for all chemicals brought on site.

Wear proper PPE for chemicals used (eyewear, gloves, etc.)

Eyewashes available on site, verify locations prior to use.

Labeling – every container with contents

Storage – coordinate with Manager on duty about storage considerations. Flammables and corrosives require proper storage.

Remove all chemicals and chemical waste from site.

Plan your work to prevent spills, and report all releases immediately.

No refueling on site without prior approval.

Make the safe choice...
Flammable Chemical Storage

Must be stored in a yellow, metal, UL listed flammable cabinet:

- Any substance with this label: ☢️
- Any substance with an NFPA diamond rating of 2 or greater in flammability.
- All flammable and combustible chemicals with a flash point <200 deg F.

Make the safe choice...
Personal Protective Equipment (PPE)

29 CFR 1910.132

• The only area requirement for PPE is:
  • Hard Hats Required while Crane in use in Level 1 High Bay and Level 5 Chamber (see previous slide for picture).
  • Hard hat OR bump cap required when on the telescope.

• Otherwise, PPE Requirements are based on Exposure
  • Safety glasses (any exposure to eyes from objects or irritant chemicals)
  • Safety shoes (lifting 30 lbs.+ and Powered Truck/Crane Use)
  • Fall Protection (exposure to fall of 4 feet or more)
  • Welding helmet/mask (while welding)
  • Chemical PPE (exposure to cryogenic or corrosive chemicals)
  • Hearing protection (>4 hours in Level 4 Equipment Room or Utility Building Chiller area)
  • Sun protection (roof work)
  • Respirators (only N95 dust masks for comfort if needed)

• Construction Contractor PPE:
  • Hard hat, safety shoes, work gloves, safety glasses

Make the safe choice...
Hot Work

29 CFR 1910.252

• Hot Work is work that produces a flame, spark, or smoke:
  • Welding, grinding, brazing, cutting, etc.

• A Hot Work Permit is Required!
  • You must get a University of Arizona Hot Work Permit
  • See “Fire Safety” http://risk.arizona.edu/forms

• Exception: LBT No-Permit-Required Area: Level 3 Lower (3L)
  • LBT pre-approval needed.

• Personal Protective Equipment Required

• Fire Watch Required

• Never look into a welding flash! Can cause eye damage.

Make the safe choice...

Plan Ahead! Unsure? Ask...
Lasers

• At times, open beam Class IV Lasers may be in use in the telescope chamber.
  • Level 5 and above is hazard zone.
  • Prior notification made over radio.
  • Signage put up on elevators.
  • Light indicator system in effect.
    • If red or yellow flashing lights are showing on level 4 (at 3 entrances to level 5), do not enter the stairways or elevators leading to Level 5.
    • Green or no light is ok to enter.

Side Note: Never point laser pointers at people.

Plan Ahead! Unsure? Ask...

Make the safe choice...
Class IV Lasers
Class IV Lasers
Make the safe choice...

Bypass of Critical Safety Elements & Controls
(interlocks, sensors, switches, e-stops, etc.)

- **We do not normally bypass safety elements (interlocks, sensors, limit switches, e-stops, alarms, etc.)**
- **If this Must be done:**
  - First consult the Mountain Manager for approval, and
  - Follow LBT’s “Bypass Procedure for Safety Interlocks and E-Stops” (M004s00017)
- The purpose of the procedure is to ensure changes to critical safety elements are communicated and get returned to their proper safe operating configuration.
- This procedure requires:
  - Management notification
  - Email to telescopework@lbto.org
  - IssueTrak creation (Issue type = Safety/Bypass Interlock, Priority=Critical)
  - Tagging of the bypass (with a tag)
  - Removing bypass and returning equipment to normal operating state, with manager review.

Plan Ahead! Unsure? Ask...