WORK PLANNING & CONTROL (WPC)

PROJECT:

COLTRIMS-GUEST

ACTIVITIES:

Compressed Gas – Gas Jet

Computer Analysis

Cryogenics – Cold Traps
Cryogenics – Low Pressure Systems

De/Pressurized Systems – Vacuum Chamber

Electric: High Voltage/Low Current
Electric: Low Voltage/High Current
Electric: In Vacuum Devices

Hazardous Materials/Chemicals

Heavy Lifting: Ergonomics

Incoming Laser Light

Magnetism: High Fields

Miscellaneous Laboratory Work

Seismic Safety

Thermal: Heater Tapes

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Compressed Hazardous Gases in a Gas Target**
Number	**CH-0026**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Operating the target gas manifold

Compressed Hazardous Gases in a Gas Target

Introduction

The gas manifold is a complex device outside of the vacuum chamber. Its purpose is to supply the target gas to the source chamber section of the endstation where the actual experiments take place. The target gas is supplied by the gas manifold to a small nozzle (5 to 100 microns in diameter) with high fore-pressure (1 to 800psi) in order to form a supersonic jet in an adiabatic expansion (internal target density translates to ~1E-5mbar with a flow of ~80sccm). The system is classified as a High Hazard Pressure System in accordance with PUB 3000, chapter 7, Work Process D.

The gas manifold consists of two separate gas preparation sections at the outside of the endstation:

1. A gas-to-gas manifold with three separate inputs for pressurized gas cylinders.
2. A liquid-to-gas manifold with one heated reservoir (150ml, rated up to 5000psi; see “LiquidManifoldReservoir” in the "Upload Files" section) which transforms liquids to the gas phase. There is also an option to bubble through carrier gases.

Both sections feed the same input to the source chamber. Depending on the desired target (lockable) valves help to select the appropriate gas preparation section.

Note: Before assembly/disassembly of any components of the gas manifold system all pressure sources have to be eliminated. This means that the gas bottles have to be closed and disconnected and the liquid reservoir is cold and drained safely. Before opening any lines the residual pressure must be drained to the exhaust and the lines shall be pumped out. In case of toxic gases close of the gas bottle, drain the lines safely first, then disconnect the bottle in the gas cabinet ! In doing so no formal LOTO procedure is needed in accordance with PUB 3000, chapter 7, Appendix F.

1) Description of Hazard

The primary hazard in this setup is the accidental release of the supply gas for the experimental gas jet into the room. There are three possible release scenarios: leaks from the gas jet supply lines and manifold, leaks from the vacuum system pump exhaust, or release from the overpressure valve at the endstation and rupture disc at the liquid-to-gas manifold. A file listing commonly used gases in the COLTRIMS experiments and their hazard analysis for components is available in the "Upload Files" section of this activity (“List_of_Gases_and_Hazards”). Moreover, an overview of NFPA rated gases is provided (“HazardousGases”).

Secondary hazards are:

The gas-to-gas manifold system allows connecting up to 3 gas cylinders at the same time to the supersonic gas jet of the COLTRIMS apparatus. The objective is to make switching between the different gases easy and quick. An inadvertent mixing of gases in the gas-to-gas manifold that can produce hazardous (e.g. explosive, corrosive) mixes must be avoided. Special locking valves are provided to prevent the inadvertent mixing of gases in the manifold (see “Gas_Manifold_Sketch” and “COLTRIMSGasManifold” in the “Upload Files” of this activity).

In the liquid-to-gas manifold a 150ml reservoir is heated in order to transform liquids into the gas phase. This could explode in case of extreme temperatures or a clogged nozzle in the source chamber of the endstation. A rupture disc, which will open at ~1200 psi, is

connected to the reservoir to prevent such an explosion followed by accidental release of target gas/liquid into the room (all other components are rated for >2000psi). In case the rupture discs breaks, the gas is released into an evacuated cylinder, which is rated for <4000psi (see “liquid_to_gas_manifold” in the “Upload Files” of this activity). Moreover, the heating will be turned off by the control unit if the max. temperature (175deg C) is exceeded or the temperature sensor is off or shortened out for longer than 10 minutes. Naturally, heating comes with hot surfaces and components and could cause injuries.

2) Controls

a) Mitigation of Hazards

The experimental gas jet will primarily be operated using non-hazardous gases. In this case, no special hazard mitigation beyond standard safe gas handling procedures will be necessary.

The source chamber is equipped with an overpressure valve and will open when 3 psi are exceeded. To accommodate hazardous (e.g. toxic) gases as well, the output of the over-pressure valve is connected to a hose which shall be connected to the building exhaust.

Both manifolds, i.e. the gas-to-gas as well as the liquid-to-gas manifold, shall be leak tested before hazardous gases or liquids are supplied. For this the respective manifold has to be pumped down to a vacuum pressure below 1E-1Torr. Once this pressure is reached, the vacuum pump valve at the manifold has to be closed; the pressure must not rise above 1Torr for 3 minutes. In case it does, the leaks have to be fixed and a new test has to be conducted.

For the gas-to-gas manifold an administrative (lockout) procedure called “COLTRIMSGasManifold”, which is available in the "Upload Files" section of this activity, is in place to avoid mixing of incompatible gases and minimize accidental release of hazardous gas into the environment. If hazardous (toxic or flammable) gases are used, the following mitigation procedures must be followed:

1. Gas supply:

The preferred approach will be to use the minimum size gas cylinder necessary for the experiment. Gas cylinders with sufficiently small volume may be used without a gas cabinet, as long as the total used gas volume is below the limits allowed for the used gas. This reduces the maximum possible exposed gas volume. If larger gas cylinders are used, a gas cabinet will be used to contain the cylinders. The cabinets will be vented to the building exhaust. The gas line from the gas cabinet to the gas jet input must be leak checked before use, and kept to a minimum practicable length.

2. Gas exhaust:

Exhaust lines from pumps connected to the vacuum system will be vented to the building exhaust. The gas pressure in the vacuum system will be periodically checked for system integrity.

For the liquid-to-gas manifold it is important to evacuate the cylinder into which the gas can expand once the rupture disc opens before operation starts. Proper preparation and operation is delineated in the procedure called “liquid-to-gas-manifold_PIDcontrols” in the “Upload Files” of this activity. Burns are mitigated by a thick layer of insulation over the heated parts. **Note:** Do not fill liquids into a hot reservoir!

Get On-the-Job-Training before first use. More details on the OJT can be found in the OJT section of this activity.

b) Personal Protective Equipment (PPE)
Standard PPE must be used, as mandated at the entrance to the laboratory or experimental area of the Advanced Light Source (ALS).

c) Hazardous Material Handling
The gas cylinders with hazardous gases will only be opened after proper secure mounting (in best case: two chains and two straps), and connection to a leak checked gas line system (incl. manifold). All gases will be handled using safe gas handling procedures. Used gas cylinders will be returned to the vendor, if possible. Contact EHS for proper disposal procedures if you have cylinders, which contain hazardous gases and are non-returnable.
Hazardous liquids will only be transferred via the supplied syringe, which will be filled and emptied in a fume hood. Residues of hazardous liquids on the syringe walls are <50 micro liters; important properties like health hazard levels (i.e. Lethal Dose LD or Lethal Concentration LC), flash points, incompatibilities, auto ignition temperatures need to checked before filling and using the syringe. The reservoir with a hazard liquid inside will either be emptied by venting the gas to the building exhaust till all liquid is gone or re-transferred via the syringe to the fume-hood before it is opened for cleaning purposes (see the procedure “liquid-to-gas-manifold_PIDcontrols” in the “Upload Files” of this activity). Note that hazards liquids can form when bubbling gases through harmless liquids (e.g. running ammonia through water forms corrosive ammonium hydroxide) !

3) Emergency Procedures
Call 7911 or 911 in case of any serious injury.

4) Maintenance
All high pressure lines, vacuum components and pumps shall be visually inspected for obvious damage (such as kinks and holes or loose or open connections etc.) before pumping down or pressurizing the system after moving or changing the equipment or any long breaks in operation. Make sure not to tamper with the gas-to-gas manifold when the gas bottles are attached to the gas inlets. **Note:** only locking the valves is not sufficient – the gas lines have to be properly vented and the bottles have to be detached if any changes need to be made to the manifold (for explanation see “COLTRIMS_Gas_Manfiold” in the “Upload Files” of this activity). In case toxic or hazardous gases are used make sure to disconnect the line(s) in the gas cabinet first!. Make sure the insulation of any hot surfaces on the liquid-to-gas manifold stays intact (inspect visually before starting the heating process).

5) Waste
When hazardous gases or liquids are used, all forepumps exhausts and the manifold outlet must be connected to the building exhaust. Any hazardous liquids must be properly stored and handled in the fume-hood. Ask your supervisor or work lead how to dispose of any waste.

6) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

7) Waste

In case waste is produced please approach your work lead or supervisor for transfer to a Satellite Accumulation Area (SAA).

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Computer Analysis**
Number	**CH-0037**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2, offices
Date	March 2015

Brief Description:

Analyzing data offline with a Personal Computer

Computer Analysis

1) Description of Hazard

The analysis of the extensive amount of data during the experiments requires an intricate sorting and cleaning in an offline-analysis at a personal computer. The experiment is re-run hundreds of time under different software conditions in a C++ or Fortran code. Such an analysis takes 6 to 15 months requiring 6 to 8 hours work days in front of the computer. Ergonomic hazards such as strained wrists, backaches, fatigue or pain of the shoulder and neck area can be the result of infrequent breaks or a wrong computer desk setup resulting in a false posture.

2) Controls

a) Mitigation of Hazards

Adequate office desk and chairs which can be adjusted to the height and needs of the person analyzing the data as well as the right computer equipment such as ergonomically formed mice, keyboards, wrist pads or monitor stands and supports help to enable the right posture. Moreover software (RSI guard) from the LBNL software website can be installed to trigger frequent breaks and small exercises to stretch or walk (e.g., 5 minute breaks each hour, or more often if fatigue is felt). An evaluation by a LBNL ergonomic specialist or an ergo advocate is recommended. It is important to be proactive, i.e. to act before problems occur and even small aches should not be ignored but reported to the supervisor to prevent chronic injuries. Use neutral postures: straight wrist, arms/elbows at sides, and head/neck balanced over shoulders. Use keyboard shortcuts, alternate hands, and/or use alternate pointing devices to minimize mouse repetition. Adjust chair, keyboard/mouse and monitor settings to avoid awkward postures. Arrange tools for easy reach.

b) Personal Protective Equipment (PPE)

Seek out computer equipment that fit your needs. Contact the LBNL ergonomist or the ergo advocate(s) of your division for advice and to try out equipment and furniture.

3) Emergency Procedures

In case of any pain stop the work. See the health personnel in building 26. Contact your supervisor and the LBNL ergonomists.

4) Maintenance

With time your ergonomic needs may change. Test out new equipment and furniture if needed. Check your current furniture and equipment for full functionality and repair or replace what does not work for you anymore. Ergo software updates may be available.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Cryogenics Usage – Cold Traps**
Number	**CH-0030**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Filling cold traps using non-pressurized dewars

Cryogenics Usage - Cold Traps

1) Description of Hazard

In order to improve the vacuum in the target chamber a cold trap (approx. 4 liters liquid N_2) is implemented in the chamber lid (see "COLTRIMS_Sketch" in the "Upload Files" of this ACTIVITY). A factor of 3 less in residual gas pressure can be expected by filling the trap with liquid nitrogen.

A second trap (approx. 1.2 liters) is used to pre-cool the supersonic gas jet by cooling the nozzle (not shown in the sketch). The same precautions and instructions as to the chamber cold trap apply (see below).

2) Controls

a) Mitigation of Hazards

LBNL cryogenic safety protocols, as per Pub 3000, will be followed. Do not overfill the trap and cover it with the supplied Plexiglas lid once it is full. In the event the trap needs to be emptied, use the available vacuum cleaner with a Dewar vessel and LN_2 approved and insulated Teflon hose (location: lab 2-102). Do not touch the metal suction spout when the hose is removed (note: it will be on LN_2 temperature, i.e. 80K). To avoid spills and splashes, do not apply any pressurized or warm air to the cold trap or stick in any warm or hot materials (such as copper pipes or stainless steal hoses etc.), while liquid nitrogen is still in the trap.

Since the volume of the trap for the supersonic gas jet is rather small, it is advised to fill the reservoir slowly and in subsequent steps when it is warm; this will avoid splashes and spills.

b) Personal Protective Equipment (PPE)

As a general rule, operators shall wear protective eyewear with side shields (or goggles) when working with cryogens. A face shield is optional when filling the traps. A face shield and gloves must be worn over the safety glasses or goggles when filling a Dewar at a pressurized cryogenic source tank. Always wear closed toed shoes and long pants.

3) Emergency Procedures

Call 7911 or 911 in case of any serious injury.

4) Maintenance

The Dewar vessels are inspected regularly for any damage or leaks; the Personal Protective Equipment is inspected regularly for damage and wear and tear.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Cryogenics Usage – Low Pressure Systems**
Number	**CH-0166**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	January 2016

Brief Description:

Using low-pressurized LN2 storage tanks and transfer lines

Cryogenics Usage – Low Pressure Systems

Introduction

Liquid Nitrogen (LN2) is often used to cool down critical components of an experimental setup. In this case for instance, LN2 is used to cool the oscillator and amplifier Yb:YAG crystals of the two-stage amplification system of a laser. The cooling has to be maintained for the duration of operation of the laser and hence requires and automatic low pressure LN2 refill system. The LN2 refill system setup uses a Teragon LN2 level controller, with a flow reduction valve, and a 10-PSI pressure relief valve to deliver LN2 at controlled rates to each of the two crystals independently. This is a closed system which is fed by a large low-pressure LN2 storage tank that is connected to the crystals via a transfer line manifold.

1) Description of Hazard

There are three major hazards to keep in mind when dealing with LN2:

- Thermal burns due to extreme cold temperatures: Contact with cryogenic liquid, its boil-off gases, or components cooled to these low temperatures can readily cause frostbite or cryogenic burns.
- Oxygen Deficiency (suffocation/asphyxiation): Cryogenic fluids have large liquid-to-gas expansion ratios (e.g. LN2 is approximately 680 to 1). These ratios mean that any accidental release or overflow of these cryogenic liquids will quickly boil into gas and may create an asphyxiation hazard by displacing the oxygen content of the surrounding area.
- High Pressure caused by warming of cryogenic liquids: Cryogenic fluids confined and allowed to warm can generate very high pressures. LN2 confined and allowed to warm to room temperature will generate a nominal pressure of 10,200 psig.

2) Controls

a) Mitigation of Hazards

Avoid accidental releases (or overflows) of LN2 which can present hazards and cause property damage, as noted in the hazards discussed above. The most frequent cause of accidental release is inadequate on-the-job training using the low-pressure LN2 storage tank and connecting it to the transfer lines (for an OJT see the files “LN2_low-pressure_OJT” explaining the general handling of the LN2 vessel and “Instructions_LN2_System_YbYAG-Laser” on how to connect the low-pressure LN2 system of the Laser in the upload section of this activity). Make sure to only use low-pressure LN2 storage tanks where the pressure relief is set at 22 psig.

Avoid touching any cold components, e.g. valves and fittings which show any signs of frosting.

Avoid tipping the storage tank. LN2 storage tanks may be accidentally tipped over when crossing obstructions, such as door thresholds. To avoid this

- handle tanks with appropriate care.
- ensure floor surfaces are free of obstructions and appropriate for moving tanks.
- ensure all parts of the tank (wheels, handles, etc.) are in proper functioning condition.
- secure the tank to a wall or appropriate stand at the experiment.

Filling the low-pressure LN2 tank should only be done in a well ventilated area (outside at the ALS LN2 filling station) to avoid asphyxiation.

b) Personal Protective Equipment (PPE)

As a general rule, operators shall wear protective eyewear with side shields (or goggles) when working with cryogens. Cryogen gloves and a lab coat must be used and a face shield and must be worn over the safety glasses or goggles when filling the low-pressure LN2 storage vessel at a pressurized cryogenic source tank and connecting it to the transfer line system (when the latter is still cold). Always wear closed toed shoes and long pants. The release of nitrogen gas during refilling of the low-pressure LN2 tank is particularly loud, so ear protection may be used as well. When opening the tank for the first time, cryogloves, a lab coat, safety glasses and a face shield are worn. If the connection is deemed to be good, then subsequent openings of the tank valve can be performed using only cryogloves and safety glasses. The fittings on the tank become exceptionally cold, so care must be taken whilst attaching or detaching tubing from them. The low-pressure LN2 vessel is heavy and cumbersome to move around: Use sturdy shoes and consider loose leather gloves when moving the LN2 tank.

3) Emergency Procedures

Call 7911 or 911 and the ALS control room x4969 in case of any serious injury.

4) Maintenance

Keep containers for cryogenic liquids clean and free of contamination from fuels, oils, and greases as this increases the risk of fires (caused by the oxygen enrichment combined with a fuel source). The Dewar vessels are inspected regularly for any damage or leaks; the Personal Protective Equipment is inspected regularly for damage and wear and tear.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**De/Pressurized System – Vacuum Chamber**
Number	**CH-0025**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Pumping down the vacuum chamber

De/Pressurized System – Vacuum chamber

1) Description of Hazard

In order to perform the experiments, the COLTRIMS setup has to be evacuated. Three main parts of the main chamber, i.e. the source chamber, the second stage, and the target chamber have to be pumped down and evacuated simultaneously. Pressure differences have to be balanced.

2) Controls

a) Mitigation of Hazards

The different sections of the setup are connected via bypasses (see "COLTRIMS_Sketch" in "Upload Files" of this Activity). These bypasses shall be opened during the pumpdown and venting phase in order to handle pressure differences between the three different sections of the setup and protect the skimmer and the small aperture of the gas jet system from damage. The 4 viewports of the apparatus, which may implode in the event of any damage or failure, while the chamber is under vacuum, shall be covered with separate protective quartz or plexi glass windows whenever possible.

If the gas supply lines of the supersonic jet fail or leak inside the chamber, the setup may experience excess inflow of gas from the gas cylinders. The excess gas flow rate is low enough so that it can be pumped out by the system vacuum pumps. In addition, a pressure relief valve is mounted on the source chamber in order to prevent over pressurizing the apparatus. Also, in order to completely exclude over pressure excursions from happening, the lid is only loosely mounted to the chamber flange while the gas jet is on. The exhaust line to the pressure relief valve shall not be disconnected during use of the gas jet. The vacuum chamber is hence classified as a Category II system according to PUB 3000, chapter 7, Work Process E: Vacuum systems.

Get On-the-Job-Training before first use. More details can be found in the OJT section of this activity.

b) Personal Protective Equipment (PPE)

No personal protective equipment beyond standard PPE, as mandated at the entrance to the laboratory or experimental ALS area, is required.

3) Emergency Procedures

Call 7911 or 911 in case of any serious injury.

4) Maintenance

All vacuum components and pumps shall be visually inspected for obvious damage (such as kinks and holes etc.) before pumping down the system after moving or changing the equipment or any long breaks in operation.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Electrical – High Voltage/Low Current (>50V and <5mA)**
Number	**CH-0023**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Operating detector electronics

Electrical - High Voltage / Low Current (>50V and <5mA)

1) Description of Hazard

The detectors and the spectrometer are supplied with high voltage (up to 4kV) via home-made decoupling boxes and voltage dividers. High voltage and low current electric power supplies (output: 4kVDC, 3mA) are used to operate the setup. Some of the home made boxes have small capacitors (<100 micro Farad) inside.

2) Controls

a) Mitigation of Hazards

High voltage exposed elements are shielded by the vacuum chamber (spectrometer) or the encasing (voltage divider, decoupling box) and cannot be reached in operation. The chamber frame as well as every single box needs to be grounded with extra cables before use. During operation the electronic boxes must be closed. No voltage higher than 4kV shall be applied. Whenever possible only SHV-SHV, BNC-BNC, and LEMO-LEMO cables are used. However, sometimes adapter cables such as SHV-BNC etc. cannot be avoided. In this case the cable must only be used according to the connector with the lowest voltage and current rating (1. LEMO, 2. BNC, 3. SHV, SHV-B, etc.). In case such an adapter cables is connected to a power supply a sign on the front panel of the supply must state to limit the power according to the lowest current and voltage rating of the cable (e.g. “do not exceed 50V”). In case of any queries do not hesitate to contact the electrical safety officer before using the equipment.

b) Personal Protective Equipment (PPE)

No special personal protective measures are necessary for protection. Wear the standard lab PPE (Personal Protective Equipment), as listed at the lab entrance. For soldering work the use of a fan to deflect hazardous fumes is recommended. Lead based solder has to be handled with gloves. Safety glasses or goggles must be worn. See “Safe_Soldering” in the "Upload Files" of this ACTIVITY.

3) Emergency Procedures

Turning the high voltage power supplies off eliminates any hazards.

4) Maintenance

To ensure a safe setup, operation and maintenance follow these guidelines:

Labeling: Label the in- and outputs of the boxes. It is recommended to put drawings or descriptions on the outside to inform you co-workers about the components inside the box. Mark special adapter cables clearly to avoid overloads.

Grounding: For metal encasings an extra grounding connection has to be provided which will prevent the box from charging up even if the signal cables have faulty shieldings. Ground the box before energizing it. Alternatively a plastic box may be used. Make sure that no potentiometers or switches which are on high voltage can be directly touched (plastic knobs for a safe operation need to be installed then).

De-energize: Before opening the box turn off the power supplies and disconnect the cables. Wait one minute for the small capacitors to be drained. In case capacitors are

connected in a chain-fashion ground them individually using a grounding connector at each appropriate socket before working on the components inside.
Spark testing: If maintenance or repair is needed, a visual spark test may be necessary. In this case define and close off a test area, where high voltage can be applied safely, while the box is open and grounded or the spectrometer and the detectors are accessible. Perform the spark test with a collaborator and keep a distance of 1 m (or 3 feet), while voltage is applied. Consider putting a transparent plastic plate on the box. Turn off the power supplies and disconnect the cables before touching the components.
Spark gaps: No MHV connectors shall be used (because they can be mixed up with BNC). Instead of adapter cables it is recommended to build adapter boxes with spark gaps (<70V) inside if possible to prevent high voltages to be accidentally supplied to BNC or LEMO lines. The adapter box must have an additional grounding connector/cable.
When in doubt: Present the boxes to an LBNL electrical safety manager or electrical liaison for inspection.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Electrical – Low Voltage/High Current (<50V and >5mA)**
Number	**CH-0027**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Operating high power supplies and bench top power supplies

Electrical - Low Voltage / High Current (<50V and >5mA)

1) Description of Hazard

I) The Helmholtz Coils are supplied with low voltage but high current. They are operated from a low voltage, high current power supply (output 30VDC, 300A).

II) Two small sets of Helmholtz coils (a.k.a. rainbow coils) are mounted vertically and horizontally to compensate the earth magnetic field. They are supplied with low power by using a low voltage, medium current power supply (output: 30VDC, 3A). A Rainbow Coil set is made from computer data cable. The special connection of the 50 x AWG 28 cables results in 2 parallel coil pairs. Each pair is connected in series. The vertically and horizontally orientated coils have an overall resistance of 12 Ohm per direction. Thus the equivalent circuit represents 2 AWG 22 coils in series, i.e., 1 Helmholtz coil pair, for each direction (horizontally and vertically).

2) Controls

a) Mitigation of Hazards

I) The Helmholtz Coils connectors are protected from contact and electric shortening by a plastic cover. Do not remove this cover while the coils are operating. Turn on the cooling water before electric power is applied to the coils. Do not tamper with the flow controller and the temperature sensor. They protect the system from overheating and electric shortening due to water leaks at the connection of the coils to the cooling waterline. Do not block the power supply fans and air outlets. Otherwise the supply will overheat and malfunction. If possible, use cable bridges to isolate the bulky AC connection cable, and to prevent trip and fall incidents. The home-made Helmholtz Coils were presented to and inspected by the LBNL electrical safety Manager Keith Gershon; in case of any queries do not hesitate to contact him before you use the equipment.

II) Operation with a laboratory DC power supply (30 VDC, 3 Amps) will meet the current limits of the AWG 22 coils. Do not apply any voltage higher than 30 VDC.

b) Personal Protective Equipment (PPE)

No personal protective equipment beyond standard PPE, as mandated at the entrance to the laboratory or experimental ALS area, is required.

3) Emergency Procedures

Turning the power supply off eliminates any hazards.

4) Maintenance

I) In the event of malfunction, the power supply has to be repaired by trained technicians only. Maintenance of the connection of the cables to the Helmholtz Coils or repair of the flow controller or temperature sensor can be done when the power supply is disconnected from the coils; turn off the power supply first. The cover must be reinstalled before turning on power again.

II) Disconnect the rainbow coils from the power supply before any maintenance work.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Electrical – in Vacuum Devices**
Number	**CH-0164**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	December 2015

Brief Description:

Operation and maintenance of Ion Gauges, Mass Spectrometers, Discharge Sources (lamps, penning traps, ion pumps), Sample Heaters, (Pico)Motors, Detectors and Spectrometers mounted inside a vacuum chamber

Electrical – in Vacuum Devices

Introduction:

Ion gauges or (sample) heater wires are sometimes operated over 50 Volts and often require currents exceeding 5 mA during operation. In cases where the ion gauge or heater wire is capsuled (i.e. set up behind a mesh or placed in a cartridge), or can be mounted recessed in the vacuum chamber so that it is inaccessible, it is safe to open the chamber. Here, inaccessible is defined as a position or condition where a single finger (3.5 in or 9 cm long) cannot reach any bare electrified components. In cases where these requirements cannot be met, the in-vacuum device is declared “a potentially hazardous accessible electrical device”, and the procedure below has to be followed.

Sometimes the filaments of ion gauges or the ion gauge itself or the heater wire need to be replaced. This is safe to do if the ion gauge or heater is de-energized and cannot be re-energized accidentally while the replacement or installation is ongoing. Follow the steps outlined below to avoid injuries.

The same rules apply for Mass Spectrometers, (Plasma) Discharge Sources (lamps, penning traps, ion pumps), (Pico)Motors, Detectors and Spectrometers inside the vacuum chamber that are connected to power supplies exceeding AC: ≥ 50 V & ≥ 5 mA or DC: ≥ 100 V & ≥ 40 mA or have stored energy in form of capacities: ≥ 100 V & ≥ 1 J, or ≥ 400 V and ≥ 0.25 J and which have bare electrical components that could be touched when opening the chamber. Consult the manufacturer’s manual to find out about the voltages and currents of the power supplies and any in-vacuum capacitors or capacitors in boxes connected to the vessel.

In some cases flanges to accessible devices can be (temporarily) covered or insulating covers can be manufactured and (temporarily) installed by the user to render the in-vacuum device inaccessible. If, after installing the cover(s), there are still one or more potentially hazardous electrical devices accessible in the same to be opened section of the vacuum vessel which cannot be controlled with an administrative cord & plug procedure (see “ACP procedure” in the upload files), do not proceed; a specific Lock-Out/Tag-Out (LOTO) procedure (developed for the respective vacuum chamber; not provided here) has to be followed and official LOTO training and equipment is then required (not covered by this activity). When in doubt do not proceed but contact the work lead to gather information about accessible electrical devices inside the vessel.

1) Description of Hazard

Some components of an in-vacuum device may be energized when it is connected to the control unit or power supply (even if those devices are turned off) or may have stored energy in form of capacitors. In case these components can be touched, electrical shock to the worker (as well as burns) may occur.

2) Controls

a) Mitigation of Hazards

1 – Assessment:

Identify the power sources and their properties connected to or inside the section of the vacuum vessel to be opened. Count all power supplies and power sources that cross the hazard threshold AC: ≥ 50 V & ≥ 5 mA or DC: ≥ 100 V & ≥ 40 mA as well as capacitors

(in-vacuum and outside the vessel): ≥ 100 V & ≥ 1 J, or ≥ 400 V and ≥ 0.25 J AND which are connected to an accessible in-vacuum device once work in the open vessel commences (e.g. a recessed ion gauge or a device with a temporary cover, installed at the time the chamber is opened, which cannot be reached does not count). Contact the work lead or supervisor to find out about the number and location of power sources and accessible in-vacuum devices. An example for an assessment is given at the end of this activity.

- If the number of power supplies is 0 you can proceed without any precautions.
- If the number of power supplies is ≥ 1 you may proceed in accordance with the Administrative Cord and Plug (ACP) procedure (see “ACP procedure” on the upload files). Consult the ACP-procedure to assess if you are allowed and trained to go forward and/or can eliminate any shock hazard by controlling cord & plug of the power source(s). If the assessment allows you to proceed follow the steps below.

2 – Control the Power Source:

- Turn down the power supply(s) before venting the chamber. Wait for one minute for any in-vacuum capacitor to discharge before proceeding.
- In case components of the in-vacuum device can be touched, either during installation, opening the vacuum chamber, or a maintenance process such as filament replacement, the in-vacuum device needs to be disconnected from its power source. This can either happen by unplugging the cable(s) at the vacuum flange or at the controller or by disconnecting the controller or power supply from its power source. Make sure the cable or power cord cannot be plugged in accidentally (e.g. unplug the power cord from the device, attach a plug-control box, or control otherwise). Cables connected to devices (active or passive) containing capacitors must also be unplugged from the chamber and controlled.
- Now open the chamber.

Note: Some (old) ion gauges have a pin-by-pin cable connection at the vacuum flange instead of a connector and hence may have exposed contacts. These pins shall only be connected if the connector at the vacuum gauge controller can be clearly identified, disconnected and controlled first. If this is not possible a QEW needs to be contacted to connect or disconnect the ion gauge pin-by-pin cable.

In case the filament or the in-vacuum device needs to replaced or installed elsewhere, disconnect the in-vacuum device from its power source as described above and follow the instructions of the manufacturer to replace like-for-like components. After completion of the repair and reinstallation make sure the in-vacuum device is touch safe before it is re-energized, i.e. it either has to be mounted recessed, re-capsuled, with insulated wires or contacts, or enough ports of the vessel have to be closed so that touching of any potentially hazardous electrical device is prevented. (Plastic) Flange covers may be used to prevent reaching into the chamber.

The knowledge of the potential electrical in-vacuum hazards and the procedure on how to work safely make you a Qualified Electrical Worker–Vacuum (QEW-V) for this particular section of the vacuum vessel.

b) Personal Protective Equipment (PPE)

Wear safety glasses with side shields or goggles when installing or repairing the in-vacuum device.

3) Emergency Procedures
Call 7911 or 911 in case of any serious injury.

4) Maintenance
If existent make sure the controller chassis of the in-vacuum device(s) stay grounded at all times.

5) Training & Base of Knowledge needed
Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

Example for Assessment:
COLTRIMS – Endstation: Main experimental Chamber

Type	Model	Specs	Quantity	Potential Haz. In-Vac. Device
Recessed Ion Gauge	Granville Philipps Controller 250	110 VAC & 10 mA	1	No (since recessed)
Spectrometer power supplies	SRS PS 325	2500 VDC & 10 mA	2	No (below threshold)
Detector power supplies	ISEWG NHQ 240	4000 VDC & 3 mA	2	No (below threshold)
Pico motor Controller	New Focus 8742	130VDC & 500mA	1	Yes
Detector capacitors (in-vacuum)	Newark	4000 VDC & 5nF $W = \frac{1}{2} F V^2 =$ 0.08 J	2	No (below threshold)

Total Number of potential electrical hazardous in-vacuum devices = 1
The Pico Motor controller can be easily disconnected from the vacuum flange and the cord can be controlled in various ways. Hence, no LOTO procedure is needed.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Hazardous Chemicals and Materials**
Number	**CH-0041**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Handling solvents for cleaning and other hazardous materials (glue, solder, lead, etc.)

Hazardous Chemicals and Materials

1) Description of Hazard

The inside of the vacuum system, flanges and several components (spectrometer, detector etc.) that go in vacuum have to be cleaned with solvents such as Isopropanol, Ethanol, and Acetone for instance. These liquids are flammable and some of them are carcinogenic. Sometimes metal cleaners need to be used. Other hazardous materials you may get in contact with are glues, lead, machine oil, solder and indium.

2) Controls

a) Mitigation of Hazards

Do not drink or inhale the solvents – do not touch your face or open wounds after handling hazardous materials. Use as little chemicals or materials as possible. Put generated waste into the Satellite Accumulation Area (SAA) of your lab (do not drain them in the sink!) and inform your waste generator manager.

b) Personal Protective Equipment (PPE)

Long pants, lab coat & resistant gloves must be worn when handling chemicals >0.5l or special or toxic chemicals of any amount. Additional PPE may be required. For help: consult the Material Safety and Data Sheets (MSDS) & PUB3000 or any other task specific procedure (e.g. OJT)

3) Emergency Procedures

Call 7911 or 911 in case of any serious injury. See the health personnel in building 26 for minor injuries. Inform your supervisor.

4) Maintenance

Order as little chemicals and materials as needed – try to avoid overstocking; check your inventory list. Discard old chemicals which are of no use anymore.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Heavy Lifting – Ergonomics**
Number	**CH-0032**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Working with heavy objects in the laboratory

Heavy Lifting – Ergonomics

1) Description of Hazard

The COLTRIMS apparatus is a transportable setup and is under constant development and use. This means heavy components and equipment such as flanges, lead bricks, pumps, and gas cylinders etc. have to be moved and mounted frequently.

2) Controls

a) Mitigation of Hazards

Worksmart Ergonomics training (EHS0062) is required. The use of lab jacks, supporting blocks and frames, carts and pallet jacks to lift and transport equipment is advised. Gas cylinders (>4 liters) have to be transported strapped to dedicated gas cylinder carts, with the pressure regulator unmounted and the protective cap screwed onto the gas cylinder. The chamber is on wheels and can be moved that way; however it is highly recommended to use a pallet jack to transport the setup from building 2 to the ALS and vice versa. Before transportation make sure the chamber feet are up all the way. In general, be sure you understand the load - assess its weight, size and balance. Get assistance with lifting heavy and/or awkward loads. Assure a clear path when moving loads.

b) Personal Protective Equipment (PPE)

No personal protective equipment beyond standard PPE, as mandated at the entrance to the laboratory or experimental ALS area, is required. However additional personal protective equipment such as sturdy work gloves and steel toed shoes are recommended.

3) Emergency Procedures

Call 7911 or 911 in case of any serious injury.

4) Maintenance

Inspect (gas cylinder) carts, pallet jacks, lab jacks etc. before using them.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Incoming Laser Light**
Number	**CH-0048**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Dealing with laser light being routed into the experiment

Incoming Laser Light

1) Description of Hazard

Infrared laser light and/or high harmonic laser light travels together with the fundamental through (vacuum) pipes to the endstation often with enclosed diagnostic or mirror stages in between. Moderate and high-power lasers are potentially hazardous because the direct beam and reflections from tools and workspace surfaces can burn the retina of the eye, or even the skin. There are several covers and viewports installed where it is possible to manipulate mirrors, indirectly observe irises in the beam path or where the beam itself could exit the pipes or endstation. Theses sections are either directly covered with a non-transparent lid or a beam block or a non-transparent box is installed around a camera or other analysis tools that prevents the beam from exiting. As long as these covers are on the beam cannot harm the operator. In some cases a beam path exists where the beam is limited to a well-defined region by optics, in which case an enclosure is required that prevents accidental intrusion in the beam path by a worker's hand or tools.

2) Controls

a) Mitigation of Hazards

All safety controls described in the LASER WPC project need to be followed. Under no circumstances the laser beam is to be viewed directly. The beam mode is to be observed by means of cameras, special viewers, or a card. When an operator wishes to remove the covers on the viewport flanges or optic boxes or reroute the piping, s/he has to follow the rules for changing laser modes described in the LASER WPC project; appropriate PPE has to be worn and appropriate barriers such as curtains or beam blocking barriers have to be installed and closed to contain the beam. The PPE and shields have to be chosen according to the laser class based on the power and wavelength (classes 1, 1M, 2, 2M, 3R, 3B, 4). Communicate your intentions to others present at all times e.g., before opening/closing shutters, removing beam blocks, or other actions that might put others (unintentionally) at risk.

The laser use area must be posted with an approved warning sign(s) that indicates the nature of the hazard. In the event of unattended operation of a Class 3B or Class 4 laser system the following controls shall be in place: a "NOTICE" sign shall be posted outside the laboratory which states that an unattended laser operation is underway.

Pay attention to housekeeping, making sure the immediate work area/bench top/optical table is free from opportunistic specular reflectors not needed. Your eye level should avoid the laser beam path/plane/height as much as possible (e.g. adjust the chair height of your work station).

b) Personal Protective Equipment (PPE)

Proper laser protective eye wear must be worn by all persons within the lab according to the mode of operation ("IR", "alignment": see LASER WPC). In case the laser is off or the laser beam is fully enclosed safety glasses with side shields or goggles ("class 1") have to be worn as required by the specific lab PPE safety regulations (see entrance placards of the respective lab).

3) Emergency Procedures

Call 7911 or 911 in case of any serious injury.

4) Maintenance

The protective eyewear shall be stored in such a manner as to protect its physical integrity. Laser eye protection shall be inspected prior to each use to ensure that it is in good condition. All flange or box covers, beam blocks, shields as well as curtains need to be inspected for physical integrity periodically.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Magnetism – High Fields**
Number	**CH-0029**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Generation of static magnetic field with Helmholtz-Coils

Magnetism - High Fields

1) Description of Hazard
The Helmholtz Coils can generate an up to 40 Gauss magnetic field. State of the art pace makers should not be affected by a constant magnetic field, however caution should be exercised with older models (<1970). However, the magnetic field might be strong enough to erase data on credit or debit cards and affect other magnetic strip cards such as bus and subway tickets (BART). It can also damage your watch or computer monitor. Please see the **"Appendix: Magnetic Field Hazards"** to get detailed information about the harmful effects of magnetic fields.
The Rainbow Coils can generate a magnetic field up to 1 Gauss and are thus harmless.

2) Controls
a) Mitigation of Hazards
The magnetic field will be measured by an ALS safety officer prior to the start of an experiment. From this measurement the nominal hazard distance (5 Gauss demarcation line) will be determined and marked off.

b) Personal Protective Equipment
No personal protective equipment beyond standard PPE, as mandated at the entrance to the laboratory or experimental ALS area, is required.

3) Emergency Procedures
Turning off the power supply eliminates any hazards.

4) Training
Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

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Appendix: Magnetic Field Hazards

Guidelines for continuous exposure to static electromagnetic fields:
Note: 1 Gauss (G) = 0.1 millitesla (mT)

5 G	Highest allowed field for implanted cardiac pacemakers.
10 G	Watches, credit cards, magnetic tape, computer disks damaged.
30 G	Small ferrous objects present a kinetic energy hazard.
600 G	Allowed TWA for routine exposure (whole body).

6000 G	Allowed TWA for routine exposure (extremities).
20,000 G (2T)	Whole body ceiling limit (no exposure allowed above this limit).
50,000 G (5T)	Extremity ceiling limit (no exposure allowed above this limit).

Note: TWA exposure time is normally only a concern for extremely high field exposures to the whole body.

Explanation: Persons wearing metallic implants, such as bone or articular prostheses, surgical clips, nails or screws in broken bones, body piercing, or even dental fillings may feel painful sensations, if exposed to high magnetic fields. Persons fitted with pace-makers encounter a specific risk as static or pulsed magnetic fields may influence the working order of their pace-makers. Please see the following explanatory notes:

Metal associated with vessels
There is a potential danger of ferromagnetic hardware being displaced by the strong magnetic field. Coronary (heart) stents are MRI safe. Most carotid (neck) vascular clamps are safe at 1.5T (except Poppen-Blaylock clamp) but untested at 3T. Stents become firmly attached to tissues, and are unlikely to move beyond first few months. You can identify the exact device and see if it is listed as safe at http://www.mrisafety.com/

Other metal in the body
Metal bullets/shot/shrapnel in the head or torso should avoid kilogauss exposures. The only exception to this is implanted dental work in place for more than 6 weeks. Longstanding immobile bullets/shot/shrapnel in bones in the limbs are not a contraindication.

Non-removable piercings
We recommend that users should not be exposed to high magnetic fields with piercings in place as there is a small risk of heating, vibration or discomfort. Any unpleasant sensations/adverse reaction (pain, heating, vibration of piercing) must be reported to Health Services.

CSF shunts
Some are programmed magnetically, and will need the unit to be reprogrammed by their doctor after high field exposure

Tattooed eyeliner, tattooed eyebrows or Bigen hair dye
One may feel pain, heating, tactile sensations in the tattoo (and complete a peripheral nerve stimulation form if tactile sensations are experienced). Any unpleasant sensations / adverse reaction must also be reported.

Transdermal delivery patch (e.g. nicotine, contraceptive or medicated pain relief patch)
These may cause local heating. Remove before kilogauss magnetic field exposure.

Hearing aids & dentures (and removable bridge)
Remove before entering a high magnetic field.

Projectile Hazard
A danger frequently encountered comes from loose Ferro-magnetic objects present in a static magnetic field. If the field is strong enough, it will attract such objects from quite a distance and cause them to fly along the field lines towards the magnet. Watch out for any Ferro-magnetic objects you may carry in your pockets. Particularly objects with sharp edges may become dangerous projectiles. The use of Ferro-magnetic objects shall therefore be excluded from any high magnetic field. Non-Ferro-magnetic tools are available commercially.
Dynamic magnetic fields cause induced voltages, and the resulting currents either cause heating of metallic objects or disturbances in the human nervous system.

Controls:
Before you work near or in an area which has a high magnetic field ask yourself and your coworkers the following questions:

For exposure to magnetic fields of several hundred or several kilo Gauss
Absolute contraindications to entering the Magnetic field

- Do you have a heart pacemaker?
- Is there a possibility of metal in your head? (e.g. aneurysm clips, do not include dental work)
- Is there a possibility of metal in your eyes or have you ever needed an eyewash having worked with metals?
- Do you have an implanted medical device? (cochlear implant, metal ear tubes, bone stimulator, insulin or other medication pump, automatic defibrillator, internal pacing wires).
- Have you had any metallic dental implants (posts, crowns) within the last 6 weeks?
- Have you had any bone, tendon, spine or joint surgery within the last 6 weeks?

Potential contraindications to entering high magnetic field

- Do you have an IUD that may contain copper, or a contraceptive diaphragm?
- Have you had any stents, clips or surgery to any of any of your vessels (carotid artery vascular clamp, coronary stent, aortic clips, IVC filter, coils for blocked arteries)
- Do you have metal anywhere else in your body? (spinal rods, dental work, piercings, shrapnel, buckshot, bullets)
- Do you have any piercings that can't be removed?
- Do you have a cerebrospinal fluid (CSF) shunt? (treatment for hydrocephalus or water on the brain)
- Do you have tattooed eyeliner, tattooed eyebrows or Bigen hair dye?
- Do you wear a hearing aid or dentures?

Your best protection is to keep your distance to magnetic fields and their sources. Magnetic fields drop fast with distance. Try to stay behind the 5 Gauss demarcation line.

The 5 Gauss line is a demarcation between uncontrolled and control area. Similar to an ionizing radiation control area.

- Less than 5 Gauss no controls or posting required.
- Greater than 5 Gauss the pacemaker/electronic implant warning criterion
- 10-30 Gauss where credit cards, BART card stripes can be erased
- 30 Gauss projectile hazard starts
- At 600 gauss+ time weighted average exposure takes over

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Miscellaneous Laboratory Work**
Number	**CH-0035**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Dealing with various tools and equipment in the laboratory

Miscellaneous Laboratory Work

Please be aware or reminded of these hazards when you deal with the following:

Pumps: Vacuum pumps are warm and noisy. Do not position the pumps next to heat sensitive equipment. Use earplugs or earmuffs or even combine them if you feel uncomfortable (please note that you have reached 90dB once you have to raise your voice in order to communicate with a person 3feet or 1m away from you; it is highly recommended to wear hearing protection then). Training is recommended (EHS0273 – Noise Exposure Awareness)

Noise: High noise exposures can lead to hearing loss. Comply with the postings at the entrance(s) to the high noise area. Wear hearing protection per the posting. Contact LBNL Health Services for hearing test (EHS0285).

Power cords: Many power cords and multiple outlets are needed in order to supply all pumps, controllers, electronics, and computers with electricity. Do not “daisy chain” multiple outlets and combine extension cords. That means do not form webs, nor do they loop back from the last device to the first. Please avoid trip and fall hazards dealing with these many power cords and cables; make use of cable bridges if possible or tape lines to the floor. The same applies to gas lines as well.

Electrical equipment: Please make sure to ground the following (electrical) equipment before use: Electronic & controller racks, decoupling boxes, voltage dividers, chamber frame (ENG1001 - Electrical Safety and EHS0260 - Basic Electrical Hazards and Mitigations). In general assure that all electrical >50V AC or DC is shielded against contact.

Gas cylinders and pressurized systems: Gas cylinders must be seismically secured. If there is no mounting frame available restrain the bottle in a gas cylinder cart, which is inhibited from moving by wooden chocks. When no gas line is connected to the gas cylinder, remove the regulator and protect the main valve with a cylinder cap, which is screwed onto the bottle. Store cylinders with proper separation between incompatible gases. Place window covers on any vacuum window >6" diameter except when actively using the window. Assure that all systems are equipped with pressure relief devices set below Maximum Allowable Working Pressure, or that all components are rated above the maximum available pressure (EHS0171 - Compressed Gas and EHS0170 - Cryogen Safety).

Ladders and stepstools: Trips, slips, falls from heights, injuries to persons below from dropped objects are possible. If you want to use a ladder or step stool higher than 3feet or 1m, safety training is required (EHS0278 – Ladder Safety). You need training if a scaffold is higher than 3feet or 1m (EHS0279 – Scaffold Users Hazard Awareness). Inspect ladders for damage and/or broken rungs daily; remove damaged ladders from service. Sign, barricade or otherwise guard the area where the ladder is set to assure that others do not disturb or work below ladder. Assure that ladder feet are level and stable.

Assure that step ladders are fully extended and locked. Do not climb higher than the third highest rung on a step ladder. Assure that extension ladders are tied off. Face the ladder and maintain three-point contact when climbing or descending. Keep both hands free (do not carry loads) when climbing or descending. Use personal fall protection if you must climb higher than six feet above the ground and are standing on any of the top three rungs of the ladder.

Open flames: If you want to operate small torches for soldering or stripping capton insulation of wires a hot work permit is needed. Moreover, the designated Hot Work area must always be free of combustibles and flammables, even when not in use. (EHS0535 – Hot Work Permit Training).

Soldering: Exposure to lead via incidental contamination possible. Wear safety glasses with side shields or goggles when soldering. Wash hands and face after completing lead work and before eating (EHS 0243 Soldering Awareness Training).

Sharps: Using tools with exposed sharp edges or points (e.g., razor blades, scalpels, chisels, needles) can result in laceration or amputation of extremities or other body parts. Determine if a safer alternative to the edged tool can be used to accomplish the Work (e.g., wire stripper versus razor blade). If the edged or pointed tool must be used, evaluate available tools and pick the safest device that will accomplish the Work (e.g., scalpels with longer handles are often more controllable than razor blades; razor blade holders should be used rather than unprotected blades). When applying force, point the tool away from the body. Wear protective gloves whenever the Work permits. Cover edges and points or dispose as soon as the work is completed (e.g., into a sharps disposal container without re-covering the edge). Do not leave unprotected sharp or pointed tools on the work surface, in a drawer, or anywhere else that accidental contact is possible. Handle and dispose of contaminated, non-contaminated, regulated and non-regulated edged sharps into sharps or other containers in accordance with PUB-3093 "Medical and Biohazardous Waste Generator's Guide" and (if applicable) your Biological Use Authorization, Registration or Notification. If the edge or point is present on a machine, evaluate the machine for the necessity of Point-of-Operation Guarding.

Stationary and portable metal working tools: Electrical shock, eye injury from flying objects, laceration can occur. Wear safety glasses with side shields or goggles when operating powered tools. Wear face shield in addition to safety glasses when operating any tool that produces flying chips. Always operate with supplied tool guards and/or chip shields in place and adjusted properly. Keep tools sharp. Wear protective gloves when laceration hazard exists and the task permits. However, do not wear gloves when operating machines with rotating parts (e.g., drill presses). Repair or replace broken tools immediately. Assure that cord-powered portable tools are either double insulated or grounded, and are plugged into GFCI-protected outlets.

Training: Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Seismic Safety**
Number	**CH-0033**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Securing the endstation and equipment in place

Seismic Safety

1) Description of Hazard

The COLTRIMS setup weighs about 450kg or 900lbs and is about 7 feet tall. During an earthquake the apparatus could move randomly or even tip over.

2) Controls

a) Mitigation of Hazards

In order to prevent the COLTRIMS setup from moving or tipping during an earthquake, the chamber has to sit on 4 support feet, which are securely hold to the ground by specially designed brackets. These brackets are approved by a LBNL engineer. Since these brackets are fastened to the ground with studs, which are embedded in the floor, there is only one position in the lab where the apparatus can be kept safely for long times. It is recommended to put cones on top of these brackets when the setup is moved out of the room, in order to prevent trip and fall incidents.
Since the experiments at the ALS do not last longer than 3 weeks, one unistrut bar with two threaded rods is used to clamp down the frame to the ground temporarily.

b) Personal Protective Equipment (PPE)

While fastening the chamber to the floor and dealing with the edgy brackets or unistrut bar, the use of sturdy work gloves is recommended. As always, wear the standard PPE as listed at the laboratory entrance or the experimental ALS area.

3) Emergency Procedures

Call 7911 or 911 in case of any serious injury.

4) Maintenance

The brackets and bar are checked visually for any damage before use. The components have to be replaced in case of any impairment.

5) Training

Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.

SUMMARY

Project:

Name	**COLTRIMS**
Lead	Thorsten Weber

Activity:

Name	**Thermal – Heater Tapes**
Number	**CH-0034**
Lead	Thorsten Weber
Division	Chemical Sciences Division
Locations	ALS, building 2
Date	March 2015

Brief Description:

Baking out the chamber – dealing with hot surfaces

Thermal - Heater tapes

1) Description of Hazard
Heater tapes are routinely used for high vacuum bake out. Heater tapes are connected to power sources through Variac's (fuse protected power adjustment adapter).

2) Controls
a) Mitigation of Hazards
Do not cross heating tapes. Use high-temperature adhesive tape to keep the heater tapes in place. Cover the heating tapes with Aluminum foil. Make sure to connect only heating tapes with similar resistance to one Variac. Do not combine more than 3 tapes. It is recommended not to combine Variac's via multiple outlets in order to prevent overloading power outlets. For a new setup or for a combination of heater tapes and Variacs, start the heating process in ascending steps until you have reached and stabilized at the desired temperature. Monitor the temperature with appropriate sensors. Use warning signs to prevent others from touching the hot surfaces. It is advised to inform the ALS control room about the bake out process.

b) Personal Protective Equipment (PPE)
Besides the standard PPE as listed at the laboratory entrance or the experimental ALS area, the use of sturdy work gloves or protective rubber gloves is recommended, in order to prevent cuts and skin irritation, during installation of the heating tapes. Use heat resistant gloves when you need to move the tape while it is warm. Do not touch the hot tapes with your bare hands

3) Emergency Procedures
Call 7911 or 911 in case of any serious injury. See the health personnel in building 26 for minor injuries. Cool burns with cold water while waiting for help.

4) Maintenance
Check the heating tapes before installation: Measure the resistance before and after installation (measure the resistance to ground as well).

5) Training
Go online to www.wpc-am.lbl.gov to see the requirements and then to http://training.lbl.gov/ for taking the training courses.