GLOVEBOX PRESSURE RELIEF AND CHECK VALVE*

MASTER

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ABSTRACT

This device is a combined pressure relief valve and check valve providing overpressure protection and preventing back flow into an inert atmosphere enclosure. The pressure relief is embodied by a submerged vent line in a mercury reservoir, the relief pressure being a function of the submerged depth. The pressure relief can be vented into an exhaust system and the relieving pressure is only slightly influenced by the varying pressure in the exhaust system. The check valve is embodied by a ball which floats on the mercury column and contacts a seat whenever vacuum exists within the glovebox enclosure. Alternatively, the check valve is embodied by a vertical column of mercury, the maximum back pressure being a function of the height of the column of mercury.

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EDB

INTRODUCTION

LLNL employs a number of inert atmosphere enclosures ("gloveboxes") with attached glove ports and which house toxic and radioactive materials. The gloves represent a hazard in that they could burst if the glove box were accidentally over pressurized thereby releasing toxic material to the environment. As a precautionary measure these enclosures are fitted with pressure relief devices which, because of the toxic material contained in the box, must vent into an exhaust system and not into the laboratory. The pressure relief setting should be set to limit the difference between the glovebox pressure and barometric pressure in the laboratory, since it is this pressure difference which causes the gloves to rupture.

A problem has arisen with the current apparatus because the pressure varies in the exhaust system by more than the specification on the setting of the pressure relief device. The need is for a passive pressure relief device which is sensitive to room barometric pressure, but not downstream pressure in the exhaust line.

A second problem has arisen with the current apparatus when the glovebox is under vacuum and has caused the mercury to draw about 30 inches up the tube from the glovebox to the bubbler. The mercury in the tube has come from the reservoir and hence the immersion of the tube into the reservoir has decreased considerably. Under this condition, if the reservoir is seismically disturbed, then the tube of mercury can gulp a bubble of air which can carry some mercury back up into the glovebox. The need is for a passive check valve which does not require a great volume of mercury to actuate.

BACKGROUND INFORMATION

Engineering Safety Note ENS 82-910 (attachment #4) describes a prototype relief and check valve device, but which exhibits the two problems described above. This safety note, however, establishes the basic design goals including, the minimum tube sizes for required flow, the pressure at which the gloves burst, and the pressure at which the relief device should actuate.

A memorandum from Kelly to Landingham dated 2 July 1984 (attachment #3) discusses the pressure drop across various in line mercury vapor filters.

DESCRIPTION OF THE APPARATUS

The device described below meets the requirements of Safety Note ENS 82-910 and addresses the two problems described above. The valve assembly comprises the following items as labeled on the attached drawings, AAA84-100334 and AAA84-111177 (attachment #1):

Item #A, the reservoir, structurally connects all the component parts and contains the mercury.

Item #B, the mercury, prevents the gas from the enclosure from entering the laboratory and provides the pressure relief for the enclosure.

Item #C, the annulus to the exhaust, is the passageway from the valve assembly to the exhaust system which conducts escaping gas from the enclosure to the exhaust.

Item #D, the check valve, conducts escaping gas when the pressure in the enclosure is greater than the setting of the relief and blocks flow when the pressure in the enclosure is less than the pressure in the exhaust system.

Item #E, the duct and filter to the laboratory, allow the barometric pressure in the laboratory to act on the surface of the mercury in the reservoir.

FUNCTION OF APPARATUS

This apparatus uses the barometric pressure in the laboratory as a reference for the relief pressure and remains unaffected by the pressure fluctuations of the exhaust system.

The valve assembly must function during three states:

1. The glovebox under vacuum.

Gloveboxes are evacuated as normal procedure when establishing an inert atmosphere inside. The valve assembly must therefore act as a check valve, that is, not allow flow into the enclosure under this circumstance. This is accomplished by the check valve. The embodiment here uses a hollow steel ball which floats on the column of mercury. When a vacuum is drawn, the mercury rises up the column until the floating ball contacts the seat thereby closing off any further rise of mercury up the column.

2. The glovebox at normal operating pressure.

While the glovebox is at a pressure slightly below the barometric pressure in the laboratory, the height of the mercury in the tube to the glovebox is above the level in the reservoir in communication with the laboratory. The height of the mercury in the annulus is also above that in the reservoir. Thus, the glovebox is sealed off from both the exhaust system and the laboratory.

3. The glovebox venting at the relief pressure.

Should the pressure rise in the glovebox, the level of the mercury in the tube to the glovebox will decrease until it reaches the bottom of the column tube at which time the gas from the glovebox will escape from the column and will rise up through the annulus leading to the exhaust system. Because the gas is much less dense than the mercury, it will not tend to migrate downward and escape to the part of the reservoir in communication with the laboratory. The setting of the relief pressure is determined by the depth which the column tube is immersed below the level of the reservoir in communication with the laboratory. Because this depth is not significantly influenced by the pressure of the exhaust system, the pressure at which the glovebox will vent is not significantly influenced by the pressure of the exhaust system.

TESTING THE APPARATUS

The attached report by Jess Squires (attachment #2) describes the testing of the relief device. With a 4.37 inch diameter reservoir, a change of 1 inch of water in the exhaust system suction caused a change of only 0.1 inch of water in the relief setting. There are a number of ways to minimize this further if the 10 fold decrease in sensitivity proves inadequate.

The attached memorandum by Ed Schmitt (attachment #5) describes the testing of the check valve.

Attachments

1. Drawings: AAA84-110334 and AAA84-111177.
2. Report: "Testing of Mercury Bubbler, Mk II".
3. Memorandum: "Glove Box Upgrade Mercury Bubbler Filter", 7/2/84.
4. Safety Note: "Vacuum Glovebox Installation, Building 24:", ENS-82-910.
5. Memorandum: "Check Valve Development for Mercury Bubbler, Mk II", 1986

ATTACHMENT 1

NOTES

UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1992.
2. SURFACE TEXTURE PER ANSI B46.1-1978.
3. ALL DIMENSIONS IN INCHES.

4. FILL RESERVOIR WITH MERCURY TO A LEVEL CORRESPONDING WITH .00 PSI (0.06 mm Hg) RELIEF PRESSURE. MEASURE PRESSURE WITH A "WALLACE TIERMAN" OR EQ. ABSOLUTE PRESSURE GAGE.

5. AFTER PROPER FILL IS OBTAINED SET TIP OF LEVEL INDICATOR SCREW .001" AT THE SURFACE OF THE MERCURY. EPOXY FILL ACCESS TO ITEM 7 TO PERMANENTLY FIX ITS POSITION.

1/4" DEPTH FOR RELIEF PRESSURE		
IN. Hg	mm Hg	PSI
.00	0	.000
.10	2.54	.049
.20	5.08	.098
.30	7.62	.147
.35	8.89	.172
.40	10.16	.196
.50	12.7	.246
.60	15.24	.295
.70	17.78	.344

4	NUT, HEX. 1/4-20 UNC	STL	13	
4	SCR. SCH CAP 1/4-20 UNC-1/2	STL	12	
1	PLUG, PIPE 1/2-14 MNPT.	BRASS	11	
2	4750-6196	WASHER, UNION 3/4	HYCAR	10
2	4750-57301	PLUG, TAILPIECE UNION 3/4	CRES 304	9
2	4750-57396	NUT, UNION 3/4	CRES 316	8
1	B2-105049	LEVEL INDICATOR SCREW TAB-02		7
1	5330-27235	O-RING, 1-5/8 LB x 3/16 W BLUWAIN	PARCEL 2-50	6
1	B2-105030	VIEWPORT GASKET		5
1	B2-05029	VIEWPORT WINDOW		4
1	B2-103798	VIEWPORT CAP		3
1	B4-111179	CHECK VALVE		2
1	B4-111177	WELDMENT		1

NO	ECO	PARTICLE	ITEM	NO	DESCRIPTION/MATERIAL	SPEC	NO	ITEM
OWN	PE	SO	LA	604	CLASSIFICATION			
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MATERIALS ENGINEERING DEPT					SHEET 2 OF 2			

1/19/2004 CW 1/19/2004

CHANG

179	Booth, C. G.	1968	2048	CHANDLER
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UNLESS OTHERWISE SPECIFIED,

- ▶ VIDEO-ETCH DNG NO 1/2 HIGH
▶ VIDEO-ETCH WORDS AS SHOWN.

[illegible]

ATTACHMENT #2

Jess Squires
August, 1985

Testing of the Mercury Bubbler, Mk II

The purpose of this experiment is to establish the influence of the vacuum exhaust system pressure on the relief pressure of the mercury bubbler.

In actual use, the vacuum will be supplied by a hood, or "green line" at a negative gauge pressure of about 5 in. H_2O . For the test, however, a line with more vacuum was used and regulated with a Hoke valve. The glovebox overpressure was simulated with a throttled compressed air line. The testing apparatus is shown schematically in Figure 2.1.

The testing procedure consisted of presetting the vacuum pressure, then cracking the compressed air valve until the relief pressure was reached. The relief pressure is immediately followed by a slight pressure drop, indicating an escaping bubble.

The data are tabulated in Table 2.1 and shown graphically in Figure 2.2. Ideally, the curve should be a line with zero slope. The observed slope in the data is due to the change in the level of the Mercury exposed to barometric pressure. Specifically, as Mercury is drawn up the annular line to the exhaust system with changing suction of the exhaust, the height of Mercury in the reservoir subject to barometric pressure slightly decreases. Therefore, the immersion height of the relief tube from the glovebox also decreased thereby decreasing the relief pressure.

The slope in Figure 2.2 is 0.1, hence for the mercury bubbler shown in drawing AAAS4-110333, a change in exhaust suction of 1 inch of water causes a change in relief pressure of 0.1 inch of water. There are several ways to further minimize this effect. For example, one simple method is to increase the ratio of the reservoir area to the area of the annular tube to the exhaust system. For example, a reservoir of 13 inches diameter would decrease the sensitivity to .01, that is a change in exhaust system pressure of 1 inch of water would change the relief pressure .01 inch of water.

FIGURE 2.1

FIG 2.2 RELIEF PRESSURE
VS. VACUUM EXHAUST PRESSURE

⊥ FIRST DATA RUN
□ SECOND DATA RUN

Hydrograph Data

Time (hr)	Water Level (ft)	Water Level (ft)	Water Level (ft)	Water Level (ft)
8.0	197	197	4.0	215
7.7	198	198	3.8	213
7.6	199	199	3.6	214
7.4	200	200	3.4	215
7.2	201	201	3.2	216
7.0	201	201	3.0	217
6.8	202	202	2.8	218
6.6	203	203	2.6	219
6.4	204	204	2.4	220
6.2	205	205	2.2	221
6.0	206	206	2.0	222
5.8	207	207	1.8	223
5.6	208	208	1.6	224
5.4	209	209	1.4	225
5.2	210	210	1.2	226
5.0	211	211	1.0	227
4.8	212	212	0.8	228
4.6			0.6	
4.4			0.4	
4.2			0.2	
			0	

Table 2.1 - Test Data

ATTACHMENT #3

interdepartmental letterhead

Mar Station L 369

Ext 2-8042

July 2, 1984
2218L

TO: R. L. Landingham

FROM: B. E. Kelly

SUBJECT: Glove Box Upgrade Mercury Bubbler Filter

Introduction

Over the past year much effort has been devoted to upgrading the safety standards of glove boxes in Buildings 222, 231, and 241. Recently, upon completion of an upgraded system in Building 241, it became apparent that further research was needed in the area of filters for the mercury bubblers. The following diagrams and test results were obtained to complete the box upgrade

Test Procedure

The purpose of the test was to determine what the pressure drop (ΔP) across the filter would be at various flow rates. Besides the obvious filtering requirements this would also help determine the maximum safe venting rate for the box. Four tests were conducted, one without a filter in the line and three more with the following filters:

1. MSA #8760 Mersorb Chemical Cartridge
2. In-line filter assy. MSA #78001
LLNL #4180-33332
3. Gas filter, David Trip Assoc., Inc.
LLNL - 8

The test of the filters was accomplished by flowing air and measuring the pressure at a point before and after the filter. (To test filter #1 a SST housing was fabricated on-site, see photo.)

The flow rate was measured through a flow meter and the pressure difference was noted for the various flow rates, see graph. For filter #3 the pressure drop was so great that a less sensitive pressure gauge had to be used.

University of California

Lawrence Livermore
National Laboratory

July 2, 1984

Summary

The MSA "mersorb" filter will be adequate for removing mercury vapor from the box atmosphere and keep particles from the box contaminating the mercury bubbler. The maximum flow rate for the argon backfill should be less than 210 l/min. As a word of caution, we found that it was necessary to treat the glove box mercury filter and bubbler exhaust vent to drain as a whole unit for setting the level in the mercury bubbler.

ASHA has not set a standard for mercury filters, but the MSA filter does meet the industry standards for mercury vapor removal. They are made with an indicator to tell when it's time to replace. This filter is designed to stop mercury vapors only--it will not stop mercury liquid.

An in-line filter housing was designed (see drawing) to fit onto the mercury bubbler. As an added attraction other MSA filters will fit into this housing. We found it useful with the .3 micron dust filter in protecting the leak detector from exposure to beryllium dust in one of the boxes.

B. Earl Kelly

BEK:jg

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Liters/min.	○	◇	□	△
	Test Stand Resistance	SST Gas Filter David Trip, Inc. Inches of Water	MSA #8760 Mersorb Filter	In-line Paper Filter 4180-33332
20			.50	.80
30				1.10
40			1.00	1.50
50			1.40	
60				2.20
70		6.94 (.25 psi)	2.00	2.60
80	.50		2.50	3.00
90		15.28 (.55 psi)	2.95	3.50
100			3.35	3.95
110			3.95	
120		27.80 (1.00 psi)		
130	1.00			
140				
150				
160				
170	1.50			
180

PLUMBING DIAGRAM

Valve

Regulator

Flow meter
Brooks #R-8M-25-4

ΔP Gauge, 0-8 inches
or 0-3 psi gauge

Filter assy.

NOTES -

1. 125/ MACHINED SURFACES & STK.
2. WELD TO BE VACUUM TIGHT, PART TO PASS VACUUM TEST PER MEL-74-001933 (LLNL SPEC) LEAK RATE NOT TO EXCEED 1×10^{-9} ATMOS CC/SEC
3. TAG PART WITH DWG NO & TAG NO.

ITEM	PART NO.	MATERIAL / DESCRIPTION	REQ'D	SPEC. NO.	LLS STOCK NO.
1	10	TUBE $1\frac{1}{2}$ OD. X .049 W X 2.06103L	300 EYES	ASTM-A269	
1	9	TUBE 1 OD. X .049 W X 2.06103L	300 EYES	ASTM-A269	4710-14208
1	8	TUBE $\frac{3}{4}$ OD. X .049 W X 2.06103L	300 EYES	ASTM-A269	4710-14208
1	7	TUBE $\frac{1}{2}$ OD. X .049 W X 2.06103L	300 EYES	ASTM-A269	
1	6	TUBE $1\frac{1}{2}$ OD. X .049 W X 2.06103L	300 EYES	ASTM-A269	4710-14208
1	5	83-115579 BODY TAB-06			
1	4	83-115579 BODY TAB-05			
1	3	83-115579 BODY TAB-04			
1	2	83-115579 BODY TAB-03			
1	1	83-115579 BODY TAB-02			

TAB-05	TAB-04	TAB-03	TAB-02	TAB-01	ITEM	PART NO.	MATERIAL / DESCRIPTION	REQ'D	SPEC. NO.	LLS STOCK NO.
DR. WALTERS DORF 11-83 CHK. M. T. GOODMAN 11-83 APPROVED 285 11-83 SHOWN ON 83-115574 DATE						CLASSIFICATION OFFICIAL USE THIS DOCUMENT IS THE PROPERTY OF THE UNIVERSITY OF CALIFORNIA LAWRENCE LIVERMORE LABORATORY. REPRODUCTION PROHIBITED WITHOUT PERMISSION OF THE MECHANICAL ENGINEERING DEPARTMENT.		MAJOR UNIT CHEMISTRY B241 SUB ASSY. MERCURY TRAP DETAIL BODY WELDMENT J.O. DRAWING NO. 83-115575-00 COPY ACCT. NO. 5017-12 SHEET 1 OF 1		

LET. DRN. CH. DATE ZONE

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NOTES -

1. See drawing for dimensions and tolerances.
2. See drawing for material and heat treatment.

3. 125/ MACHINED SURF & STOCK

WELD TO BE VACUUM TIGHT,
PART TO PASS VACUUM TEST
PER MIL-76 - 001333 (LLNL SPEC)
LEAK RATE NOT TO EXCEED
 1×10^{-9} ATMOS CC/SEC.

5. TAG PART WITH DWG NO &
TAG NO.

1			10	TUBE 1 1/2 O.D. X .049W X 2.06 ± .03L	304 CRES	ASTM A269
	1		9	TUBE 1 O.D. X .049W X 2.06 ± .03L	304 CRES	ASTM A269 4710-14204
		1	8	TUBE 3/4 O.D. X .049W X 2.06 ± .03L	304 CRES	ASTM A269 4710-14202
			7	TUBE 3/8 O.D. X .049W X 2.06 ± .03L	304 CRES	ASTM A269
		1	6	TUBE 1/2 O.D. X .049W X 2.06 ± .03L	304 CRES	ASTM A269 4710-14208
1			5	83-11557B COVER TAB-06		
	1		4	83-11557B COVER TAB-05		
		1	3	83-11557B COVER TAB-04		
			2	83-11557B COVER TAB-03		
		1	1	83-11557B COVER TAB-02		
TAB-05	TAB-04	TAB-03	TAB-02	TAB-01	ITEM	PART NO.
					MATERIAL / DESCRIPTION	REQ'D
					SPEC. NO.	LLN STOCK NO.
					DR. WOLTERS DOOF	83
					CHK. H. V. GOODMAN	83
					APPROVED RFE 2/16	
					SHOWN DWS-115574	DATE

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LEG. DIM. CH. DATE ZONE CHANGE

4. INSTALL & TEST PER EHS 21-905.

ASSEMBLY

LEGEND	
	VALVE
	BOURDON TUBE COMPOUND GAGE
	T/C VACUUM GAGE
	REGULATOR
	FILTER

LAWRENCE LIVERMORE LABORATORY - UNIVERSITY OF CALIFORNIA		FILE NO.	PAGE
ENGINEERING NOTE		EHS 82-910	1
SUBJECT	MECHANICAL ENGINEERING SAFETY NOTE		NAME Stan Lord
VACUUM GLOVEBOX INSTALLATION - BLDG. 241		DATE November 22, 1982	

ATTACHMENT #4

MECHANICAL ENGINEERING SAFETY NOTE

VACUUM GLOVEBOX INSTALLATION - BLDG. 241

Prepared by: Stanley C. Lord
Stanley C. Lord
Responsible Engineer
Engineering Design Section
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LAWRENCE LIVERMORE LABORATORY - UNIVERSITY OF CALIFORNIA		FILE NO.	PAGE
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SUBJECT	MECHANICAL ENGINEERING SAFETY NOTE		NAME Stan Lord
VACUUM GLOVEROX INSTALLATION - BLDG. 241		DATE November 22, 1982	

A. DESCRIPTION

This is a general engineering note to outline an updated method for installing gloveboxes in Bldg. 241. With gloveboxes such as AAA67-105501 and others used in the building the atmosphere is controlled. Work is moved into and removed from the work chamber through an air lock (entry port). A vacuum tight door is installed in the opening between the two chambers. Evacuation and backfilling of either the air lock or work chamber are independently controlled. The following three systems are required for a glovebox of this type. Installation of these systems is outlined on schematic AAA82-112790-0A

1. Vacuum system
2. Argon system
3. Venting system

With these three systems the experimenter can obtain and maintain an inert atmosphere in which to carry out the work.

Authorized personnel in Building 241 will use the gloveboxes.

B. HAZARDS

Operation of this type of a glovebox has the following potential hazards:

1. Rupturing of gloves by excessive pressure.
2. Mercury contamination by the relief device.
3. Backstreaming of pump oil into the chambers.
4. Room contamination by the air lock atmosphere.
5. Window breakage.
6. Earthquakes.

ENGINEERING NOTE

SUBJECT

MECHANICAL ENGINEERING SAFETY NOTE

NAME

Stan Lord

DATE

November 22, 1982

VACUUM GLOVEBOX INSTALLATION - BLDG. 241

Glove Rupture Protection

In a series of gloves tests conducted by Hazards Control in June 1982 a minimum burst pressure of 0.379 psi was observed. This was for a 15 mil butyl NORTON #081532 glove, the kind used in the building. See Hazards Control memorandum dated June 21, 1982 in the appendix. Based on the test data it was decided to set the mercury relief device at 0.196 psi for glove pressure protection, approximately 50% of the minimum burst pressure. At this pressure the end of the relief line is submerged about 0.40 inches which provides an approximate glove pressure protection S.F. of 2. This is half the S.F. required for pressure vessels but it is considered adequate since an internal pressure condition will cause the gloves to protrude which is easily observed by the operator.

Mercury Contamination

The mercury pressure relief device is a source of mercury contamination to the glovebox, air lock, and room. When either the glovebox or air lock is evacuated the mercury will suck back toward the chambers. To prevent the mercury from entering the chambers the connecting line must extend at least 33 inches above the surface of the mercury. Such a column if filled with mercury is 10% more than a standard atmosphere. Also there must be sufficient mercury in the reservoir to fill the line and prevent sucking air. A mercury line filter is installed at least 30 inches above the surface of the mercury. Nothing else is installed in the line.

An over pressure condition in either the work chamber or air lock is relieved through its mercury relief device. The gas discharge picks up mercury contamination as it bubbles through the pool of mercury and must not be discharged directly into the room. Instead it is vented through a line and passes through a HEPA filter before being discharged outside above the roof of the buildings.

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Pump Oil Backstreaming

Only one pump (a mechanical pump such as a Sargent-Welch) is used for evacuation. Should it fail to function oil can backstream and contaminate the chambers. This is prevented by the Leybold-Heraeus Secuvac valve in the line. When there is a failure the valve closes.

Room Contamination from the Air Lock

The atmosphere in the air lock is a source of low-level contamination. This occurs when its outside door is opened and the pressure inside the air lock is above ambient. To prevent this the pressure inside the air lock is reduced to less than one atmosphere by opening the vent valve, valve 20, first. Hazards Control recommends a minimum air velocity of 50 feet per minute through the door opening. See their memorandum dated December 20, 1982 in the appendix. The outside air lock door and vent valve are interlocked so that the door can only be opened when the vent valve is open.

Window Breakage

The glovebox window is a Lucite window (1" thick) made of a self extinguishing material (Elexson plexiglass, SE3). Rubber gaskets are required on both sides.

Earthquakes

The glovebox shall be secured to the floor with appropriate fasteners. Both mercury relief devices are to be fastened to the frame above the floor.

ENGINEERING NOTE

SUBJECT

MECHANICAL ENGINEERING SAFETY NOTE

NAME

Stan Lord

DATE

November 22, 1982

VACUUM GLOVEROX INSTALLATION - BLDG. 241

C. RELIEF DEVICE PRESSURE SETTING

There are several models of mercury relief devices used in the building. These models have reservoirs of various diameters. Only the six-inch diameter model shown on drawing AAAB2-109148 is to be used on the work chamber with gloves. All models including AAAB2-109148 may be used on the air lock. There must be sufficient mercury in the reservoir to fill the connecting line to a minimum height of 33 inches above the surface of the mercury. This column of mercury serves as a check valve and prevents the suck back of mercury when the chambers are evacuated.

The proper depth of fill of mercury in the reservoir is obtained by the relief pressure setting. These settings are shown in Table 1. Relief pressures are to be set so that the pressure corresponds to that of a Wallace Tiernan absolute pressure gage, or equal. For a 33 inch column of mercury the relief pressure decreases as the reservoir diameter increases.

D. INSTALLATIONS GUIDELINES**1. Glovebox**

Each glovebox being installed shall be appropriately anchored to the floor per the LLNL earthquake tiedown policy. For this note the glovebox is to be the vacuum type and shall have a lucite window with a minimum thickness of one inch. It shall be a self extinguishing material (Flexon plexiglas, SE3). Hookup of the glovebox is shown on Dwg. AAAB2-112700.

ENGINEERING NOTE

FILE NO.
ENS 82-910PAGE
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SUBJECT MECHANICAL ENGINEERING SAFETY NOTE

NAME Stan Lord

VACUUM GLOVEBOX INSTALLATION - BLDG. 241

DATE November 22, 1982

TABLE 1.

$$(D-2t_1)^2 \pi/4 h - d^2 \pi/4 h = (d-2t_2)^2 \pi/4 (H-h)$$

$$h = \frac{H(d-2t_2)^2}{(D-2t_1)^2 - d^2 + (d-2t_2)^2}$$

$$D = 4.25$$

$$t_1 = t_2 = 0.06$$

$$d = 0.75$$

$$H = 33$$

$$h = 0.381 \text{ psi (0.775 inch Hg)}$$

RELIEF PRESSURE SETTINGS "h"

H (in Hg)	RELIEF PRESSURE SETTINGS "h"							
	DIA = 4.25"		DIA = 4.50"		DIA = 5.00"		DIA = 6.00"	
	h (psi)	h (in Hg)	h (psi)	h (in Hg)	h (psi)	h (in Hg)	h (psi)	h (in Hg)
31	0.358	0.728	0.318	0.647	0.256	0.520	0.176	0.358
32	0.369	0.752	0.328	0.668	0.264	0.537	0.181	0.369
33	0.381	0.775	0.338	0.689	0.272	0.554	0.187	0.381
34	0.392	0.799	0.348	0.710	0.280	0.571	0.193	0.392
35	0.404	0.822	0.359	0.730	0.289	0.587	0.198	0.404
36	0.415	0.846	0.369	0.751	0.297	0.604	0.204	0.415
37	0.427	0.869	0.379	0.772	0.305	0.621	0.210	0.427
38	0.439	0.893	0.389	0.793	0.313	0.638	0.215	0.438
39	0.450	0.916	0.400	0.814	0.321	0.655	0.221	0.450
40	0.462	0.940	0.410	0.835	0.330	0.671	0.227	0.461

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VACUUM GLOVEBOX INSTALLATION - BLDG. 241		DATE November 22, 1982	

2. Vacuum Pump

Only one vacuum pump is to be installed on each glovebox. With the pump both the air lock and work chamber are to be evacuated. A Sargent-Weich, Model 1397 or 1402, mechanical pump, or equal, is recommended for this service. A Leybold-Heraeus Secuvac, model KF-20 or KF-32, valve shall be installed on the pump inlet port to prevent backstreaming in the event of a power failure. For pump stoppages due to other causes, i.e., belt failure, a CPA Fail Safe Detector, model 9860, is installed. This device will close the Secuvac valve. (See Appendix for equipment brochures).

3. Mercury Relief Devices

Two mercury relief devices are installed on each glovebox. One is installed on the work chamber for glove pressure protection and the other on the air lock. For glove pressure protection, only relief device AAA82-100148 is to be used. This model and the other models, such as AAA 65-115700, may be used on the air lock. Each device is to be secured to the frame above the floor and the relief lines from the work chamber and air lock shall extend at least 33 inches above the surface of the mercury. A mercury filter shall be installed in each relief line at least 30 inches above the surface of the mercury. There are to be no other obstructions in the lines. Vent lines are to be connected to the building negative air exhaust system. Exhaust from the work chamber and air lock shall pass through a HEPA filter before entering the trunk line of the negative air system.

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VACUUM GLOVEROX INSTALLATION - BLDG. 24J

4. Lines

The main lines (4710-14138) in the vacuum system shall be a minimum diameter of 1.125 inches. Lateral lines to the glove ports etc. may be smaller. The vent lines shall also be 1.125 inch minimum except for the lateral to the individual components. These lines (4710-14137) may be 0.875 inches O.D. A 1/2 inch (0.625 O.D.) diameter line (4710-14136) is recommended for the argon line. This size line will prevent the need for excessive pressures in order to obtain a reasonable fill time.

5. Valves

Use Worcester type ball valves (4560-41612) in vacuum and larger lines of the vent system. Hoke type valves may be used for other requirements.

6. Gages

Use compound Bourdon tube gages (6685-20035) and T/C gages (5960-56510) where shown on drawing AAA82-112790. Use a Bourdon tube type pressure gage in the argon system.

7. Regulator

Install a pressure regulator in the argon supply line.

8. Air-Lock Door Latch

Install an interlock latch on the outside door of the air lock. A small diameter steel cable shall be used to connect the latch to the handle of valve 20, drawing AAA82-112790. Adjust the cable so that the latch will only be open when valve 20 is open. This insures a negative pressure in the air lock when the outside door is opened.

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E. TESTING

After the installation is completed all the features of the glovebox are to be checked by an authorized individual. This includes a vacuum check of the glovebox and a 0.3 psig pressure test.

F. LABELING

After testing a label sufficiently large to be easily seen shall be attached to the glovebox in a conspicuous place. The following information should be on the label:

Assemble AAA 67-105501
 Installation AAA82-112790
 Safety Note ENS 82-905
 Date of Test
 Date of Retest
 Tested by: _____

ENGINEERING NOTEFILE NO.
ENS 82-910PAGE
10

SUBJECT

MECHANICAL ENGINEERING SAFETY NOTE

NAME Stan Lord

VACUUM GLOVEROX INSTALLATION - BLDG. 24T

DATE November 22, 1982

APPENDIX

o	Landingham Memo	3 pages
o	Patterson Memo	3 pages
o	Leybold-Heraeus Data	2 pages
o	CPA Fail Safe Data	1 page
o	Graph of Burst Test	1 page
o	Hazards Control Memo	4 pages
o	Dwg. AAA 82-112790	1 page
o	Hazards Control Memo	1 page

Doc

Page 1 of 1

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2-8022

April 12, 1982
0962R

TO: Distribution

FROM: Richard L. Landingham

SUBJECT: IMPROVE RELIABILITY AND SAFETY OF VACUUM GLOVEBOXES

A wide variety of vacuum gloveboxes have been designed, built, and installed in Building 241 and other locations at LLNL. The original designs met the need of the programs funding that work. As the gloveboxes are used for other programs, the plumbing and electrical setups are modified to meet the needs of the newer programs. Most of the gloveboxes were not originally setup to handle toxic or radioactive materials. The glovebox line in Room 1887 of Building 241 is one exception.

I believe a basic design must be adopted that all these gloveboxes should be upgraded to and any modifications then documented in OSP's and/or on the glovebox itself. I propose this basic design should include all the features shown in the attached diagram. This diagram includes the following features:

1. Negative exhaust system on the entry port which is connected to a filter box.
2. A connection latch between this exhaust system and entry port door to prevent opening this door without negative exhaust being drawn through the port to the filter box.
3. Only one vacuum pump is connected to the box system to evacuate the glovebox, gloves, and/or entry port. If the pump fails, the glovebox, gloves, and port bleed back to atmospheric pressure equally with less chance of imploding the gloves or entry port. Pump exhaust is vented through the filter. A normally closed vacuum valve is located between the pump and the glovebox system which will close if electrical power to the pump is lost.
4. A mercury (Hg) bubbler trap is installed on the glovebox. Only a line filter is installed between the glovebox and Hg bubbler to remove Hg vapors; no valves or mechanical relief valves are allowed. These bubblers must be secured to the glovebox, filled with Hg to bubble between 0.2 and 0.3 psi, and exhaust through the filter. No Hg bubbler is required on

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0962R

-2-

April 12, 1982

the entry port so long as the back-fill gas comes from the glovebox. If a gas line is attached to the entry port directly from a high pressure (≥ 3 psi) source, a Hg bubbler must be installed on the entry port similar to that installed on the glovebox.

5. Pressure/vacuum gauges should be installed on the glovebox, glove evacuation line, and the entry port for rapid determination of the pressure in these areas.
6. The lucite window (≥ 1 " thick) should be made of self extinguishing material (Elexson plexiglass, SE3), and have rubber gaskets on both sides.
7. Final checkout of these gloveboxes will include a vacuum and pressure (≤ 0.3 psi) check.

Since most of the gloveboxes do not meet the above specifications, I propose immediate upgrade on those now being used programmatically and continue upgrade on maintenance accounts until all the installed gloveboxes are up to these minimum standards. Any modification of these standards or handling of toxic materials within these gloveboxes should be reviewed by our Facility Managers and appropriate Section Leader(s).

I would appreciate any comments to improve on this basic design and on any programmatic impacts generated by this upgrade. This upgrade could be considered as one portion of the general upgrade proposed by Matthias J. Kotowski on December 23, 1980 (see attached memorandum).

Richard L. Landingham
Section Leader
Ceramics, Corrosion, & Thermochemistry

RLL:rm

Attachments

Distribution

Bender, C.	L-326
Hammerel, G.	L-369
Kelly, R.	L-351
Kotowski, M.	L-384
Lepper, J.	L-338
Mara, G.	L-217
Meisenheimer, R.	L-370
Robbins, J.	L-326
Short, D.	L-217
Southwick, E.	L-369

Vacuum Glove Box
Schematic Diagram

RLR
4/4/82

Interdepartmental letterhead

Mail Station L- 384

Ext- 25259

December 23, 1980

TO: H. W. Patterson
FROM: Industrial Safety
SUBJECT: Proposal for Glove Box Upgrade

So far this year there have been four glove box incidents in Team 1 areas that have come to our attention: The two incidents in B/332, one in B/241, and one in B/231. Reports are available for the first three incidents. The last incident (B/231) did not result in a breach of the glove box containment and does not qualify for an incident report because of the fairly benign nature of the work carried out in the box.

While we are aware of the four cited incidents, there have been, perhaps, many more near-misses and minor incidents this year that never were brought to our attention.

Review of these known incidents indicates that the following are factors in the causal process:

- Operator error caused by lack of understanding of glove box systems and their limitations.
- Insufficient consideration of human factors in the design of glove box systems that leads to operator error.
- Unforgiving design of glove box systems; e.g. lack of interlocks, pressure relief, etc.

It's significant to note that these incidents invariably seem to stem from general safety type events, such as mechanical failure, pressure and operator error, even though the major problem is contamination by radioactive materials. We therefore believe that it is appropriate for us to raise this issue and to propose that the following steps be taken to improve glove box safety.

Recommendations:

1. That an interdisciplinary Laboratory committee be formed to establish standards for glove box design and use. We would envision that the committee would have representatives from Mechanical Engineering, Hazards Control, and Users.

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2. That mandatory standard designs be adopted for all new glove boxes and control systems. Separate designs would be needed to cover air boxes, inert flushing boxes, inert static boxes and vacuum boxes.
3. That mandatory minimum requirements be established for existing glove boxes.
4. That all operations requiring the use of standard glove boxes (2 and 3 above) be identified by type or category. (This would enable exemption of low risk work from unnecessarily strict requirements.)
5. That standards be established for what work is permissible in glove boxes in terms of compressed gas use, flammable liquids, exothermic reactions, heating equipment, etc.
6. That minimum training requirements be established to teach all personnel the features and limitations of standard glove boxes as outlined in item 5 above.

Discussion:

1. **Standard Design:**

The only Laboratory guidance for design of glove boxes is contained in the Mechanical Engineering Safety Manual and Health and Safety Manual Supplement 12.03. This guidance is quite general in nature and the designer has a great deal of latitude when he designs a glove box. Consequently, there are many different designs for glove boxes intended for similar service. This condition is improved only slightly by the fact that some components are more or less standard and by the practice of copying from successful designs already in service. It might be argued that the current system is the best possible since the box designers can tailor each box exactly to the needs of the operation, providing the best possible protection for the hazards presented by that operation. While this may have been the intent, past experience indicates that this is not necessarily true. We see the following problems which would be lessened by standard glove box design:

- Some designers have much more experience, talent or interest in glove box design than others. Consequently, the quality of glove box design varies, and there are some that are not as well designed as is desirable.
- Hazards Control design review is very difficult. Since each glove box is an entirely new system, a thorough system safety analysis would be appropriate. This is usually not possible because of time constraints and lack of detailed drawings and engineering documentation. Further, the review frequently takes place after much of the plumbing is in place already. This effectively limits Hazards Control input to minimum requirements; human factors considerations and preferential recommendations can rarely be accommodated.

- Operators and maintenance personnel must learn the peculiarities and safety procedures for each glove box. When an individual has to deal with many different boxes this may be difficult; operators may become confused about which glove box has what capabilities and may make errors.

2. Standard Operating Parameters

Operating parameters are generally discussed in glove box OSPs. The review process for such OSPs is intended to assure that all proposed operations can be carried out safely in the glove box. While this usually works well, there is little technical guidance for the experimenter or reviewer. Some examples of problem areas are:

- How can gas be used in a glove box without undue risk of over-pressure? What are the pressure, flow, and total volume limits?
- Under what circumstances can flammable liquids and gases be safely used in glove boxes? What flushing rates are required? Is it wise to permit them in static boxes under any circumstances? Are oxygen monitors needed?
- How much heat can be introduced into a glove box by a furnace? Is there a potential steam explosion problem if a water-cooled furnace is used in a glove box?
- What limits should be established for chemical reactions in glove boxes?

3. Operator Training

While the vast majority of personnel using glove boxes undoubtedly are well trained in contamination control techniques, additional training is needed to assure that all glove boxes users understand what steps must be taken to prevent accidents that could result in containment failure. This would not take the place of detailed training for a particular procedure or specific glove box; rather, it would cover the standard design features and operational parameters and explain their purpose. To assure training of all personnel we would envision that this training be mandatory for all personnel who work in or on glove boxes.

Matthias J. Kotowski

Matthias J. Kotowski
Safety Engineer
Industrial Safety Group

SECUVAC valves are vacuum safety valves which are used to isolate the vacuum system from the mechanical pump in case of power failure. They have the following features:

- Close immediately on power failure
- Do not open until intake line is evacuated
- Leak rate less than 10^{-7} Torr ltr/sec
- Can be mounted in any position

Specially designed for connection to mechanical pumps, SECUVAC valves are electromagnetically opened, but close due to the pressure difference between atmospheric pressure and vacuum. One SECUVAC valve performs the functions of two valves; i. e. a rapidly closing vacuum valve for isolating the vacuum chamber (and/or vapor pump) from the backing pump and an air inlet valve for venting the backing pump. Because isolation and venting follow at a predetermined interval of time (brought about by means of devices built into the valve), the amount of air drawn into the vacuum chamber is less than 4×10^{-2} Torr ltr per cm² of the valve plate surface area. On opening the valve, the pressure rise in the fore-vacuum line of standard pump sets comprising of diffusion and backing pumps, does not exceed the critical backing pressure of the diffusion pump. By parallel connection of the drive motor of the backing pump and the solenoid coil of the SECUVAC valve, the vacuum chamber and the vapor pump are protected from an inrush of air on power failure and the backing pump is vented. The venting time is so fixed that sucking back of oil from the pump is avoided.

The SECUVAC is a right angle valve. Conductance and corner dimension across the valve correspond to those for pipe bends of the same nominal diameter. The leak rate is less than 10^{-7} Torr ltr/sec. The valves from KF 10 to KF 32 are of steel and KF 50, 3" and 4" are of light alloy.

Applications

As vacuum-securing isolation valves between backing pump and vacuum chamber or vapor pump – for protecting the vacuum chamber from inrush of air when the backing pump stops due to a power failure or switch-off.

Fig. 7.1 SECUVAC valve KF 32

Fig. 7.2 SECUVAC valve 3"

Fig. 8.2 Drawing of the SECUVAC valves KF 10 to KF 50

Fig. 8.1 Standard mounting configuration for SECUVAC valve.

Fig. 8.3 Drawing of the SECUVAC valves 3" and 4" with rotatable ASA flanges

Technical data

Size	KF 10	KF 20	KF 32	KF 50	3"	4"
b	1 3/16	2	2	2 3/4	4 3/4	5 7/8
b1	2 1/8	3 1/8	3 3/4	5 1/8	7 1/2	9 1/2
b2	3 1/8	3 7/8	3 7/8	4 1/2	6 11/16	7 7/8
h	5 1/8	5 1/8	5 1/8	7 1/4	10 1/4	12 1/16
Weight, lbs.	1.7	2.4	3.5	4.8	8	15
Amperage at 115 V, 60 Hz ¹⁾ (Starting/Holding), approx.	0.17/0.11	0.17/0.11	0.17/0.11	0.17/0.11	0.21/0.11	0.26/0.11

SECUVAC valve Cat. No. 273 01-1 273 02-1 273 03-1 273 05-1 272 77-M 272 80-M

(All dimensions in inches)

In addition, the necessary sealing and clamp parts are required for connecting the valve.

¹⁾ 220 V, 60 Hz. module available on request.

We accept the right of invention.

R - R

LEYBOLD-HERAEUS, INC.

5500 ROAD, MONROEVILLE, PA 15146 Telephone (412) 372-8800

circuits processing apparatus, inc.

CPA FAIL SAFE — MODEL # 9860

MECHANICAL PUMP FAILURE DETECTOR FOR BELT DRIVEN PUMPS

- Protect your vacuum systems from mechanical pump failure
- The mechanical pump failure detector has a moving magnetic field that is detected by a transducer, mounted on the belt guard of the mechanical pump. The output of the transducer is electronically monitored by a missing pulse detector. If the pulley ceases to rotate, the circuitry actuates a relay which is used to interlock the vacuum system.
- For thin film evaporators, sputtering systems and other diffusion pumped pumping systems. If the mechanical pump stops for any reason - belt breakage, vane freeze up or motor failure, the valve at the foreline of the diffusion pump should be closed immediately, to stop air and mechanical pump oil or oil vapor from being sucked back into the hot boiler of the diffusion pump. At the same time, the diffusion pump heater should be turned off, and the hi-vac valve closed to prevent contamination of the working chamber.
- All of this can easily be done by connecting the mechanical pump failure detector to a multipole power relay which can close both valves, and turn off the diffusion pump.
- For other pumping systems which use a belt driven mechanical pump, the mechanical pump failure detector can be connected directly to a sonic alarm, visual alarm or interlocks that require two (2) amps or less to operate. For interlocks that require more than one (1) relay contact or currents in excess of two (2) amps, an auxiliary relay can be easily connected.

SPECIFICATIONS

- 1 - Detects the motion of the mechanical pump pulley.
- 2 - Provides one form C (single pole double throw) 2 amp relay contact for interlock purposes.
- 3 - Operates on 115 V AC line. Requires no special or auxiliary power supplies.
- 4 - Power requirements 115 V AC - .015 amps
- 5 - Nominal size of the transducer box 2" deep x 2 1/4" wide x 4 1/2" long

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ENGINEERING NOTE

FILE NO.

PAGE
20

SUBJECT

NAME

DATE

Internal Security - Subclassified

Reference 386

Ref 2-5165

June 21, 1982

TO: Eugene Hammerl
FROM: Safety Science Group, Hazards Control Department
SUBJECT: Bursting Pressure of Various Gloved Box Gloves

M. H. Chew and P. E. Barry determined the bursting pressure and approximate volume of a 30-mm neoprene and butyl gloved box glove in 1975, attachment 1. To confirm their data and expand the data base, a series of gloved box gloves have been burst (15-, 25- and 30-mm).

Each glove was attached to the properly sized gloved port, 5" or 8" and secured with two O-rings. The mounted glove was inserted into the port with the outside edge of the port pressed against a rubber coated aluminum plate and held in place by four or six bolts. This arrangement corresponds to the configuration used to secure gloves on LLNL vacuum boxes. A 1/8" x 17 NPT inlet in the plate equipped with a needle valve and compressed air line was used to inflate and burst the test gloves. Pressure within the inflated gloves was measured by a calibrated magnehelic gauge. The results of our tests are listed on the attached table.

As pressure was applied to the test glove it became rigid and the pressure rose significantly. After the glove began to deform the pressure dropped quickly (< 30 sec) and leveled off at the burst pressure. As can be seen from the times reported to burst, there is in some cases a significant variation. Since our inlet flow was set at a constant rate, this fluctuation in time must be related to the variation in elasticity of the gloves we tested.

Stan Lord observed all of our tests and participated in the data collection and experimental observations. If you require any additional information or tests don't hesitate to give us a call.

James S. Johnson, Leader
Safety Science Group

Charles Harder
Safety Science Group

cc: J. Becker
R. Griffith

University of California

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Glove Bursting Data

<u>Glove Type</u>		<u>Initial Pressure psi</u>	<u>Burst Pressure psi</u>	<u>Time to Burst (Min)</u>
1	Cat. #5N1532 Cuff Dia. 5"	Glove #1 0.90 (25.0)*	0.72 (20.0)*	7:15
	15 Mil Neoprene Norton	Glove #2 1.22 (34.0)	0.68 (19.0)	3:30
2	Cat. #8BSF-1532A Cuff Dia. 8"	Glove #1 0.67 (18.5)	0.53 (14.8)	9:01
	15 Mil Butyl Norton	Glove #2 0.65 (18.0)	0.57 (15.8)	9:44
3	Cat. #8B1532 Cuff Dia. 8"	Glove #1 0.43 (12.0)	0.40 (11.0)	7:47
	15 Mil Butyl Norton	Glove #2 0.43 (12.0)	0.38 (10.5)	7:30
4	Cat. #8B3032 Cuff Dia. 8"	Glove #1 0.83 (23.0)	0.68 (18.8)	7:49
	30 Mil Butyl Norton	Glove #2 0.86 (24.0)	0.66 (18.2)	7:04
5	Cat. #8N3030 Cuff Dia. 8"	Glove #1 2.16 (60.0)	1.76 (49.0)	3:39
	30 Mil Buta-Sol Charco	Glove #2 2.27 (63.0)	1.84 (51.0)	4:18
6	Cat. #7BT-2532 Cuff Dia. 7"	Glove #1 0.68 (19.0)	0.46 (12.8)	8:43
	25 Mil Butyl Norton	Glove #2 0.64 (17.8)	0.49 (13.5)	19:30

*inches of water

ENVIRONMENTAL PROTECTION

Gloved Box Expansion and Pressure Test

In a recent experiment in Building 241, an inert hard vacuum gloved box was used to perform experiments with unstable hydrides. Theoretically, if the hydrides were to disassociate, a large volume of gas under pressure would expand into the gloved box. A 2-psi pressure relief valve was deemed necessary for safe relief of the entire system. The relief valve would be adequate if all the gloved ports covered with the gloves inside the box were properly secured. However, during the times when the gloves were in use, the weak link in the system would be the bursting pressure of the gloves.

A quick experiment was set up to determine the bursting pressure and the approximate free volume of the two standard types of gloves normally used at LLL. Glove A is fabricated from 30-mil neoprene, and Glove B is fabricated from 30-mil butyl rubber with a durasol coating. Both are manufactured by Charleston Rubber Co.

Each glove was attached to a standard 8-in. gloved port and was secured with an aerosol clamp. An aluminum plate was attached to the gloved port with the proper hose-barb connection.

Both gloves were quickly filled with air to simulate a sudden expansion. A monometer was used to measure the resultant pressure on the glove. Both gloves reached an equilibrium pressure within a few seconds. However, the free volume obtained by the butyl glove was approximately twice that of the neoprene glove before bursting.

The results of the tests are given below:

Glove	Bursting pressure	Approximate volume
Neoprene	1.1 psi	0.5 m ³
Butyl	0.5 psi	0.2 m ³

In conclusion, the bursting pressure of the gloves should be considered in designing a pressure relief valve for the system.

The following photographs show a sequence of the glove expansion. The black glove is the neoprene glove (Fig. 44).

Fig. 44(A). Neoprene glove expansion test.

Fig. 44(B). Butyl rubber glove expansion test.

ITEM		PART NO.		MATERIAL / DESCRIPTION		WEIGHT		SPEC. NO.		ALL OTHER NO.	
<div style="display: flex; justify-content: space-between;"> <div> <p>DR. <u>W.D.</u> <u>1963</u></p> <p>DR. <u>W.D.</u> <u>1963</u></p> <p>APPROVED <u>2/28/64</u></p> <p>SIGNED <u>DATE</u></p> </div> <div> <p>THIS DOCUMENT IS THE PROPERTY OF THE NATIONAL LABORATORY. IT IS TO BE RETURNED TO THE NATIONAL LABORATORY ON REQUEST. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.</p> </div> <div> <p>MAJOR UNIT <u>BLDG 231</u></p> <p>SUB AREA <u>SCIENCE - PHYSICS</u></p> <p>INTERNAL ACCESSION SHEET NO. <u>C</u></p> </div> </div>											
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Interdepartmental letterhead

Memorandum 384

Ext. 25267, 25170

December 20, 1982

TO: Stan Lord L-341

FROM: Jerry Schweickert, Industrial Hygiene Group
Ross Wilson, Health Physics Group
RSW

SUBJECT: Airflow into Glove Box Openings

The Health and Safety Manual Supplement 12.03, "Work Enclosures for Toxic and Radioactive Materials" addresses airflow requirements for glove box openings. The inward airflow through any opening to control hazardous materials is 150 linear feet per minute (1 fpm) when feasible. However, a lower value may be accepted in some situations.

For the case of vacuum boxes which are not designed to move large volumes of air, a rate of 150 lfpm is difficult to achieve. This criteria is valid for the box proper where loose toxic materials will be used and an accidental breach could cause external contamination. In pass through ports, an airflow less than 150 lfpm is acceptable if hazardous materials are suitably contained or in a nondispersive form. At no point in the opening should the flow drop below 50 lfpm, which is the minimum needed to overcome room drafts or turbulence from passersby.

After modification, each glove box should be evaluated by the Hazards Control Safety Team to ensure its adequacy for the intended use.

JS:RW:jre

cc: J. Becker L-327
P. Linnes L-369
Bldg. 241 File
Date File

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ATTACHMENT #5

Interdepartmental letterhead

Mail Station L 369

Ext: 2-9932

February 28, 1986
EDS-86-19

TO: K. L. Blædel

FROM: E. H. Schmitt *E.H.*

SUBJECT: Check Valve Development For The Mercury Bubbler, MKII

A number of accidental spills of mercury have occurred while a glove box is under vacuum when the bubbler has been jarred allowing a burst of air to push the mercury into the vacuum box not only contaminating the box contents with mercury but air as well. A solution to this problem is to place a ball and seat check valve between the glove box and the bubbler to act as a positive vacuum seal and hence limit the amount of mercury required while the glovebox is under vacuum. Conventional check valves available through vendors are not compatible with many of the glove box contents. The possibility of corrosion or a reaction between the glove box contents and the check valve could lead to a catastrophic failure.

The check valve design shown in the attached drawing (AAA84-111179) provides a high conductance flow channel during the pressure relief state by pushing a hollow stainless steel ball (item 6) located in a cage (item 4) against a flow through seat (item 1). Alternatively, the check valve provides a seal against flow during the state where the glove box is at vacuum by a hollow ball floating on a column of mercury thus being forced against a Sil Guard seat (item 2). A sight glass is provided in the design to allow an outside observer to view the location of the stainless ball.

EHS:bjh

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NOTES

UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. SURFACE TEXTURE PER ANSI B46.1-1978.
3. PRESS FIT ITEM 4 ON ITEM 2 ORIENT TO AVOID PORTS

4	SOC HD CAP SCR 10-32 X 2 1/2 LG CRES	8
2	O'RING 1.737 ID X .103 W BUNA N #2-132 PARKER	7
1	BALL, HOLLOW, Ø 1.250 ± .002 X .064, CRES 410 INDUSTRIAL TECHNOLOGICAL	6
1	84-111184 SIGHT GLASS	5
1	84-111183 CAGE	4
1	84-111182 SPACER	3
1	84-111181 UPPER CAP	2
1	84-111180 LOWER CAP	1

NO	REQD	PART/ILLU	STK NO	DESCRIPTION/MATERIAL	SPEC NO	ITEM
		DWN I. MURRAY	7/84	CLASSIFICATION	MAJOR UNIT	
		CHK. WOLTERS DOUG	7/84	THIS DOCUMENT IS THE PROPERTY OF THE UNIVERSITY OF CALIFORNIA LAWRENCE LIVERMORE LABORATORY	SUBASSY	BUZZLER - BALL CHECK
		APVD B.C. Ford	7/84	REPRODUCTION PROHIBITED UNLESS PERMITTED BY THE MECHANICAL ENGINEERING DEPARTMENT	DETAIL	CHECK VALVE
		TITLE	DATE	SHOWN ON AKA	DRAWING NO	COPY
				ACT 3531-19	AAA84-11179	0A
				SCALE	1.00	SHEET 7 OF 7

A 1/8" DIA 1/8" B5 ITEM 6 WAS TEFLON

LTH DWN CHE DATE ZONE CHANGE

12-1000-1
(Rev. 5-88)