Energy Technologies Area

2015 Self-Assessment Project 1

A Self-Assessment of Laboratory Area Glove Box Operation and Maintenance Practices

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Approved by:

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Introduction

Glove boxes are used to provide an inert argon atmosphere for research involving water/air reactive metals such as lithium and sodium. Built into the sides of the glove box are gloves arranged in such a way that the user can place their hands into the gloves and perform tasks inside the box without breaking containment. Part or all of the box is usually transparent to allow the user to see what is being manipulated. The inert gas in a glove box is pumped through a series of treatment devices, which remove solvents, water and oxygen from the gas. Inert atmosphere glove boxes are typically kept at a higher pressure than the surrounding air, so that any microscopic leaks are mostly leaking inert gas out of the box instead of letting air in. Due to the hazardous nature of this activity, it is important to ensure that the gloves boxes are properly operated and maintained.

The ETA Safety Committee has selected glove box operation and maintenance practices in laboratory areas as a self-assessment project. This is the first ETA self-assessment project for FY2015.

Requirements

Requirements for the safe handling of reactive metals are described in the following documents:

- LBNL Environmental Safety and Health Manual, Chapter 45, "Chemical Hygiene and Safety Manual", Work Process Q- Control Procedures for Water Reactive Metals
- LBNL Environmental Safety and Health Manual, Chapter 14, "Electrical Equipment Safety Program"
- LBNL Environmental Safety and Health Manual, Chapter 41, "Ventilation, Hoods, and HEPA Filters"
- MBraun Glove Box Operation and Maintenance Manual
- VAC Omni Glove Box Operation and Maintenance Manual
- ETA Integrated Safety Management (ISM) Plan- Section 5, "Roles and Responsibilities"

All ETA personnel are assigned to one or more Work Activities in the "Activity Manager" Work Planning and Control system. Each Work Activity identifies hazards and various controls for the types of work being performed. This includes use of glove boxes; fume hoods, and hazardous materials such as reactive metals. Personnel who are assigned to glove box-related Work Activities are required to complete EHS0348 "Chemical Hygiene and Safety" training. Additional required training includes: EHS0171 "Pressure Safety", EHS0520/522 "Fire Extinguisher Safety", and EHS0604 "Hazardous Waste Generator". Each glove box-related Work Activity includes additional controls such as "On the Job " training, reactive metals handling requirements, waste disposal requirements, and emergency procedures.

All ETA personnel are required to maintain a safe work area, wear personal protective equipment when required, and report any safety issues immediately to their supervisor for follow-up and corrective action.

Methodology

The following methodology was used to conduct this glove box self-assessment:

1. The self-assessment team made field observations in each lab. See Attachment 1 for the survey form used. The information collected included:
    a. Glove box brand/model
    b. Emergency power status
    c. Nationally Recognized Testing Laboratory (NRTL) approval status
    d. Chemical inventory (CMS bar code) status of containers inside glove box
    e. Waste/sample management
    f. Ergonomics issues
    g. Ventilation survey status
    h. Noteworthy practices

2. A researcher self-assessment survey was also generated and distributed to the Principal Investigators/Area Safety Leads as an on-line "Google Survey" to all ETA lab areas that use glove boxes. See Attachment 2 for the survey form used. The information collected included:
    a. Are written glove box operational procedures maintained?
    b. Is there a documented program for performing glove box maintenance?
    c. Describe your glove box user training/authorization requirements.
    d. Do you have any suggestions that would improve glove box user safety?

3. A summary of the observations, noteworthy practices, and suggested improvements was compiled by the self-assessment team and presented Attachment 3 of this report.

4. The following personnel participated on the self-assessment team:
    a. Ron Scholtz- ETA Safety Manager
    b. Dan Best- EHS Division
    c. Susan Synarski- ETA Building Manager
    d. Yuyi Li- ESDR Division

5. The scope of this project applied to the following ETA lab areas:
    a. Building 62
        62-246, 62-312, 62-320, 62-342, 62-346, 62-350.
    b. Building 70
        70-108, 70-114, 70-123, 70-218, 70-226, 70-263, 70-291, 70-295, 70-297, and 70-299.

6. The following were not included in the scope of this self-assessment:
    a. Non-ETA operated areas in Buildings 62 and 70 such as Facilities, Earth Sciences, and Materials Sciences.
    b. ETA lab areas that do not include glove boxes
    c. Office and break areas

Summary of Findings, Observations and Noteworthy Practices

The following is a summary of findings, observations, and noteworthy practices identified by the self-assessment team. Significant items identified in the findings section are each entered into

the Corrective Action Tracking System "CATS" to ensure these are addressed and completion documented. Detailed survey results are found in Attachment 3.

Findings:

1. Five of the glove boxes surveyed were not included in the Electrical Equipment Inspection Program (EEIP) database. A bar code was affixed to each by an EEIP surveyor and entered into the EEIP database for inspection (**completed**).
2. Thirteen of the 24 glove boxes surveyed have not had their EEIP inspections completed. Arrangements need to be made to ensure EHS electrical inspectors can access each and perform the inspections. Any issues identified need to be corrected. The end result should be a green "approved" sticker affixed to each glove box. (CATS #9881)
3. Each glove box contains hazards such as water reactive metals and flammable solvents. Although an inert atmosphere is normally maintained, this hazard should be clearly identified on the outside of each glove box. This will address worker and emergency responder hazard communication requirements. (CATS #9882)

Survey Observations:

1. A survey response was received from each ETA lab area using glove boxes (100%). The results are tracked by Principal Investigator (10 total) rather than by individual glove boxes. See Attachment 3 for a summary of data collected.
2. Results of available glove box procedures:
    a. Written procedures are available for 3 of 10 PI's (Balsara, Kostecki, Srinivasan)
    b. The remaining PI's may have procedures, but they are not formally documented.
    c. The types of information documented in the three procedures consist of basic operating parameters, "do's and don'ts", and basic maintenance requirements. They do vary greatly in format and detail.
3. Results of documented glove box maintenance program:
    a. All PI's indicated some form of maintenance criteria. Most are not formally documented but all survey responses indicated frequency and types of maintenance usually performed.
    b. Common maintenance activities listed include: pump oil changes, catalyst regeneration, moisture sensor cleaning, oxygen sensor change-out, glove leak checks, and argon cylinder change-outs.
    c. None of the survey responses indicated that there were any maintenance logs in use. However, there were three lab areas observed with logs posted near the glove boxes. All appeared to be out of date and not actively used.
4. Results of glove box training authorization:
    a. All respondents rely on "On the Job" training by either the PI or an Area Safety Lead prior to authorizing glove box work. No documented training materials or handouts are available.
    b. All ESDR glove box related Work Activities in the Activity Manager WPC system list a summary of OJT topics that are covered. Topics listed in each Work Activity include:
        i. Familiarization with the locations of emergency equipment such as eyewash/shower, fire extinguisher, and spill cleanup supplies in lab area.

ii. Familiarization with emergency notification procedures, and location and use of posted Emergency Guide
iii. State and demonstrate procedures to follow in the event of a breached glove box in which significant air contamination occurs.
iv. State the hazards of lithium, organic solvents, and other hazardous materials used in these experiments.
v. Demonstrates the ability to perform work with pyrophorics unsupervised.
vi. Demonstrates the proper use of glove boxes. This includes transferring of materials into and out of a glove box without exposing the interior to air.
vii. Demonstrates the proper use of personal protective equipment.
viii. Read and is familiar with the requirements listed in Work Activity "EE-0000"

c. Work Activities were recently established in Activity Manager and all workers have been assigned, approved and accepted. However, none of the Work Activities includes any information under the "assign workers" section regarding documentation of OJT completion dates/trainer.
d. The Balsara group documents OJT on a hard copy check sheet and includes the worker's signature.

5. Some respondent suggestions include:
   a. Two suggestions were received in the survey results. They are as follows.
   b. *The gloves stick out of the box. If people touch the gloves with gloved, contaminated hands, the next person to enter the box could get contaminated. We strongly suggest using lab coats when working in the glove box and that the lab coats have sleeves that gather at the wrists.*
   c. *Having a identified glove box permanent person in each building. For example, in B62 Yuyi knows all the persons and the labs. So he is aware of the type of glove boxes in all B62. If I have a specific question, I usually meet him for discussion. For B70 I don't know which person could that be. To me, this would be interesting mostly during unexpected building shut-down and during holiday lab. shutdown (Christmas to new year period)*

Lab Walkthrough Observations

1. A total of 24 glove boxes were observed in 16 different lab areas. See Attachment 3 for a summary of data collected.
2. Results of NRTL status:
   a. Of the 24 glove boxes observed, 11 have a green "NRTL Approved" sticker affixed. The remaining 13 are not NRTL listed. All have the EEIP bar code affixed, are entered into the EEIP database and are awaiting electrical inspection. Of the 13 awaiting inspection, 5 did not have a bar code affixed until this self-assessment.
3. Results of glove box housekeeping:
   a. Each glove box was evaluated for housekeeping on a scale of 0-10. The highest scores were given to lab areas 62-246 (9), 62-350 (9), 70-108 (9), and 62-348 (8.5). The average score for all glove boxes was 7.9. The glove boxes in 70-218 scored the lowest (5 and 6) and need improvement. Overall, the past efforts to reduce clutter in the glove boxes are noticeable.
4. Results of chemical/waste storage in glove boxes:
   a. No chemical spills or unattended open containers were observed in any of the glove boxes during this self-assessment.

   b. No hazardous waste/Satellite Accumulation Area labels were observed inside any of the glove boxes. This is in accordance with Waste Management practices for "in process" wastes.
   c. Several glove boxes had chemical containers with no Chemical Management System (CMS) bar codes affixed (Lab areas 70-114).
   d. Several glove boxes had unidentified bags of wipes and other debris inside. It is not clear if they contain non-hazardous trash or if they are contaminated with hazardous materials (Lab areas 62-346, 70-299)
   e. Several vacuum pump containment trays were observed with spilled oil inside (Lab areas 62-312, 70-218). These need to remain free of spillage.
5. Results of emergency power availability:
   a. Of the 24 glove boxes observed, 11 are connected directly to an emergency power outlet or circuit (Lab areas 62-246, 62-312, 62-342, 62-348, 70-123, 70-218).
   b. Of the 24 glove boxes observed, 13 are not connected directly to an emergency power outlet. There are 4 glove boxes that have an e-power outlet available in the lab area and simply need to be connected by use of an extension cord (Lab areas 62-246, 70-108). The remaining 9 glove boxes do not have an e-power outlet available in the lab area and must be connected through an extension cord leading to another room (Lab areas 62-320, 62-350, 70-114, 70-226, 70-263, 70-291, 70-295, 70-299).
6. Results of ventilation surveys of glove boxes:
   a. All 24 glove boxes surveyed had a ventilation survey sticker affixed and were recently checked by EHS. None of the glove boxes had any ventilation issues noted.

Noteworthy Practices:

1. Lab areas 62-348 and 70-123 (Balsara) conduct monthly glove box clean-outs of unlabeled and unwanted samples/chemicals. On an annual basis, a "deep cleaning" is performed to make sure each glove box well organized.
2. Lab areas 62-348 (Balsara) and 70-295 (Battaglia) use clearly labeled sample boxes with each researcher's name identified. This allows for easier identification of unwanted samples when clean-outs occur.
3. The glove boxes in 62-348 (Balsara) has an Uninterruptible Power Supply (UPS) battery back-up system connected to each glove box. This allows for temporary power of glove box controls even when emergency back-up power systems fail.
4. Lab area 70-108 (Kostecki) has all equipment mounted on top of each glove box seismically secured with straps to prevent damage in the event of an earthquake.
5. Lab are 70-218 has a glove box that is clearly labeled "Caution- Water Reactive Metals". This information can be useful to emergency responders.
6. Lab areas 70-218 and 70-295 (Battaglia) have glove box housekeeping checklists affixed. These identify housekeeping tasks and who is responsible for them. In addition, maintenance logs are also maintained on each glove box.
7. Lab area 62-348 (Balsara) uses an On the Job Training checklist that also serves as a written procedure. Workers sign and date the check sheet as a means of documenting that OJT was completed and understood.

Conclusions and Future Improvements

Conclusions

The following conclusions summarize the results of the ETA glove box self-assessment project:

1. All glove boxes observed appeared to be in good operating condition. Considerable progress has been made in housekeeping practices in a number of the lab areas, particularly 62-246. These efforts need to continue.
2. There is little written documentation available regarding operation and maintenance of glove boxes. The type and detail of information provided by those lab areas with written procedures varies greatly.
3. All workers using glove boxes receive OJT training prior to use. However, there is little documentation regarding the information covered, trainer, and training date(s).

Recommendations and Suggested Future Improvements

The following recommendations and improvements should be made in order to enhance glove box use in ETA lab areas:

1. The results of this self-assessment will be made available to ETA personnel so that they are aware of issues identified and future plans (**Completed**- Posted on ETA Safety website and announced in division communications).
2. A standard format or "template" for glove box operations and maintenance written procedures should be developed and made available to each lab area Principal Investigator. The template should include types of maintenance needed, maintenance frequencies, and any suggested forms for documentation. Good practices found in current procedures can be incorporated into the template. PI's can customize the basic procedure based on specific requirements.
3. Only a limited amount of training material is made available to workers specific to glove box use. ETA should consider developing a standard glove box user-training module and make available to Principal Investigators for use as part of their OJT. This could possibly be made into a short on-line course that is required as part of the specific Work Activity training controls.
4. Glove box manufacturer equipment manuals and other relevant documents have already been added to all ETA glove box-related Work Activities. As the use of these Work Activities progresses, Principal Investigators should consider adding additional information such as the lab area's specific written glove box operation procedures, maintenance logs, and training materials.
5. The new Activity Manager system allows for documentation of OJT in the worker's training summary "comments" section. Activity Leads should consider using this feature for documenting specific OJT training information such as date of training and any restrictions.
6. Each glove box should be clearly labeled with information regarding emergency back-up power (or lack of). This will assist in planning in the event of building power outages or other emergencies.
7. A follow-up self-assessment should be performed in 2-3 years to determine if there have been any changes in glove box use or procedures. A special focus may be on how the effectively the new Activity Manager system is used towards implementing glove box user training and awareness.

ATTACHMENT 1
ETA Glove Box Field Evaluation Form

ETA Glove Box Self Assessment Evaluation Form

Lab Area:

Glove Box ID:

Brand/Model:

1) Housekeeping Rating (0-10):

2) Emergency Power Status:

3) NRTL Approval Status:

4) Chemical Inventory (CMS Bar Codes):

5) Waste/Sample Management:

6) Ergonomics:

7) Ventilation Survey Status:

8) Other Issues Observed:

9) Best Practices Observed:

ATTACHMENT 2
ETA Glove Box Researcher Survey Form

ESDR Glove Box Safety Self Assessment

A glove box self-assessment is currently being performed. The survey below will help us assess how glove boxes in ESDR are being managed and if there are any best practices that can be shared with other researchers. If you have supporting documentation such as glove box procedures or forms, please send to Ron Scholtz for inclusion in the self-assessment. Please submit your completed survey no later than Friday, January 30, 2015.

* Required

1. **Your Name** *

2. **Lab Areas** *
   Designate applicable lab areas where your glove boxes are currently used

3. **Are glove box operational procedures maintained? If yes, supply a copy to Ron Scholtz.** *

4. **Is there a documented program for performing glove box maintenance? If so, describe the maintenance frequencies for various glove box components such as gloves, purifier canisters, monitor calibrations, etc.** *

5. **Describe your glove box user training/authorization requirements. Who provides the training and what are the topics covered? Is the training documented?** *
   example On the Job Training (OJT)

6. **Do you have any suggestions that would improve glove box user safety? If so, describe.**

Google Forms

ATTACHMENT 3
ETA GLOVE BOX SURVEY DATA

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
62-246	246-3	VAC Nexus	B. McCloskey	Very old procedures posted on glove box. No current procedures.	Very old log posted on glove box. No current logs.	One on one instruction by Safety Lead. Not documented.	9	Major clean out of glove boxes completed.	Yes- Needs to be clearly identified	OK- Green Sticker	OK- 4/27/15	
	246B-2	VAC HE-43-2	B. McCloskey	Very old procedures posted on glove box. No current procedures.	Very old log posted on glove box. No current logs.	One on one instruction by Safety Lead. Not documented.	9	Major clean out of glove boxes completed.	Yes- Needs to be clearly identified	OK- Green Sticker	OK- 5/14/15	
	246B-3	VAC HE-553-2	B. McCloskey	Very old procedures posted on glove box. No current procedures.	Very old log posted on glove box. No current logs.	One on one instruction by Safety Lead. Not documented.	9	Major clean out of glove boxes completed.	No- needs to be plugged into a e-power outlet in the room	#41683- needs inspection	OK-5/14/15	
62-312	312-2	VAC HE-453-6	G. Chen	None	Regeneration performed every 2 months. Gloves inspected every 6 months and replaced when needed. Procedure available in lab area.	OJT provided by PI or Safety Lead. Users are observed the first couple of times before they are authorized to work independently. They are also authorized in Activity Manager after OJT.	7	Oil in pump containment tray	Yes	#28787- needs inspection	OK- 5/20/15	
62-320	320-3	VAC Nexus	G. Chen	None	Regeneration performed every 6 months. Gloves inspected every 6 months and replaced when needed. Procedure available in lab	OJT provided by PI or Safety Lead. Users are observed the first couple of times before they are authorized to work independently. They are also	7		No- needs to be plugged into an e-power outlet in the utility corridor	#44077- needs inspection	OK- 5/28/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
					area.	authorized in Activity Manager after OJT.						
62-342	342-6	VAC Nexus	M. Doeff	None. A status sign is posted on the antechamber.	Records are not maintained. A sign on the antechamber indicates status. Gas cylinders are changed as needed.	Senior members of the group carry out OJT. New users are asked to read the relevant Work Activity and then added.	7.5	Unlabeled bags of material in glove box	Yes	OK- Green Sticker	OK- 5/21/15	
62-348	348-5	MBraun (Box 1)	N. Balsara	Yes, but electronic copy not yet available	A document describing the maintenance procedures such as glove box regeneration. Maintenance frequency are describe below: - Glove: change is done as soon as a hole is spotted on it. Several extra gloves are in the labs. - Purifier canister inside glove box: every year. - O2 sensor cleaning: every year - Regeneration: as many as necessary to keep ultralow concentration of	The training is done by group member and is documented. The topic include glove box proper use, maintenance (regeneration, gas tank change), what to do in emergency, typical mistake to avoid when operating the glove box.	8.5		Yes- plugged into outlet	OK- green sticker	OK- 5/28/15	Monthly glove box clean out of unlabeled samples. Annual "deep cleaning".

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
					H20 and O2. - Copper column: every year - Vacuum pump oil cleaning: every 6 months or every year.							
	348-6	MBraun "Custom" (Box 2)	N. Balsara	Yes, but electronic copy not yet available	A document describing the maintenance procedures such as glove box regeneration. Maintenance frequency are describe below: - Glove: change is done as soon as a hole is spotted on it. Several extra gloves are in the labs. - Purifier canister inside glove box: every year. - O2 sensor cleaning: every year - Regeneration: as many as necessary to keep ultralow concentration of H20 and O2. - Copper column: every year - Vacuum pump oil cleaning: every 6 months or every year.	The training is done by group member and is documented. The topic include glove box proper use, maintenance (regeneration, gas tank change), what to do in emergency, typical mistake to avoid when operating the glove box.	8.5		Yes- plugged into outlet	OK- see 348-5	OK- 5/28/15	Samples stored in clearly labeled boxes with researcher name

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
	348-7	MBraun "Labmaster DP" (Box 1, 2, 3)	N. Balsara	Yes, but electronic copy not yet available	A document describing the maintenance procedures such as glove box regeneration. Maintenance frequency are describe below: - Glove: change is done as soon as a hole is spotted on it. Several extra gloves are in the labs. - Purifier canister inside glove box: every year. - O2 sensor cleaning: every year - Regeneration: as many as necessary to keep ultralow concentration of H20 and O2. - Copper column: every year - Vacuum pump oil cleaning: every 6 months or every year.	The training is done by group member and is documented. The topic include glove box proper use, maintenance (regeneration, gas tank change), what to do in emergency, typical mistake to avoid when operating the glove box.	8.5		Yes- plugged into outlet	OK- green sticker	OK- 5/28/15	Back-up UPS battery for each glove box

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
62-350	350-3	VAC HE-43-2	W. Tong	None	The gloves are checked to prevent leakage every month. If any leakage on the glove is found, the replacement will be done. The glove box regeneration is performed every six months.	The user will be trained with the general operation procedure, including sample transfer, glove protection, status monitoring, etc. After qualified by the supervisor, the user could start to use the glove box.	9		No-needs to be plugged into an e-power outlet in the utility corridor	OK-Green Sticker	OK- 4/6/15	Surge protector mounted off floor
70-108	108-9	VAC DLX-001-5-P	R. Kostecki	Yes, written procedure is available	Maintenance described in written procedure.	Area Safety Lead provides training prior to releasing for work	9		No-separate plug available in room	#35597/35598-Needs inspection	OK-6/25/15	Seismic Straps for equipment located above glove box
	108-10	VAC Nexus	R. Kostecki	Yes, written procedure is available	Maintenance described in written procedure.	Area Safety Lead provides training prior to releasing for work	9		No-separate plug available in room	OK- Green sticker	OK-6/25/15	Glove boxes are clearly labeled
	108-11	VAC Nexus	R. Kostecki	Yes, written procedure is available	Maintenance described in written procedure.	Area Safety Lead provides training prior to releasing for work	9		No-separate plug available in room	#28749-needs inspection	OK-6/25/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
70-114	114-5	VAC Omni-Lab	G. Liu	We have procedures but they are not written down. Here they are: 1) Check the oxygen and moisture level; fill the number in the sheet. 2) Check Argon cylinder, if the pressure is low, report it to the responsible person (look up house keeping task list) 3) Use glove box 4) After finish using, clean used area; place trash to trash bag; return tools to their original box; organize equipment, stuff. 5) Keep antechamber in the state vacuum. 6) Check oxygen and moisture level and write them down in the sheet."	Maintenance is not documented yet, but we monitor the oxygen and moisture level on a daily basis. The catalyst is regenerated every 2 months	To use the glove box in 114, users will first get authorized by Gao Liu at room 124. Hui Zhao will then provide the training covering the typical procedure for the use of this glove box. This training is not documented yet.	7	Chemical containers missing CMS bar codes	No	#28752-needs inspection	OK-6/25/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
70-123	123-8	MBraun	N. Balsara	Yes, but electronic copy not yet available	A document describing the maintenance procedures such as glove box regeneration. Maintenance frequency are describe below: - Glove: change is done as soon as a hole is spotted on it. Several extra gloves are in the labs. - Purifier canister inside glove box: every year. - O2 sensor cleaning: every year - Regeneration: as many as necessary to keep ultralow concentration of H20 and O2. - Copper column: every year - Vacuum pump oil cleaning: every 6 months or every year.	The training is done by group member and is documented. The topic include glove box proper use, maintenance (regeneration, gas tank change), what to do in emergency, typical mistake to avoid when operating the glove box.	8		Yes	#7707-needs inspection	OK-6/25/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
	123-9	MBraun MB150B-G-II	N. Balsara	Yes, but electronic copy not yet available	A document describing the maintenance procedures such as glove box regeneration. Maintenance frequency are describe below: - Glove: change is done as soon as a hole is spotted on it. Several extra gloves are in the labs. - Purifier canister inside glove box: every year. - O2 sensor cleaning: every year - Regeneration: as many as necessary to keep ultralow concentration of H20 and O2. - Copper column: every year - Vacuum pump oil cleaning: every 6 months or every year.	The training is done by group member and is documented. The topic include glove box proper use, maintenance (regeneration, gas tank change), what to do in emergency, typical mistake to avoid when operating the glove box.	8		Yes	#7708-needs inspection	OK-6/25/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
70-218	218-2	VAC DLX-002-D-P	V. Battaglia	We have procedures but they are not written down. Here they are: 1) Check the oxygen and moisture level; fill the number in the sheet. 2) Check Argon cylinder, if the pressure is low, report it to the responsible person (look up house keeping task list) 3) Use glove box 4) After finish using, clean used area; place trash to trash bag; return tools to their original box; organize equipment, stuff. 5) Keep antechamber in the state vacuum. 6) Check oxygen and moisture level and write them down in the sheet.	Yes, her is the maintenance frequency schedule: 1) oil change of pump per 3-4 months 2) regeneration of catalyst per 6 months. 3) Calibration of oxygen sensor per year and replace fuel cell for oxygen sensor per year (Vac. glove box) 4) regeneration of moisture sensor per year (MBraun glove box) 5) replacement of active carbon of solvent trap when solvent mass >1.1kg 6) leak check of gloves frequently	Hui Zhao provides glove box training in these areas. 1) How to transfer stuff into or out of glove box using antechamber. 2) How to deal with waste (hazardous and non hazardous) produced inside glove box 3) how to keep glove box in organized state after using. 4) how to use crimper 5) how to use balance 6) policy for chemicals using inside the glove box, especially for chemicals harm to catalyst and lithium.	6		Yes	OK- Green sticker	OK- 5/20/15	Sign posted "Caution Alkali Metals"; housekeeping checklist is posted

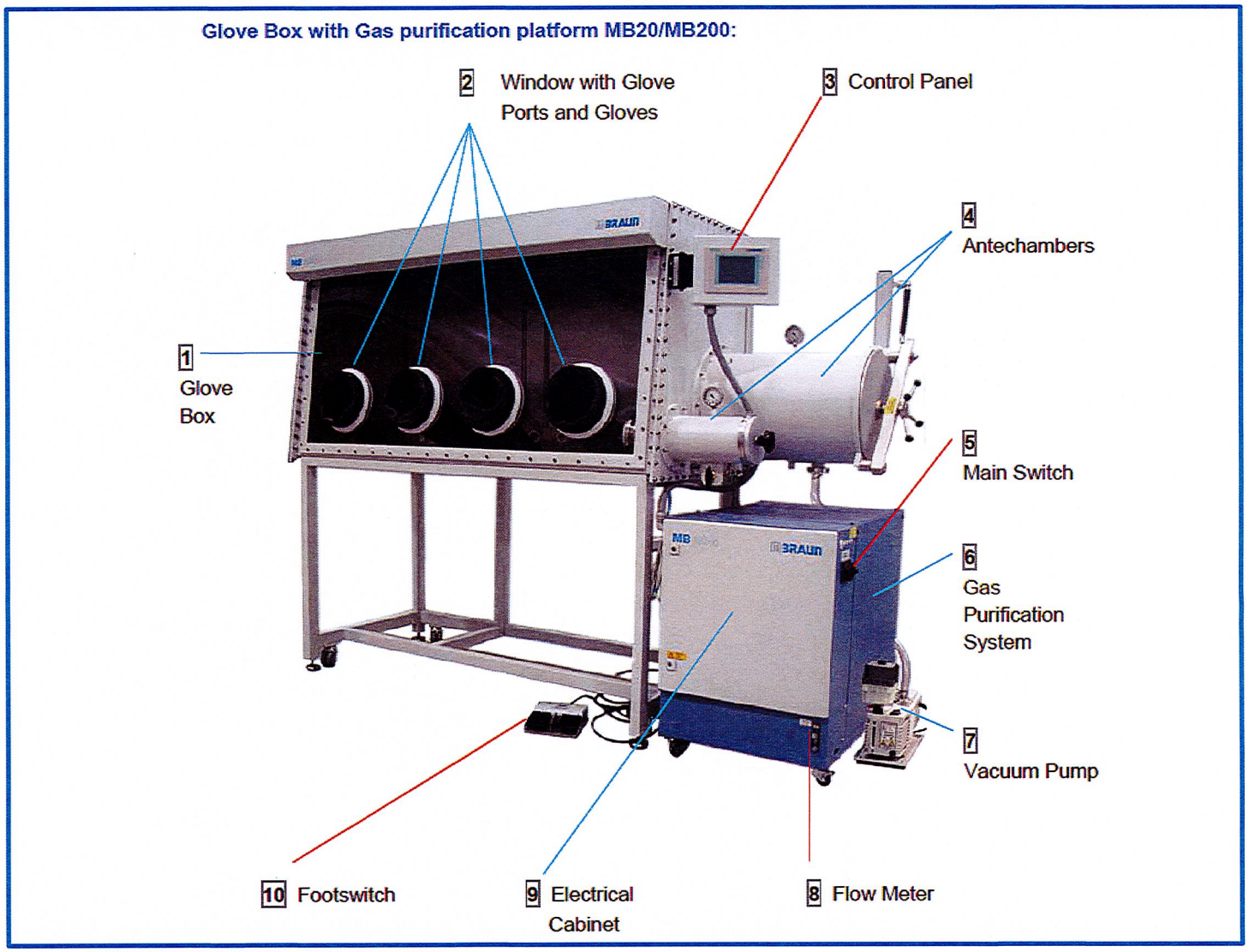
Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
	218-3	MBraun UniLab	V. Battaglia	We have procedures but they are not written down. Here they are: 1) Check the oxygen and moisture level; fill the number in the sheet. 2) Check Argon cylinder, if the pressure is low, report it to the responsible person (look up house keeping task list) 3) Use glove box 4) After finish using, clean used area; place trash to trash bag; return tools to their original box; organize equipment, stuff. 5) Keep antechamber in the state vacuum. 6) Check oxygen and moisture level and write them down in the sheet.	Yes, her is the maintenance frequency schedule: 1) oil change of pump per 3-4 months 2) regeneration of catalyst per 6 months. 3) Calibration of oxygen sensor per year and replace fuel cell for oxygen sensor per year (Vac. glove box) 4) regeneration of moisture sensor per year (MBraun glove box) 5) replacement of active carbon of solvent trap when solvent mass >1.1kg 6) leak check of gloves frequently	Hui Zhao provides glove box training in these areas. 1) How to transfer stuff into or out of glove box using antechamber. 2) How to deal with waste (hazardous and non hazardous) produced inside glove box 3) how to keep glove box in organized state after using. 4) how to use crimper 5) how to use balance 6) policy for chemicals using inside the glove box, especially for chemicals harm to catalyst and lithium.	5	Pump oil in containment tray	Yes	#28753-needs inspection	OK-5/20/15	Maintenance records are posted near the glove box

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
70-226	226-2	VAC DLX-001-G-5	G. Liu	We have procedures but they are not written down. Here they are: 1) Check the oxygen and moisture level; fill the number in the sheet. 2) Check Argon cylinder, if the pressure is low, report it to the responsible person (look up house keeping task list) 3) Use glove box 4) After finish using, clean used area; place trash to trash bag; return tools to their original box; organize equipment, stuff. 5) Keep antechamber in the state vacuum. 6) Check oxygen and moisture level and write them down in the sheet."	Maintenance is not documented yet, but we monitor the oxygen and moisture level on a daily basis. The catalyst is regenerated every 2 months	To use the glove box in 114, users will first get authorized by Gao Liu at room 124. Hui Zhao will then provide the training covering the typical procedure for the use of this glove box. This training is not documented yet.	7		No-needs to be plugged into an e-power outlet in another room	#39218-needs inspection	OK-5/20/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
70-263	263-3	VAC Omni-Lab	V. Srinivasan	Yes. These are maintained on a Wiki site.	Yes, for some items. Vacuum pump oil is changed approximately every 6 months; catalyst regeneration is done approximately every year. We have not yet changed the oxygen sensor or gloves.	Training is not documented, but I provide training to users as needed for their experiments. Another postdoc or I carefully monitor new users until we are confident in their abilities.	8		No- needs to be plugged into an e-power outlet in another room	#45051- needs inspection	OK- 5/20/15	
70-291	TBD	MBraun B786	E. Cairns	None	None	None	Being Installed		No	#28758- needs inspection	N/A- Being Installed	
70-295	295-3	VAC GB-102-D	V. Battaglia	We have procedures but they are not written down. Here they are: 1) Check the oxygen and moisture level; fill the number in the sheet. 2) Check Argon cylinder, if the pressure is low, report it to the responsible person (look up house keeping task list) 3) Use glove box 4) After finish using, clean used area; place trash to trash bag; return tools to their original box; organize	Yes, her is the maintenance frequency schedule: 1) oil change of pump per 3-4 months 2) regeneration of catalyst per 6 months. 3) Calibration of oxygen sensor per year and replace fuel cell for oxygen sensor per year (Vac. glove box) 4) regeneration of moisture sensor per year (MBraun glove box) 5) replacement of active carbon of solvent trap when solvent mass >1.1kg 6) leak check of	Hui Zhao provides glove box training in these areas. 1) How to transfer stuff into or out of glove box using antechamber. 2) How to deal with waste (hazardous and non hazardous) produced inside glove box 3) how to keep glove box in organized state after using. 4) how to use crimper 5) how to use balance 6) policy for chemicals using inside the glove box, especially for chemicals	8		No- needs to be plugged into an e-power outlet in another room	#35705- Needs inspection	OK-5/22/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
				equipment, stuff. 5) Keep antechamber in the state vacuum. 6) Check oxygen and moisture level and write them down in the sheet.	gloves frequently	harm to catalyst and lithium.						
70-297	297-4	PlasLabs 818-GBB	V. Battaglia	We have procedures but they are not written down. Here they are: 1) Check the oxygen and moisture level; fill the number in the sheet. 2) Check Argon cylinder, if the pressure is low, report it to the responsible person (look up house keeping task list) 3) Use glove box 4) After finish using, clean used area; place trash to trash bag; return tools to their original box; organize equipment, stuff. 5) Keep antechamber in the state	Yes, her is the maintenance frequency schedule: 1) oil change of pump per 3-4 months 2) regeneration of catalyst per 6 months. 3) Calibration of oxygen sensor per year and replace fuel cell for oxygen sensor per year (Vac. glove box) 4) regeneration of moisture sensor per year (MBraun glove box) 5) replacement of active carbon of solvent trap when solvent mass >1.1kg 6) leak check of gloves frequently	Hui Zhao provides glove box training in these areas. 1) How to transfer stuff into or out of glove box using antechamber. 2) How to deal with waste (hazardous and non hazardous) produced inside glove box 3) how to keep glove box in organized state after using. 4) how to use crimper 5) how to use balance 6) policy for chemicals using inside the glove box, especially for chemicals harm to catalyst and lithium.	8		No- needs to be plugged into an e-power outlet in another room	OK- Green sticker (pump)	OK- 5/22/15	

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
				vacuum. 6) Check oxygen and moisture level and write them down in the sheet.								
70-299	299-3	MBraun Unilab 2000	V. Battaglia	We have procedures but they are not written down. Here they are: 1) Check the oxygen and moisture level; fill the number in the sheet. 2) Check Argon cylinder, if the pressure is low, report it to the responsible person (look up house keeping task list) 3) Use glove box 4) After finish using, clean used area; place trash to trash bag; return tools to their original box; organize equipment, stuff. 5) Keep antechamber in the state vacuum. 6) Check oxygen and moisture level	Yes, her is the maintenance frequency schedule: 1) oil change of pump per 3-4 months 2) regeneration of catalyst per 6 months. 3) Calibration of oxygen sensor per year and replace fuel cell for oxygen sensor per year (Vac. glove box) 4) regeneration of moisture sensor per year (MBraun glove box) 5) replacement of active carbon of solvent trap when solvent mass >1.1kg 6) leak check of gloves frequently	Hui Zhao provides glove box training in these areas. 1) How to transfer stuff into or out of glove box using antechamber. 2) How to deal with waste (hazardous and non hazardous) produced inside glove box 3) how to keep glove box in organized state after using. 4) how to use crimper 5) how to use balance 6) policy for chemicals using inside the glove box, especially for chemicals harm to catalyst and lithium.	7.5	Unlabeled bag with wipes	No- needs to be plugged into an e-power outlet in another room	OK- Green sticker	OK- 7/2/14	Maintenance schedule posted and documented

Location	Exhaust ID #	Brand/Model	PI	Procedures	Maintenance	Training	Housekeeping (0-10)	Chemicals/Waste	Emergency Power	NRTL	Ventilation Survey	Best Practice
				and write them down in the sheet.								

ATTACHMENT 4
TYPICAL GLOVE BOX DIAGRAM