

HAWGS

Hall-A

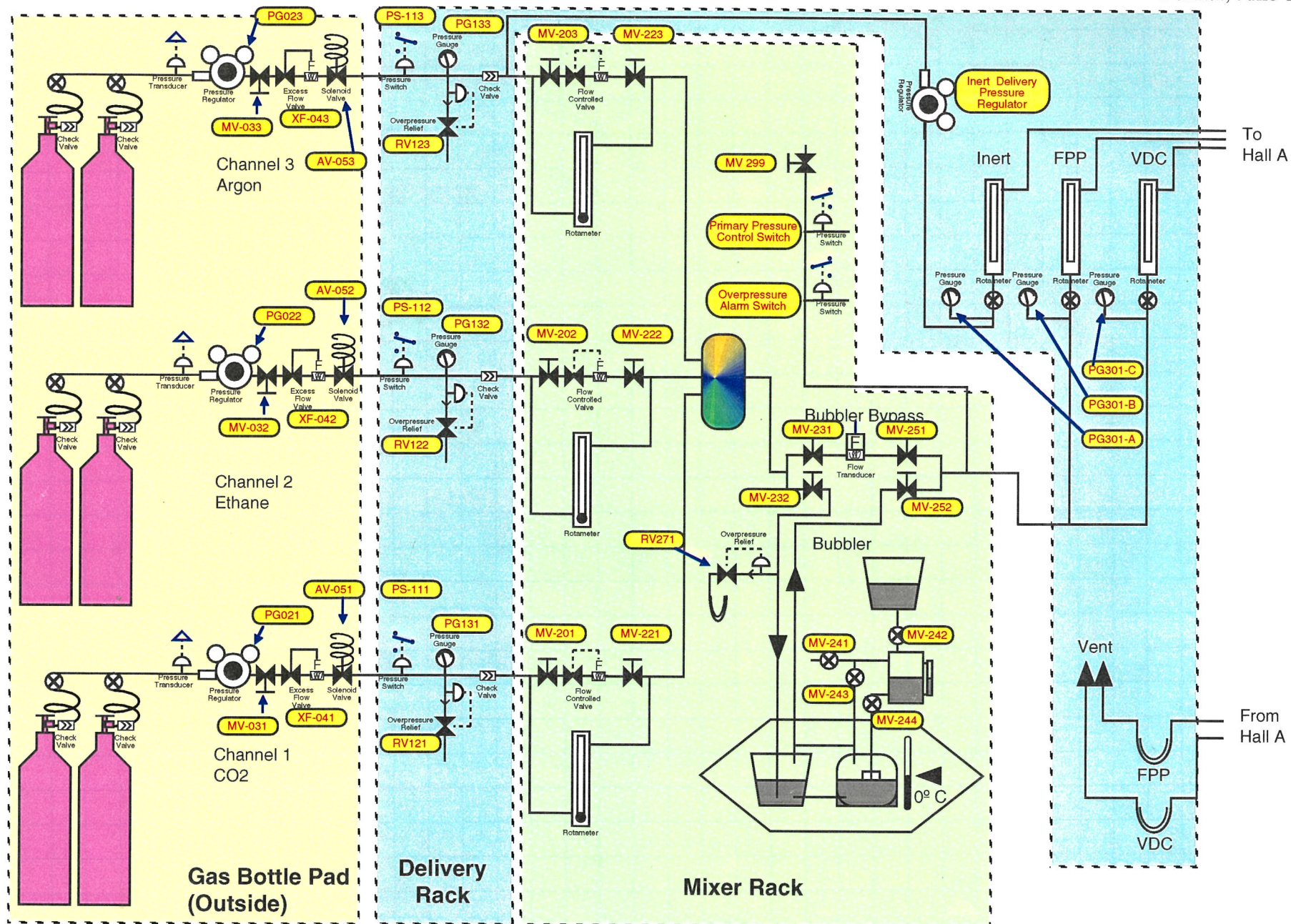
Wire chamber

Gas System

OPERATIONS LOG

Hall A Gas System - Gas Schematic in Gas Shed

Fenker, June 1996



17-July-96

3

→ All interlocks jumped out except

AIRFLOW

Gas Steel Overtemp

Post Mixer pressure

Low Supply Pressure

→ Channel 1 (CO_2) Leak checked in Gas Steel using CO_2

→ Channel 3 (Air) " " using N_2

Exercising pressure control loop using N_2 in channel 1 at 100 sccm and tiny outlet flow. OK after 24 hours.

Temporarily install SRS SR630 to read thermocouple on bubbler.

initial reading was 0.0°C . Not bad. Touched TC to verify sensitivity & went up to 5° , now drifting back down. 1.8° after ~10 minutes. SR630 recording T_{bubb} every 5 min. Set Date/Time correctly.

Thermometer inserted through TC lead hole in top of reefer reads $\sim 8^\circ\text{C}$. Temp control set $\sim 90\%$ max.

To test Ethane system I changed inlet hoses so I could connect a CO_2 bottle to the Ethane line. Leak check & piped Ethane circuit (#2). ✓

Now flowing N_2 (ch 3) and CO_2 (ch 2) at "100 sccm" each.

Set relief pressures on RV121, RV122, RV123 to just stop flow at nominal pressure. (45 psi on Air & Ethane. CO_2 has to be a little lower??)

1705 - Bubbler temp now at 2.6° and $\sim$ steady. Room temp. is 32°C .

July 22, 1996 0845

$T_{\text{BUBB}} = -3.6$

Channel 2 (Ethane $\leftarrow \text{CO}_2$) was 'off'. Turned on. Flows normal now.

CO_2 Supply pressure dropped to 36, but regulator still at max.??

26-July-96

0900 $T_{Bobb} = -2.4^\circ$ on TC. Thermometer reads 4° .

Opened FPP valve a little to lower pressure...

Dynamax Channel 2 went 'off' when program C switched in. Reset.

* We've got a problem here with Ch. 2 *

Cycled pressure again, and again it tripped off.

29-July-96

11:30 Same exercise as above - did not trip off this time. 'OK'? $T_B = -1.4$ Check: Controller was in "non-VG" mode, as desired.It appears that the DM-2401 does remember the ON/OFF status of each FM-8 channel in each of the flow programs (A, B, C, D). The ON/OFF status seems to be set while in 'flow' mode.As of now, to test, I have Ch. 1 on only for program B.
2 & 3 are always on. 4 is always OFF.

All ramp times set to 2 seconds.

Set-up Program A in ratio modes:

Ch.	Flow
1	off
2	66.6 %
3	Mester - 400 sccm
4	off

$$6\%_{40} = \frac{40}{60} = 66.6\%$$

... seems to be OK.

Back to fixed flow (AUTO pressure) mode. $C = 0 + 250 + 250 + 0$
 $D = 0.$ 8/6/96 Flows set to 900 sccm N_2 (ch. 3), others = 0.

Bring Alcohol sight-glass up to pressure: open MV-243+244.

—Must go slowly to avoid tripping X-Cross flow valve.

Purge canister by cracking MV-241. and rotameter on ch. 3. (MV-242?)

Sight-glass canister leaked around top seal. Tightened clamps.
Now leak-tight at 15 psig.

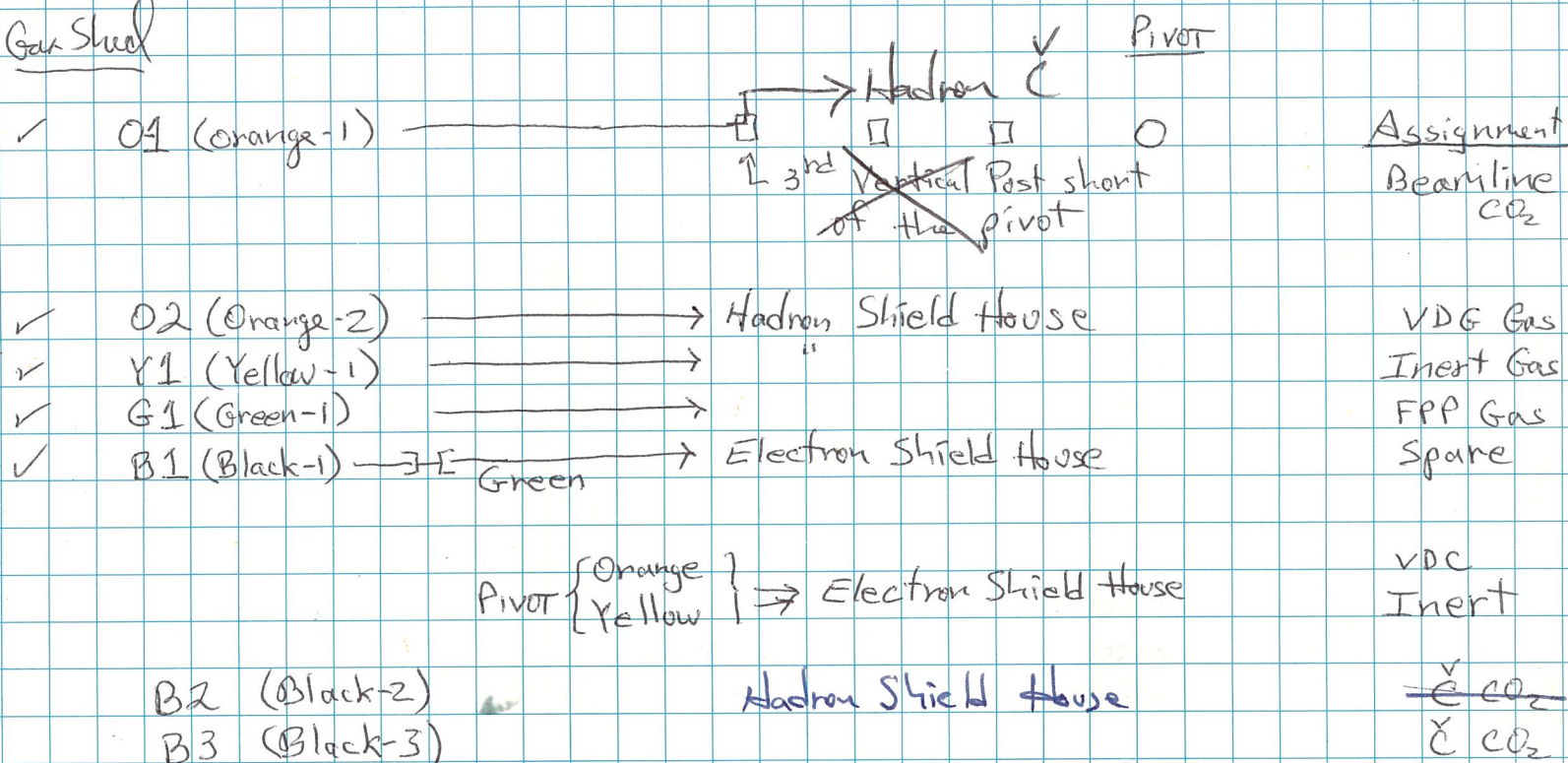
8/9/96

5

Gas line pulls.

Note: VDC & Inert get feed at the pivot.

Lines have splices in the truck ramp cable tray - above the big '56' painted on the wall.

Gas Shield

↑ Check-mark (✓) indicates lines have been blown out with N₂.

Temporary setup: Supply on Ch. 3 is pre-mixed ArCO₂. Flow metered at 900 sccm. Feed to Electron House via tube B1 (green in e-house).

8/21/96 Cable from High-Pressure Transducer at bottle rack into gas shield

Red	+24	
Black	Common	
Orange	Transducer #1	Signal
Green		2
Blue		3

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Sept. 12, 1996

On 9/5/96 completed VDC connection from gas shed to
 Eduction air shield house for both VDC gas and inert gas.
 Supply is one bottle of 85/15 Ar/CO₂ pre-mix through Ar channel.
 Flow rate at gas shed outlet is 10 (~34 slph).

Today bottle pressure is 1200 psi at 11:30 AM.

Supply lines to Hadron are changed also and capped in the shield house.
 All lines were blown out with N₂ and purged for ~30 min. with Ar/CO₂.

Sept 17, 1996 ArCO₂ bottle pressure is 550 psig. at 17:50

9/17	1800	550	
9/12	1100	1200	⇒ ~130 psi/day
<u>5</u>	<u>7</u>	<u>700</u>	

Bottle will be empty ~ 4 days = 9/21 = Saturday

$$T_{alc} = -0.8^{\circ}\text{C}$$

21-Sept-96 22:20 H7

ArCO₂ bottle pressure is 1925 psig.

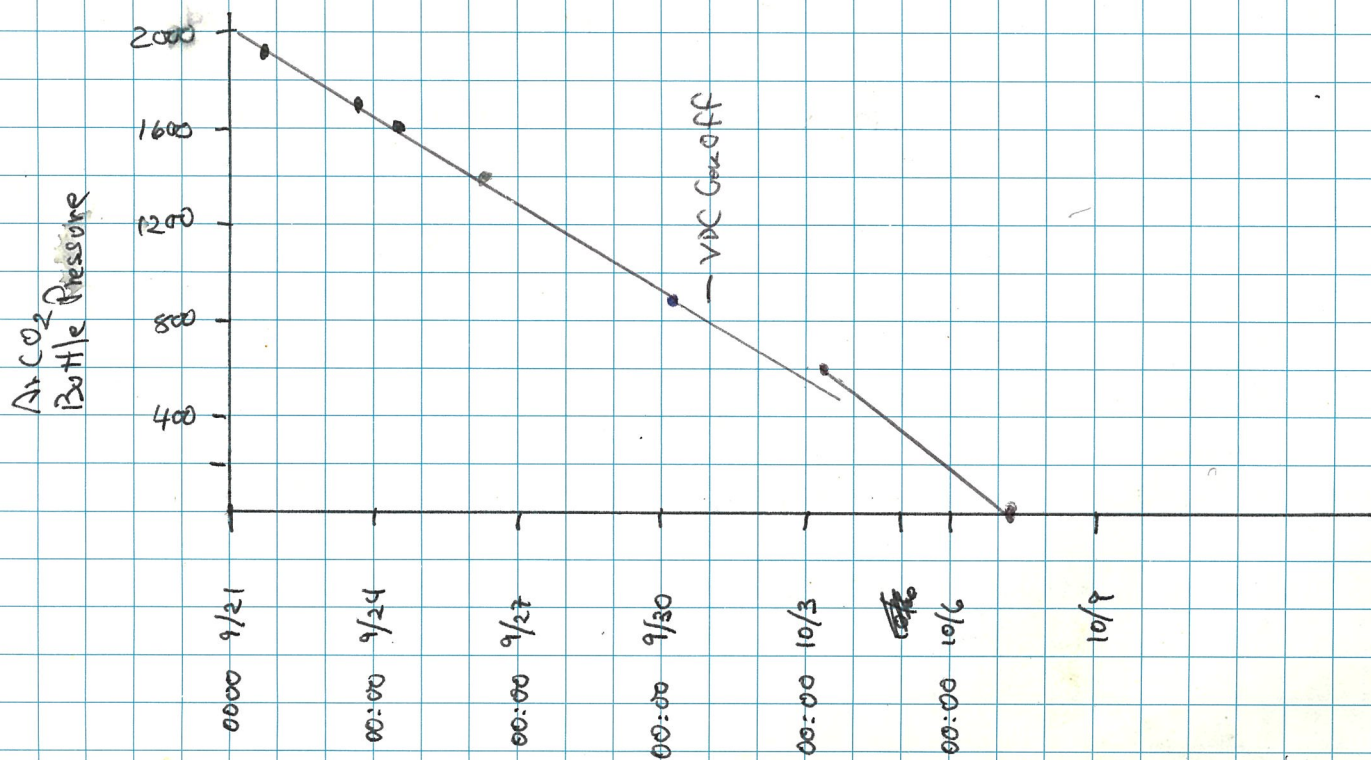
Note: XF-043 is set to 'ON-RESET' for now.

23-Sept-96 1530

Bottle press. = 1700 psig.

24-Sept-96 1200

Bottle press. = 1600 psig



10/8/96 0830

Found rain leaking into gashead through ceiling

Put Ale. bubbler on bypass. (There is no gas being supplied - ArCO_2 bottle empty)

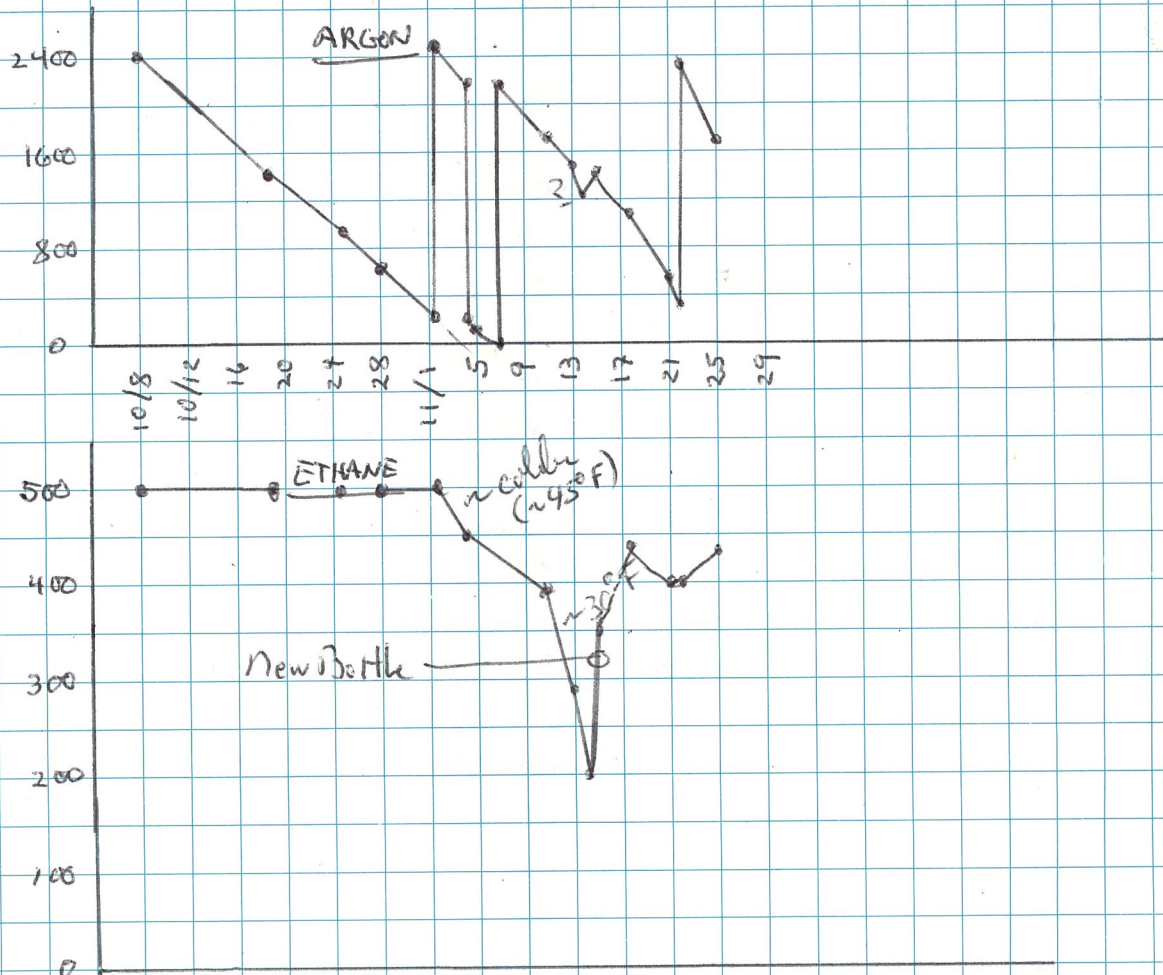
Follow procedure to add 2 Gal. Ethyl Alcohol VSP

(Found leak in bottom of Alcohol fill can - at weld)
(Removed fill can to take to shop for repair)

Ale. level is $\sim 1.2"$ below top of sight glass

1145 H7 & BW put on Argon 62% + Ethane 38% through alcohol.
(620 sccm + 380 sccm - Calibration constant 1.45/0.50)

10/9/96



Installed temporary vent on E-Arm to get VDC exhaust out of shield house

1-Nov-96 HT 1220 Valved on new bottles of Ar and Ethane. New bottles are on right-hand-side. We must tag. Valved off old bottles which are not empty. Purpose is to provide flow over weekend while nobody is present to change bottles which would run out.

4-Nov-96 HT 1240 Switched back to the mostly empty bottles to consume remainder of gas.

7-Nov-96 HT 0900 Ar ran out overnight. Alarms worked. Replaced empty bottle and valved on the standby bottle. Note that there is a problem with the '400V' check valve on Ar manifold - RHS.

14-Nov-96 HT 1055 Getting intermittent 'Electron VDC Oxygenum' (vent) alarms. Plumbing to e^- VDC is mis-labeled. Be careful.

15-Nov-96 1100 HT Replaced empty C_2H_6 bottle.

21 Nov 96 JD Hadron arm supply plumbing corrected. Fixed all leaks in gas shed (3) tested with sweep & electronic gas detector. 1 leak remains hadron arm behind bubbler to ~~right~~ left when looking at panel from rear.

HT Fixed leaks in Hadron bubbler panel & I/O lines to detector.

19-Dec-96 HT 1445 Set Ar/Ethane mixer flows to 820/500 sccm to try to supply more gas. System had been operating at ~4 psig due to mixer flow limit.

1620 - Checked individual flowmeters. Current flows are (at 3.6 psig)

H ₂	35	30	18	18	40	34	e ⁻	25	38	Arbomate
	11.5	10	6.4	6.4	13	11		8.5	12.4	~ slph

Total = 78.2 slph = 1303 sccm.

At 500 + 820 = 1320 sccm supply we could, in theory, just make it.

12/19/96 Continued

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* Set Mipec to 900/553, then overriding ethane controller by 10%.

12/20 HF

- Alcohol temp. is $\sim -3^{\circ}\text{C}$. Cold outside. Can't do much about it.
- Reset leak sensor low/high trip levels to 10/25 %LEL per flammable gas procedures, Was 20/40 %LEL per manufacturer's recommendation.
- Supply pressure has crept up to ~ 9 psig.

3-Jan-97

- Supply pressure is 10 psig on PG-301-B/C
- Flows: VDC = 9 FPP = 15 units on rotameter next to PG-301 B,C.
- Mipec is delivering 900 Ar, 553 Ethane (sccm)

* Prepare for static leak tests.

At hydrogen gas panel. All MV-51x set to 'operate'!
PG 501 B,C = 10 psig 501-A = 14.5 psig.
Flows at MV521-526 = 30, 30, 30, 23, 39, 39
Bubbles on VDC-Top, FPP1, FPP2. VDC-Bottom needs more oil.

At helium gas panel. All MV-41x set to 'operate'!
PG 401C = 10 psig PG 401A = 15 psig
Flows at MV-421-22 = 20, 32
Both VDC's bubble

Close MV 421, 422.
Close MV 521-526.

Pressure stabilized at PG 301C = 14.5, PG 301B = 15, PG 301A = 14.5 psig.

Close MV 302 A, B, C. Trip AV-051, 52, 53 with crash button in gas shed.

PG 133 = 42, PG 132 = 44.5, PG 131 = 5.5 psig

11:00 AM PG 401A = 14.4 PG 401C = 14.0 / PG 501A = 14.4 PG 501C = 14.0 PG 501B = 14.4 psig
(Purge) (VDC) (FPP)

		<u>length</u>
Supply lines: ~260'	from detector gas panel to pivot.	A
20'	pivot to Tees near end of 6" cable tray.	B
75'	~ to East wall	C
140'	~ to lower personnel door on truck ramp.	D
260'	~ to truck ramp penetration into gas shed.	E
15'	~ to delivery rack in gas shed	F

FPP Supply line: $A+B+C+D+E+F \approx 770'$ ($\sim 18\ell$)

VDC Supply line: $2 \cdot (A+B) + C+D+E+F = 1050'$ ($\sim 25\ell$)

Tubing ID = $\frac{3}{8}"$

The 45 psig data. are $\sim 45'$ of $\frac{1}{4}"$ Ca tubing.

Note Leak rate is $\lambda \Delta p$ λ is leak size in $\frac{V}{FP}$ or $\ell/h \cdot \text{psi}$ for example

Contained volume V in $V(t) = V_0 - \int_0^t dt \lambda \Delta p(t)$ and $p(t) = \frac{P_0}{V_0} V(t)$

or $\frac{dV}{dt} = -\lambda \Delta p = -\lambda \left(\frac{P_0}{V_0} \right) V(t)$

or $V = V_0 e^{-\Lambda t}$ $\Lambda = \lambda \frac{P_0}{V_0}$ and p is gauge pressure

$\Lambda = -\frac{1}{t} \ln \left(\frac{V}{V_0} \right)$ (10.1)

$= -\frac{1}{t} \ln \left(\frac{P}{P_0} \right)$

↓ already closed
11:15 Close MV221, 222, 223, PG 131, 132, 133 = 5.5, 39.0, 30.0 psig.

- Restore solenoid valve power (reset interlocks)

PG 131, 2, 3 = 5.5, 46, 44
CO₂ Eth Ar

11:20 - Again ~~trip interlock~~ close solenoid - this time by disconnecting its power & jumping low-pressure alarm ckt.

11:40 Using SNOOP I located a small leak in Argon ckt. at rotameter inlet after MV-302A. Repaired.

Similarly found leak in FFP ckt. at rotameter inlet after valve MV302-B. Fixed.

... and outlet of rotameter after MV-302-C !! Fixed.

12:05 Turn supply interlocks back to normal mode & fill system w/ gas. Will have to re-start tests.

13:45 Pressure backup. Close MV302 A, B, C. Close MV222, 223

Jump low pressure interlock. Disconnect solenoid valve power.

PG 301A, B, C = 15.5, 15.0, 14.5 psig

PG 131, 2, 3 = 6.0, 44.5, 41.5 psig

13:51 PG 501A, B, C = 14.5, 14.4, 14.5 psig

(FFP2 supply bubbler is sucking air at about 0.5 bubbles/second)
(Added oil to VDC-bottom exhaust bubbler)

14:00 PG 401A, C = 14.5, 14.4 psig

14:20 14.5 14.1

14:27 PG 301A, B, C = 14.5, 14.0, 14.0

14:54 PG 301A, B, C = 15.0, 14.5, 14.1 PG 131, 2, 3 = 6.0 44.5 29.5

Note that RV123 is leaking slowly, even at 30 psig

16:45 PG 301A, B, C = 14.8, 13.8, 13.6

PG 131, 132, 133 = 6.0, 44.5, 19.5

16:50 PG 501A, B, C = 13.4, 13.2, 12.8

16:53 PG 401A, C = 13.4, 12.7

17:07 Starting pressure and approximate flows have now been restored. System back to normal operation. (Except that total gas consumption still exceeds min capacity.)

7-Jan-97

Summarizing Friday's measurements...

VDC delivery lines...

$$\text{Volume} = 1050 \cdot \frac{1}{144} \cdot \pi \cdot \left(\frac{3}{16}\right)^2 = 1050 \cdot 7.67 \times 10^{-4} = 0.81 \text{ ft}^3$$

$$\times 28.3 (\text{l}/\text{ft}^3) = \underline{22.9 \text{ l}}$$

PG 401C, 501C:

	14.5	@ 13:51
14.4		@ 14:00
	14.0	@ 14:27
14.1		@ 14:20
	12.8	@ 16:50
12.7		@ 16:53

1.7 psi in 3 hours
1.7 psi in 2:53

$$\text{In 3 hours } \frac{\Delta P}{P_0} \approx \frac{1.7}{14.5} \Rightarrow \Delta V \approx (22.9 \text{ l}) \cdot \frac{1.7}{14.5} = 2.7 \text{ l}$$

$$\Rightarrow \underline{\sim 0.9 \text{ l/h}}$$

FPP delivery lines...

$$\text{Volume} = 770 \cdot 7.67 \times 10^{-4} = 0.59 \text{ ft}^3 = \underline{16.7 \text{ l}}$$

PG 501 B

14.4	@ 13:51
14.0	@ 14:27
13.2	@ 16:50

1.2 psi in 3 hours

$$\text{In 3 hours } \frac{\Delta P}{P_0} = \frac{1.2}{14.4} \Rightarrow \Delta V \approx V_0 \frac{\Delta P}{P_0} = (16.7) \left(\frac{1.2}{14.4}\right) = 1.4 \text{ l}$$

$$\Rightarrow \underline{\sim 0.46 \text{ l/h}}$$

Inert Gas Supply delivery lines:

$$\text{Volume} = \text{same as VDC} = 22.9 \text{ l}$$

$$\Delta P = 14.5 - 13.4 = 1.1 \text{ psi in 3 hours (PG 401A or 501A)}$$

$$\Delta V = (22.9) \cdot (1.1/14.5) = 1.74 \text{ l}$$

$$\Rightarrow \sim 0.58 \text{ l/h}$$

1.8 slph

0.92 slph

1.16 slph

PG 132 - No change (44.5) in 3 hours $\Rightarrow$ no leak detectable in ethane det.
Ethane

$$V \approx (45') \cdot \pi \cdot \left(\frac{3}{32}\right)^2 \cdot \frac{1}{144} = 8.6 \times 10^{-3} \text{ ft}^3 = 0.24 \text{ l}$$

< 3.6 scch

Pressure reading precision ± 0.5

$$\text{So leak is } < \frac{0.5}{44.5} \cdot 0.24 = 2.7 \text{ cc/hr} \cdot \frac{1}{3} = 0.9 \text{ cc/hr}$$

PG 133

Argon

$$\Delta P = (41.5 - 19.5) = 22 \text{ psi in 3 hours}$$

$$\text{Linear approx. gives } \Delta V \sim \frac{22}{41.5} \cdot 0.24 = 0.13 \text{ l/3 hr} = \underline{0.04 \text{ l/hr}}$$

Exponential form (eqn 10.1) gives

$$\Lambda = -\frac{1}{t} \ln\left(\frac{P}{P_0}\right) = -\frac{1}{3} \ln\left(\frac{19.5}{41.5}\right) = 0.25 \text{ hr}^{-1}$$

$$\lambda = \Lambda \frac{V_0}{P_0} = (0.25) \left(\frac{0.24}{41.5}\right) \frac{\text{l}}{\text{hr} \cdot \text{psi}} = 0.0015 \text{ l/hr} \cdot \text{psi}$$

$$\underline{\underline{\text{leak} = 0.06 \text{ l/hr @ } 41.5 \text{ psi}}}$$

Note: RV23 leaks



All must be corrected to 'standard' volumes using operating pressures.

Results are written in the margin.

Notes -

- 1) Need to check $\frac{1}{2}$ " line joints
- 2) Need to use C_2H_6 sniffer over entire system
- 3) Need to fix adj / replace RV 123
- 4) Need to check RV 121-3 operation
- 5) Need static test of bubbler rack.

Check when done

☒ 1/22/97

☒ 1/22/97

☒ 1/23/97

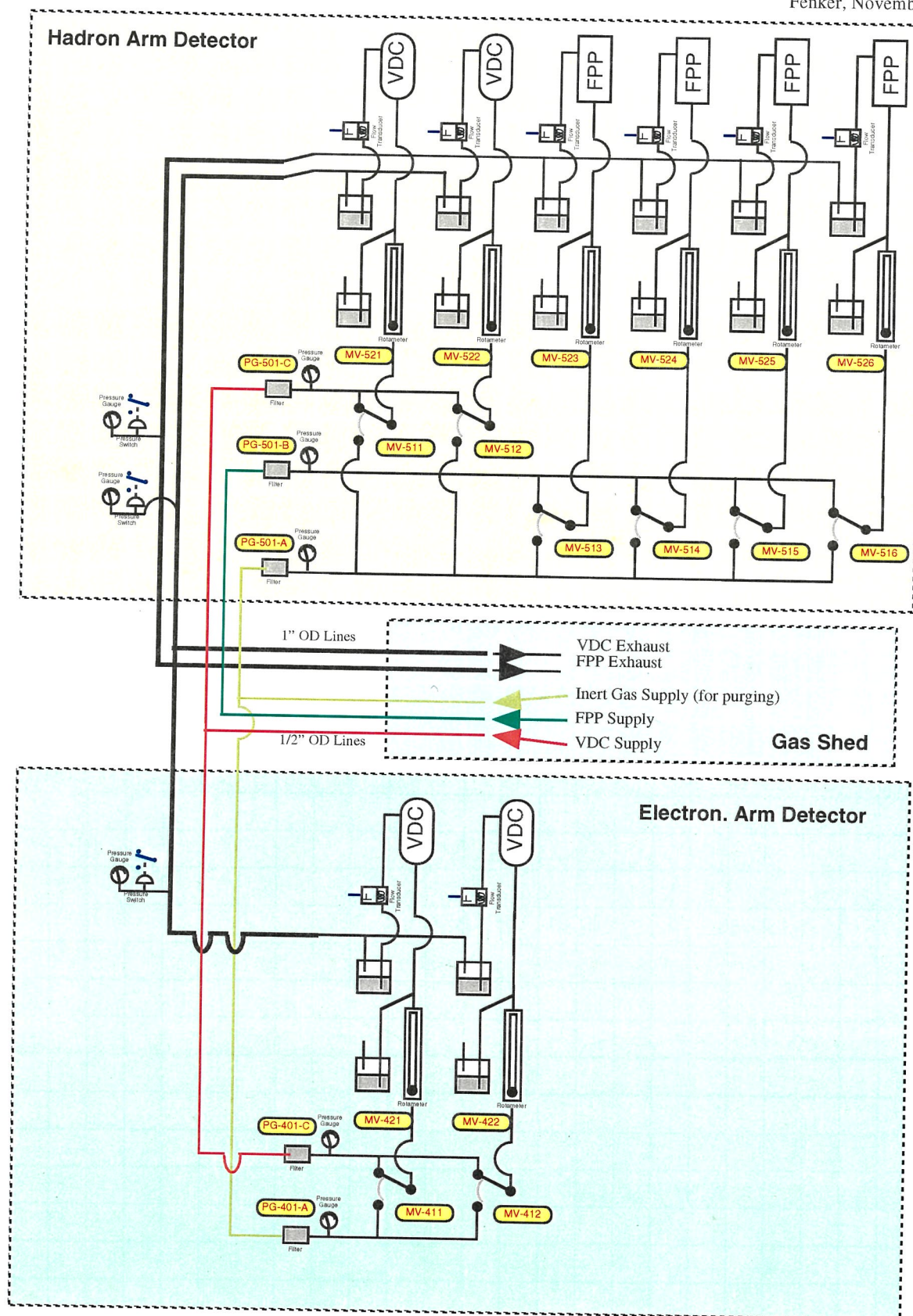
☒ 1/23/97

☒ 2/10/97

HT
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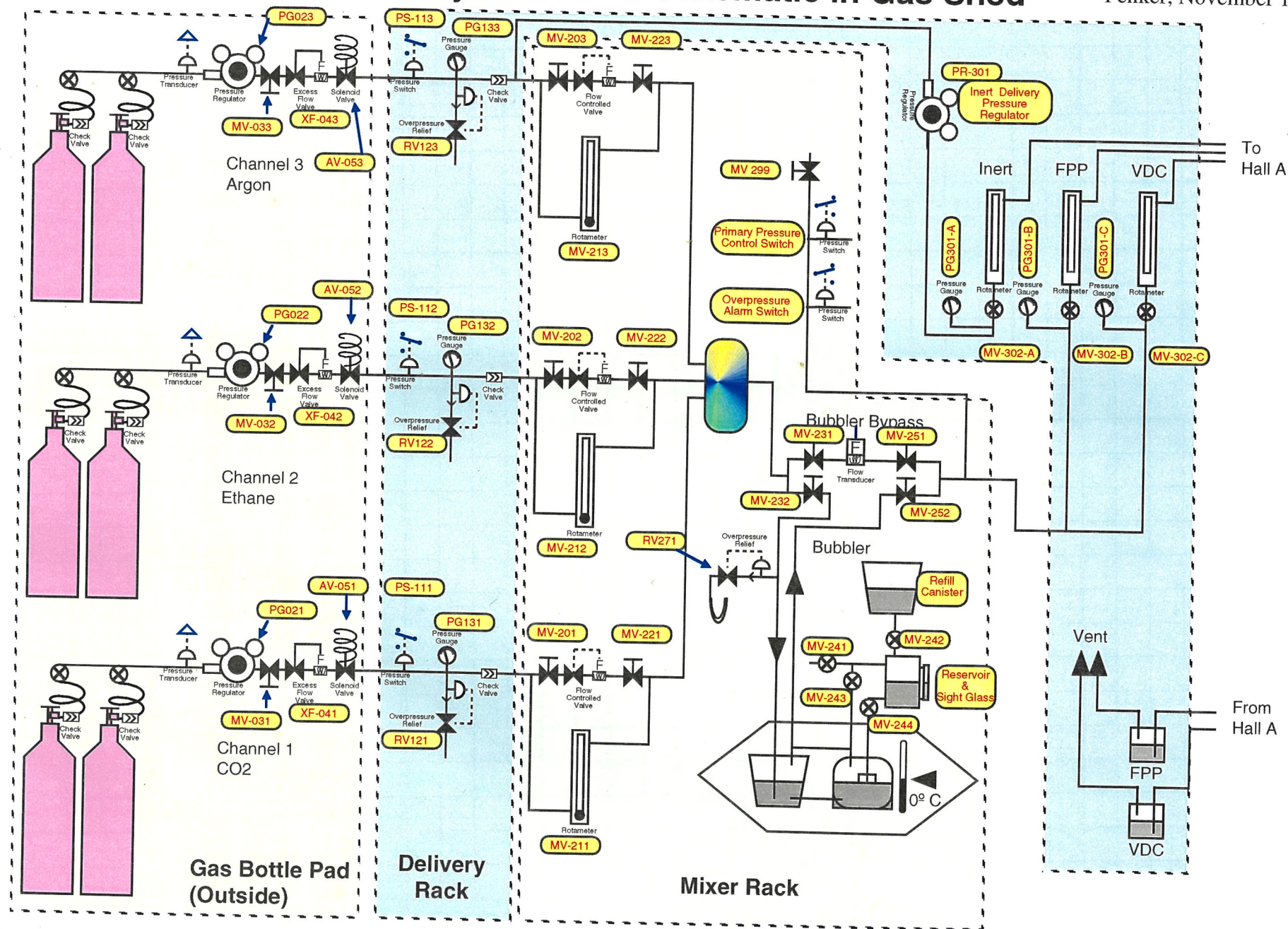
Hall A Gas System - Gas Schematic in Shield Houses

Fenker, November 1996



Hall A Gas System - Gas Schematic in Gas Shed

Fenker, November 1996



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10-FEB-1997

H7 - 11:20 Gas is back on after a problem last night / yesterday when the Argon Hg-Switch apparently would not stay on. All I changed was the Ar supply regulator pressure: I found Ar pressure at ~ 35 psig and I set it to 45, where it should be set. Maybe the knob got adjusted by mistake or maybe 30°F weather affected the setting (but it has been $\sim 30^\circ$ for many days). Or - maybe something is deteriorating - we must monitor this, I guess.

* I also re-zero'd the Electron Arsenic flammable gas detector system - it was reading -8% LEL, set to Zero.

Static leak, copper neck...

Close Solenoids. Close MV302 ABC. Bleed pressure down until digital manometer is on-scale, then stable. Close MV202, 203.

Time	Press	Temp (Steel)	Temp (Room)	~Volume Trapped
1145	1093.0	-1.4	6.3	~ 13 L
1200	1093.6	-1.4	6.3	
< Close MV-232, 252 >				
1210	1059.5			20.1 L
1214	1046.0			
< Open MV-232, 252 >				
1215	1094.5	-1.3	6.5	~ 13 L
1221	1094.1	-1.3	6.5	

Atmospheric Pressure = 803.1

10 Feb 97

1340

Filled 1 bottle Ethyl Alcohol per procedure

Using eqn 10.1 and data at bottom of p. 18

$$\begin{aligned}\Lambda &= -\frac{1}{t} \ln\left(\frac{P}{P_0}\right) = -\frac{1}{6} \ln\left(\frac{1094.1 - 803.1}{1094.5 - 803.1}\right) = -\frac{1}{6} \ln\left(\frac{291.0}{291.4}\right) \\ &= 2.29 \times 10^{-4} \text{ min}^{-1} \\ &= 1.37 \times 10^{-2} \text{ hr}^{-1}\end{aligned}$$

$$\lambda = \Lambda \frac{V_0}{P_0} = (1.37 \times 10^{-2} \text{ hr}^{-1}) \frac{13 \text{ l}}{291.4 \text{ mmHg}} = 6.13 \times 10^{-4} \frac{\text{l/hr}}{\text{mmHg}}$$

Nominal operating pressure is ~~~760~~ mmHg (14.7 psig)

$$\text{leak rate} = \lambda \cdot P = (6.13 \times 10^{-4})(760) = 0.47 \text{ l/hr at 14.7 psig}$$

Corrected to Standard Volume (gas at 1 Atm) this is ~0.94 l/hr

NB - This apparent leak may be dominated by temp. changes during the measurement interval.

12-May-97

8:15 AM Riad called me about "gas system alarm"

8:30 I had found that Ethane pressure is "0", tried to switch to second bottle, however the second "reserved" bottle also EMPTY! When I took the bottle from Jack reserved with label "FULL" it also appear EMPTY! Next in Jack's stock was OK.

8:45 the gas flow was restored. BW

970512 15,15 KF/JG

→ changed the Ar bottle & got a LOW PRESSURE & MAIN RELAY alarm. Followed the reset procedure & got all systems back again.

RESET procedure:

ALARM SILENCE

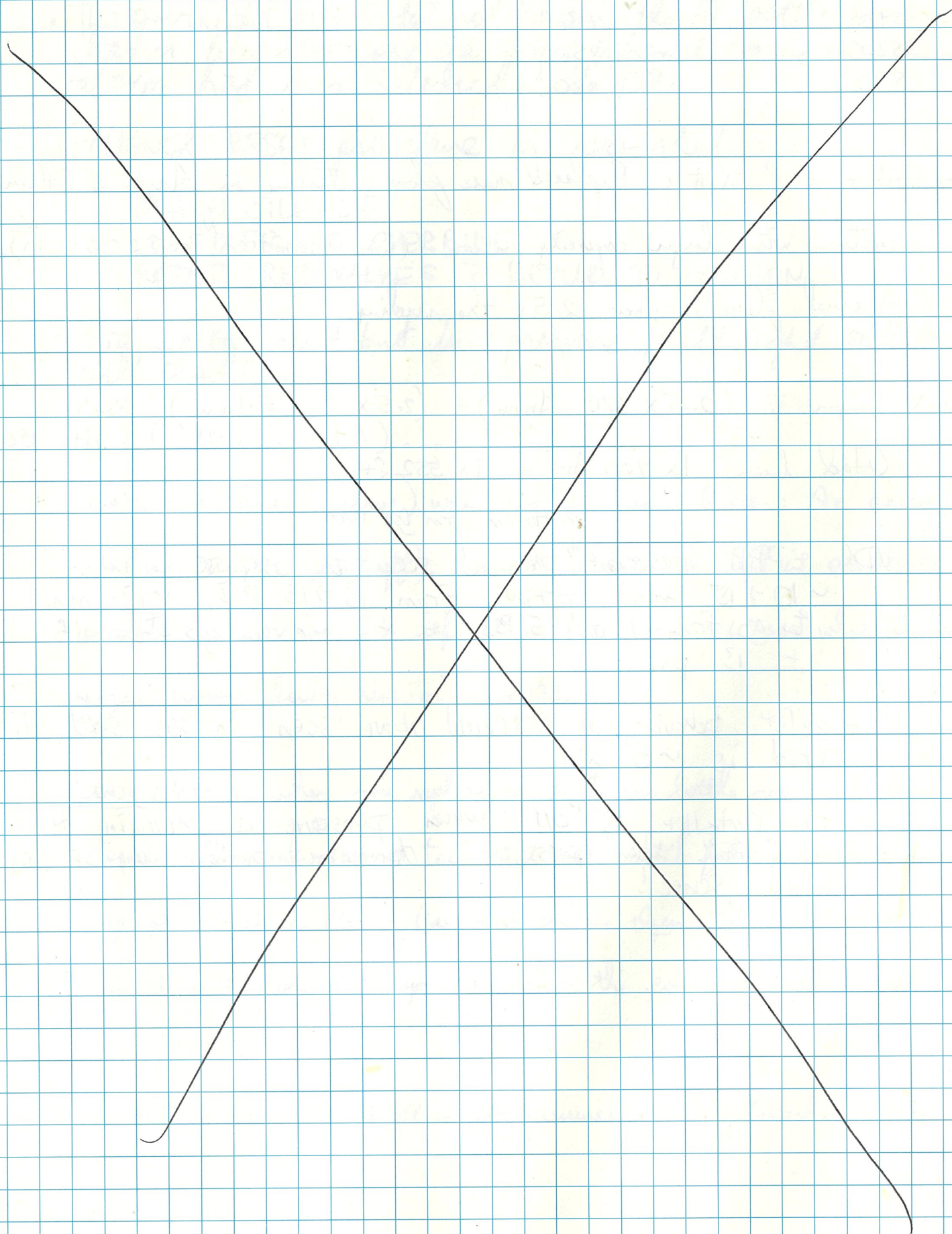
LOW PRESSURE OVERRIDE

ROTATE BOTH VALVES ON BOTTLES (RED) & RETURN TO POSITION.

5/27/97

9 am had found sound alarm was shut off by somebody without notifying Jack or me.

replaced Ar bottle, note that ethane near the end.



Daily Pressure log (To get a feel for how fast empty out)

Date	Ethane	Argon
5/27/97 12:00	800 + (psi) [new bottle]	2,500 (psi)
5/28/97 11:00	540	1,750
5/29/97 3:00	520	1,350
5/30/97	590	1,080

6/10/97 H. Finken & P. Rutt: Replaced mass flow controller on Argon & Ethane systems with larger capacity valves. (Was 1000 sccm ^{N₂}, Is 2500 sccm ^{N₂}). Actual flow is now 2.5x the reading.

Set mixer to $(2.5 \times 620 \text{ Argon}) + (2.5 \times 380 \text{ Ethane}) \text{ sccm}$.
(Had been 1x 900 Ar + 1x 552 Eth)

6/10/97
17:30
P.M. Rutt
VDC + FPP reset ^{in Hudson atm gas tank} pressures seem to oscillate with ~10-15 minute period. From 13-15 PSI, ~12 min. to go from 13 to 15 PSI & ~2 min. to go from 15 to 13 psi.

6/10/97
19:35
P.M. Rutt
Similar behavior as described above seen in gas shed, but period is ~8 min.

Flow controller is "ON" when pressure is increasing & is "OFF" when pressure is decreasing; perhaps all of this makes sense!

6/13/97 09:45 (KF)

- The overnight crew did not change the Ar bottle so we had a low-pressure gas trip. When I came in, the alarm had been silenced in the CH.

Followed RESET procedure in Gas shed

ALARM SILENCE

LOW PRESSURE OVERRIDE

ROTATE RED VALVES & RETURN TO POSITION

- main relay reset but low pressure fault light still on. Will check....

1430 HF (Called in by BD) ---

Low pressure fault (above) was never cleared. Reason: An excess flow valve was tripped (shut off). Probably it was not left in OPEN/RESET long enough this morning. I left it in 'Reset' for ~60 sec while I watched Argon pressure slowly rise on PG-133.

PLEASE NOTE: when you replace an empty gas bottle you must leave the excess flow valve(s) set to "OPEN/RESET" until full pressure shows up at PG132 or PG133 (see diagram) — then the LOW PRESSURE fault will clear and you may return the excess flow valve (XF-042/043) to "AUTO".

Now all is OK. VDC & RPP supply pressures climbing towards 15 psig.

970619 17:30 (KH)

We are showing a 15% LEL alarm in the Gas House, but nothing is obvious as to what is wrong. Will track it.

Jack sniffed out the leak. It is the exhaust tubes above the sniffing unit as well as the bubbler apparatus. Also, there are two capped spigots on the back of the bubbler - capped with duct tape. Replace the caps with brass fittings.

After that & some time has passed.

No gas detectable with TIF8800 detector. Still showing 15 on Gasmaster in C.R. I read
 - 1.77 Volts from black to red wire on sensor head.
 - 0.88 Volts from green to red wire on sensor head.
 Calling it quits for now.
 FPP does not bubble.

20-JAN-97

1030 HT

- ① FPP new bubbles - chamber leak, return line disconnected at shield house?
- ② Working on LEL reading problem...

*→

* Jumped lead alarm on back of interlock chassis so I can work.

Measure round-trip resistance of single-pair wire (leak status line) from gas shed to counting room: $84 \pm \Omega$. Thus 3// wires will give 28Ω loop. Spec. calls for 12.5Ω max. Known problem ... we need to pull bigger wires. Existing wire is 28 AWG. We need 18 AWG or larger. $\left(\frac{84}{12.5} \sim 6.5 \right)$ Reduce AWG by 9 to lower R by 8.

Nominally, CROWCON sensor head gets 375 mA at 2V. With a loop resistance of 28Ω we will have an IR drop of $.375 \times 28 \approx 10V$, so we would need $10+2 = 12V$ at control unit.

Currently 7.92 V at controller. Map. avail. is $\sim 8.9V$ Set 8.9V and zero the reading ($\sim 2\%$).

*→

Jump removed. 11:00 HT

14-July-97

1530 HZember

Added 1 Gal. alcohol to bubble reservoir.

NOTE: LIGHTS IN GAS SHED ATTRACT BUGS!

20-July-97

17:50 HZ

~~Low Pressure~~ 'Over Pressure VDC Electron' was tripping intermittently for last ~18 Hrs. Jumped at Gas Shed alarm chime. System looks OK from gas shed. Note that VDC bubble is 'breathing' - a long string of bubbles then a ~10s pause.

21-July

0900 HZ

Electron sensor is no longer tripping like it was (0 times in 10 minutes) - and VDC bubble is nearly steady now - not 'breathing'! → ReArm alarm and notify experiment to call me if there is an alarm.

19-Aug-97

11600 JD

HALASC17 is VME controller. Configured by James Proffitt. Outputs on CH1, CH2 & CH3 of HP E1313A. Can start work on Medm/display.

29 Sept 97

KF 16,30

Low pressure alarm. Probably due to some work on the Gas System during the day. Reset.

12/12/97

JS Emptied the "rain bucket."

9/30/97

GasMaster Flammable Gas Sensor Calibration Procedure (Hall A Detector Gas System -- HAWGS)

1. Ensure that the sensor head is in an atmosphere containing no flammable gasses.
2. Check the voltage **at the terminals of the sensor head**. The voltage between the black and red terminals should be 2.05 V. Adjust this voltage using the 'Head Volts' control on the input/alarm card.
3. Turn the 'Zero' adjustment on the input/alarm card to obtain a reading of 0% LEL.
4. Apply the calibration gas (50% LEL Methane) to the detector at a rate of no more than 0.5 liter per minute.
5. Adjust the 'Cal' control on the input/alarm card to give a reading of 70%LEL. (This calibrates the system for Ethane detection).

	Head Volts	Final Cal Reading (70% Normal.)	Final Zero Reading	Trip	
				Low	High
Gas Sh	2.01v	87%	1%	10	26
(2) Elevation	2.03v	70%	2%	10	26
(3) Hadron	2.05v	70%	1%	11%	24%
(3) Gas Shed	2.03	70%	0%	10%	26%

6328

9/30/97

All 3 heads tested & calibrated and trip levels checked per notes above.

HCFenken 9/30/97

Punfkin 9-30-97

10/7/97 H7 & JS Re-Calibrated Gas Shed sensor. At ~1700 it was reading 10% LEL. Head voltage measured 1.99v, but with a different DVM than before. Final readings: 0% - 64%.

11/7/97 13:40 refilled ethanol reservoir. Filled to about $\frac{1}{2}$ height of sight tube. Left upper reservoir full of ethanol to minimize water absorption in the ethanol. It is raining today. Shed roof still leaks.

12/12/97 19:46 Emptied the "rain bucket." Check after the next rain ~~to~~ to see if roof leak is repaired.

2/24/98 10:30 HF

① Found system in alarm - Argon bottle empty. No back-up bottle in the supply rack. Carted in new bottle and put on line. 10:35

② 7:00 am is dry. Rain bucket is empty.

Mixer running at $(2.5 \times 382) \text{ sccm}$ Ethane + $(2.5 \times 620) \text{ sccm}$ Argon.

About 1" of Alcohol showing in sight tube.

12:15 Supply P ~ 15 psig at PG301 B/C Flows are 12 (VDC) 29 (FPP)

System don't make enough gas to enter pressure control loop.

2/27/98 09:30 KF

→ replaced both C_2H_6 bottles but of course the alarm tripped because there was nothing to switch to. Reset alarm.

3/10/98 1650 HF

MJ reports 12 psig at And. shield house. FIP flow at 11V302B is 40

→ ~ 116 sL/h. VDC is getting ~ 37 sL/h. Total ~ 150 sL/h

Mix rate is currently $((620 + 380) \times 2.5) \text{ sccm} = 2.5 \text{ sL/m} = 150 \text{ sL/h}$

So we're at map,

So - increase mix rate by ~50% to

$$620 \times 1.5 = 930$$

$$380 \times 1.5 = 570$$

An.

Ethane

} x 2.5 actual scfm

$$= 3.75 \text{ l/m}$$

$$= 225 \text{ l/h}$$

**

Done. 1655 March 10, 1998. H

1714 - Pressure loop cycled off.

1716 - Pressure loop cycled on.

3/11/98

10:30 H7

Added 1 Gal. Ethyl Alcohol to bubbler.

10:34:40 OFF

10:35:50 ON

VDC-17 58 sl/h

FPP-49 136 sl/h

$$\Sigma = 194 \text{ sl/h}$$

10:39:25 OFF

> 0:55

10:40:20 ON

> 2:45

10:44:05 OFF

> 0:55

10:48:00 ON

> 2:35

10:46:35 OFF

> 0:45

10:47:20 ON

> 2:40

10:50:00 OFF

> 0:45

10:50:45 ON

On = 8:00

$\div 3 = 2:20$

Off = 2:25

$\div 3 = 0:48$

$$\frac{8:00}{10:25} = \frac{480}{625} \approx 77\% \text{ ON}$$

$$\begin{array}{r} 0.768 \\ 625 \overline{) 4800} \\ \underline{4375} \\ 4270 \\ \underline{3750} \\ 5200 \end{array}$$

Present Gas Consumption is $\approx 173 \text{ sl/hour}$

~30% to VDC

~70% to FPP

$$\begin{array}{r} 225 \\ .77 \\ \hline 1575 \\ 1575 \\ \hline 173.25 \text{ sl/h} \end{array}$$

3/17/98 Hooked up the nitrogen bottle for the Air/Eth
automatic bottle changeover system. Charged the
polyflo lines to ~75 PSI. Shutoff valve on the
nitrogen bottle at 10:45 AM. Does it hold pressure?

3/18/98

(CF)

Told there were several gas alarm trips that no one seemed to
have logged here. Yet another trip at 16:40. Reset.

17:15 another gas alarm trip low-pressure. Reset.

17:40

10

3/18/98 let auto shutoff valve on Ar to "open" position. After yet another trip I came to the shed immediately. Shutoff valve seems to have been in its "shutoff" state. i.e. - it seems to have tripped off. In HAWES the trip point is $\sim 415 \text{ lpm}$ or $\sim 240 \text{ slph}$. Ar flowmeter shows $\sim 960 \text{ sccm} \Rightarrow \sim 84 \text{ slph}$ (using 1.45 for Ar) so, is it reasonable the valve tripped?

3/19/98 12:30 Gas alarm trip.

(ICP)

3/24/98 11:25 HT

Note that delivery pressure is down to 10-11 psi. Mixer is making gas at full rate = $2.5 \times (930 + 570) \text{ sccm}$. Rotameter read 27 (VDC), 42 (FPP). Pressure is recovering.

JG $\nearrow$ Jack was working on installing the Matheson auto-changecover valves.

20:50

Auto-changecover for Ar & Ethane seems to be functional. Switchover tested ≥ 4 times for each bottle. Switch occurs at a little over 100 PSI on the gauge by the pneumatic valves. Started gas flowing for FPP & VDC.

UPS brought in for the controllers. When switched on the power LED was red. I left it to charge up. Don't know if that is what red means.

GasMaster Flammable Gas Sensor Calibration Procedure

(Hall A Detector Gas System -- HAWGS)

1. Install a jumper across the "Gas Leak" terminals on the rear of the Interlock System chassis in the Hall-A gas shed in order to prevent interruption of gas flow to the chambers during this calibration.
2. Ensure that the sensor head is in an atmosphere containing no flammable gasses, and that the sensor has been powered for at least 30 minutes.
3. Check the voltage **at the terminals of the sensor head**. The voltage between the black and red terminals should nominally be 2.05 ± 0.1 V (1.95 - 2.15 V). Adjust this voltage using the 'Head Volts' control on the input/alarm card.
4. Turn the 'Zero' adjustment on the input/alarm card to obtain a reading in the range (-1% to +1%) LEL.
5. Apply the calibration gas (50% LEL Methane) to the detector at a rate of no more than 0.5 liter per minute (flow rate is already set if using the calibration kit).
6. Adjust the 'Cal' control on the input/alarm card to give a reading of 70%LEL. (This calibrates the system for Ethane detection).
7. Turn off the calibration gas flow and expose the sensor to clean air. Verify that the reading on the control panel returns to near zero. If not, repeat steps 4-6 until both the zero (0%) and calibration point (70%) stabilize within 1% of nominal.
8. By adjusting the "zero" adjustment to raise the LEL reading, determine the "low" and "high" trip levels of the control system. Adjust to obtain alarms at $10 \pm 2\%$ LEL (low) and $25 \pm 2\%$ LEL (high).
9. Re-zero the reading.
10. Remove the interlock jumpers installed in step 1, fill out the table below, sign this form and attach it in the Hall-A Gas System logbook.

Start
Finely

Sensor Location	Final Head Volts	Final Zero Reading	Final Calibration Reading	Final Low Trip Level	Final High Trip Level
Gas Shed	2.00	0%	74%	10 %	26 %
Electron Arm	1.99	0%	⁶⁵ 71%	11%	26%
Hadron Arm	2.04	0%	⁶² 71% 72%	11%	24%

This calibration was performed by

signature

signature

Had some trouble on Hadron and Shield channels - input cards were poorly seated on the mother board. Re-seated and readings became stable.

4/3 Checked auto-changover lines for leaks using "Snoops"
 Argon line had a loose fitting at the regulator.
 Nitrogen line had a loose fitting at the valve after the regulator.
 Both were tightened.
 "Snoop" shows everything is currently ok.

5/5/98 Put 4-20 mA current loop in for readout of thermocouple in the ethanol.
 SRS model SR630 was showing $\sim 1.0 \rightarrow 1.1^\circ\text{C}$ before it was disconnected.
 Loop display is showing 8.9
 for 4-20 mA display shows 0-100
 $\Rightarrow 6.25/\text{mA}$
 $8.9 \Rightarrow 1.42 \text{ mA} + 4 \text{ mA}$

5/8 100 Ω on current loop measured as 99.7 Ω with GoldStar DMM. 0.546 V drop measured across the 100 Ω resistor $\Rightarrow 5.42 \text{ mA}$ in the loop. Adjusted meter on the loop to read 5.4 mA (adjusted "Z" setting)

5/27 Thermistor on ADC terminal board is now being readout on Ch 31 of the ADC. This will give us a room temperature reading.

6/2/98 refilled ethanol bubbler

7/1/98 removed 100 Ω from high side of current loop for ethanol temperature readout. Put a 100 Ω on the low side of the loop. ADC is now happy. Loop display showing 5.7

7/15 6:20 PM cl find water is condensing on the ethane regulator on the bottle manifold (outside).

0741

10/11

Argon bottles were allowed to run dry. Charged them.

(KF)

11/11/98 Found the HVAC set to cool. Intake temperature was 59°F. Set to AUTO. It's heating now.

12/4/98 Found the CGA-320 fitting on the Coleman grade CO₂ high pressure regulator was leaking. Tightened it up.

12/11/98 The Ethane regulator output is about 56 PSI. Desired range is a little over 40 PSI. The lock nut on the regulator adjust is still snug. Perhaps some temperature variation of the regulator? Aging? I don't know. I readjusted the regulator to a little over 40 PSI. Ethanol loop display shows 5.6. ~~Flow~~ rates are 574/850.
Eth Ar

12/29 JS Bogdan shut off the VOC & FPP gas flows after it was reported the VOCs were having some problems. He made an entry in HALOP. I have hit the low pressure override and am starting the flow again. ~18:55. Ethane delivery pressure is low, ~30 PSI. Argon is ~10 PSI and not climbing. Argon excess flow valve was in auto shut off. Changed to open. Argon pressure is up. Ethane still low. Ethane regulator output meter has the needle fully clockwise (pegged). Bottles are now valved off. Low pressure override to allow pressure to drop off. VOC & FPP valved off. Opened vent on ethanol reservoir to drop some more pressure. Output valves on regulators turned off for Ar and Ethane.

shut off FPP & VOC. Still not climbing.

1/3/99 JS I opened removed the ethane step down regulator yesterday. I took off the low pressure gauge and saw what looked + smelled like some sulfur deposits. Today I disassembled the regulator and cleaned it out. On the low pressure side there was sulfur and heavy oil deposits. The high pressure side was clear. The low pressure side

manual shut off valve also had some oil deposit in it. The outlet of the manual valve and the inlet of the excess flow valve appeared dry and free of deposits. I disassembled the manual valve and cleaned it, also. ~~Then~~ I saved about half of the oil & sulfur from the regulator. It weighed about 32 grams. My guess is about a half gram of total buildup in the regulator. When I tried to reassemble the system I found the excess flow valve stuck in the off position. I removed the valve and put in a temporary section of polyflow. The system is now functional, but the regulation of the ethane line seems poor.

The low pressure on the ethane slowly increases when there is no flow to the chamber. I turned off the ethane supply, both bottles & the manual valve after the regulator.

1/4 Ethanol in the bubbler has a nice yellowish brown tint to it.

2/2/99 Regulator and manual valve and excess flow valve have all been replaced. Bubbler has been flushed out till the ethanol is clear. The copper line from the outside regulator to the Meroid ~~the~~ control pressure switch was flushed with ethanol.

This past Saturday the ethane regulator was again having trouble. After fiddling around for a while I eventually wrapped some heater tape around the regulator. After the regulator warmed up it functioned in an acceptable fashion.

Today I installed the Matheson 450B purifier and the Matheson membrane filter. The chambers were valved off prior to the system purged before the chambers were valved back on. The system seems functional. Argon flow is 973/582 when first turns on. Drops to 1945/572 after a couple minutes or so.

2/17/99 HT & BW 10:00

35

System in low pressure alarm, but bottles OK. Reset low pressure and all seems well?? However, outside C_2H_6 pressure reads >60 psi, while inside pressure is ~42. Bad gauge, maybe?

Also found C_2H_6 XS flow valve disabled! Put it back to ARMED state.

2/19 ~~14:50~~ 14:50 System again in low pressure. Reset and things seem ok. Regulator on ethane not very warm. Variac driving the temporary heat tape is set at 80V output. Set to 90V output.

XS flow valve had been disabled because it was tripping off during normal flow, while I was previously working on the system. XS valve is not currently in a "tripped" state. I am leaving it in the "disabled" state.

3/17 13:45 Connected CO_2 line to Hadron Arm. Will start gas flow ~~is~~ to purge the line.

4/22 Low pressure alarm but all bottles OK.

4/28 ~~On~~ On Monday I replaced the ethane regulator by the cylinder. It was again having problems regulating. After opening the replaced regulator I found deposits on the low pressure side, around the diaphragm and pin.

Today I came in to check the ethanol level. The reservoir sight glass was dry. There was still ethanol in the bubbler. The reservoir always has filled slowly from the fill tank. This time it would not seem to fill at all. I ~~took~~ after the lid off the reservoir and found the ethanol dripping past the restriction on the inlet pipe. I rubbed the goo off the inlet pipe & the ethanol flowed a bit more. I took the lid off the reservoir and found some almost waxy substance in the inlet pipe. I found some grey, chalky goo between the rubber disk and the aluminum lid. I cleaned out the inlet pipe & the lid & rubber. There is pitting on the lid where the seal was made, I put it all back together & checked it with Snoop. Looks ok.

9/8/99

-10 @ no flow reading on digital

Bypass Digital
Flowmeter-10
+180

Flow (From)

0 valved off
.108 Lpm Ar (Rotameter at 10)

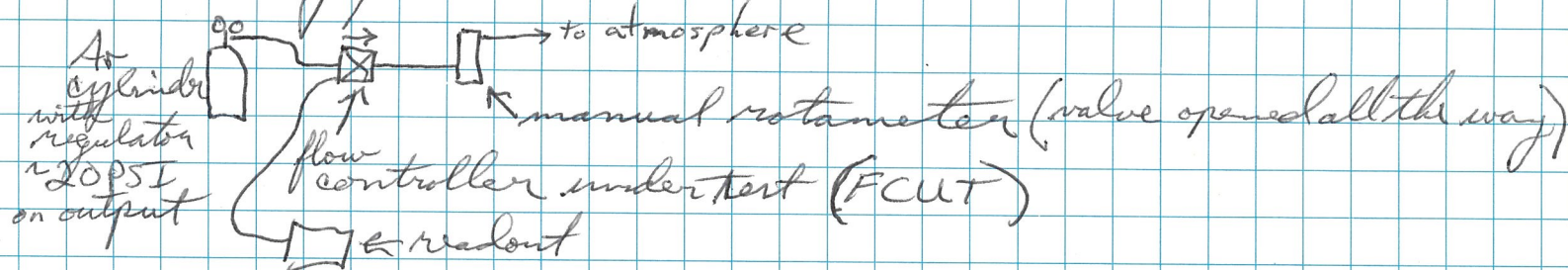
9/28/99

Ongoing problems with the gas mixing system. The flow controllers for the argon and helium both began behaving erratically. They were removed and sent back to Millipore for servicing. The manual bypass flowmeters were too small of a flow rate for what we required. I jury-rigged some flowmeters and ordered some of appropriate flow capacity. At this time the new manual valves have been in place for almost three weeks.

Manual flowmeters are Air Products with a model E29-4-150MM3 tube.

All 5 flow controllers have been serviced and returned. 2 have 2500 sccm max. flow and 3 have 3500 sccm max. flow rates.

Checking flow controllers.



with Dynamass set to 500 readout is 514 and flowmeter shows SS at 141 (center of ball) (ball is ~3mm diameter). This is about 4 LPM of Ar!

S/N AW 9705162	set to	readback	flowmeter	
	500	514	141 SS	
	450	461	120 SS	
	400	408	101 SS	
	350	356	83.5 SS	
	300	303	67.5 SS	
	200	200	40 SS	94 BB
	100	96.97	15.5	39

S/N AW9705163	set to	readback	flowmeter
	100	100	18 SS 44 DB
	200	205	42.5 100.5
	250	253	55.5 136
	300	303	69.5
	350	355	85.5
	400	408	103
	450	460	122
	500	513	143

S/N AW9203172	set to	readback	flowmeter
	500	521	pegged
	450	466	pegged
	400	411	pegged
	350	356	138 SS
	300	303	108
	250	251	84.5
	200	200	62.5
	150	149	43.5 SS 103 DB
	100	100	26.5 62
	50	50	10.5 28.5

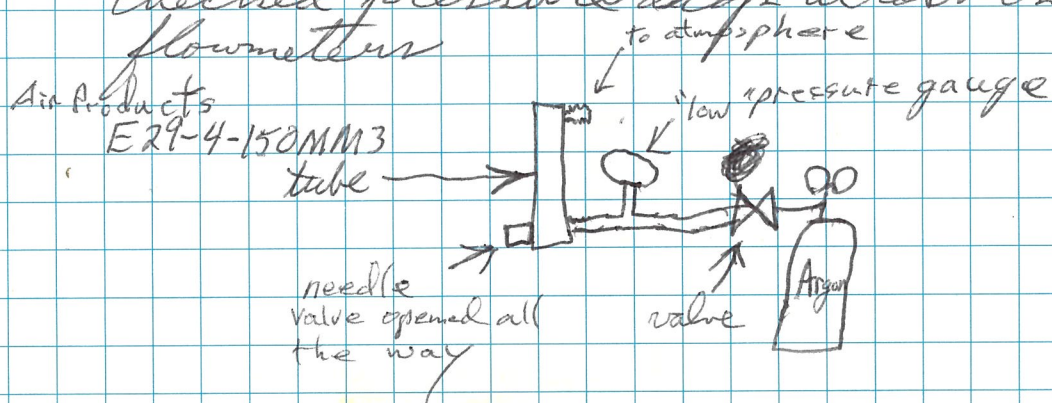
putting backpressure on the system by putting a cap plug on the output of the flowmeter. The output flow rate is very much reduced. It almost seems to have an optimal flow rate & pressure range.

10/14/99 JS Howard pointed out that the flowmeters also had to be corrected for gas pressure they are run at.

The argon and ethane flow controllers were installed on 10/12. They are 3500 sccm of d_2 at full scale.

At the start they seemed to be having problems stabilizing. After about 1 or 2 hrs later I found they were running in a fairly stable manner.

Checked pressure drop across one of the manual flowmeters



At max. flow rate pressure drop was about 1 PSI.

The flow controller outputs are fed to the inputs of the manual flowmeters we were using to mix the gas. Needle valves fully open.

	Argon	Ethane
present flow setting	820	500
flow readback when start flowing	853	522
flow reading ^{just before} when flow switches off	840	518
manual meter reading when starts flowing	49(ss)	45 (black bead)
manual meter reading just before shuts off	51(ss)	47.5 (b.b)

~~As~~ As the number on the display is dropping the bead is rising in the manual flow meter.

program "C" → ratio 50.0 50.0
ramp time 2 2 ← set both to 0

program "A" → flow 500 820
ratio 66.6 99.9
ramp time 2 2 ← set both to 0
cal ~~ratio bar~~ .5 1.45
ratio bar — —
range 1000 1000
zero set 00 00
opt 1 1 1

10/15 Flow rates are set to 820/520 Argon/Ethane
JA per request of Ron Gilman. FPP is drawing a bit of
current.
Readback is 851/530.

11/3/99 854/531 are the readbacks for the argon/ethane
JA

Calibrating the e^- + Hadron sensor heads. 4/17/00
Following procedure on p. 31, the calibration done
2 years ago. Where is last year's calibration?

Mike Wimbush took the calibration kit down to the
hall. Started on e^- arm. Pulled orange box (sensor)
out of the hut. Set on platform at front of detector stack.

Mike measured 2.03V on sensor head (OK)
I zeroed the reading. Display shows 0%. (OK)
Mike turned on the gas. Went up to 52%. I could only (BAD)
turn the CAL pot to 54% on the display.
The voltage on the monitor output (going to HP131340C)
was 1.27V. Turned gas off & removed gas ~~cap~~ supply
cap. Display went to 10% and .38V on monitor output.
Adjusting the zero I find trip levels set at 11% & 26% (OK)

Mike went to the Hadron arm

2.06V on sensor head (OK)
I zeroed the display. Display shows 0%. Monitor (OK)
output is .396V
Mike turned on the gas. Went up to 60%. Turning CAL
pot I got to 63%. Eventually crept up to 65%. (BAD)
Monitor output is 1.43V. Voltage on the head was
2.11V.

I went and got the new sensor head from the gas
shed. Mike took it down and replaced the head on
the Hadron arm.

2.19V on sensor head. Adjusted till 2.04V (OK)
Zeroed display. 0.421V on monitor out.
Turned on gas. 92% on display. 1.86V on monitor
adjusted to 70% on display. 1.51V on monitor
gas off 8% on display. 1.546V on monitor
adjusted to 0% on display. 1.414V on monitor head voltage at 2.02V
gas on 62% on display. 1.39V on monitor
adjusted to 70% on display. 1.51V on monitor
gas off 2% on display. 1.379V on monitor
adjusted to 0% on display. 1.412 on monitor
gas on 73% on display. 1.554 on monitor
adjusted to 70% on display. 1.516V on monitor
gas off drifts between 0.41V
on display. 1.426V on monitor

LOW trip is at 11% OK

HIGH trip is at 25% OK

reset display to 0%. 426V on monitor OK

Hadron arm sensor now checks out OK

Electron arm needs the sensor head replaced.

4/27 Rusty and I replaced the sensor head on the
 JS electron arm.
 Final head volts 2.05V
 Final zero reading 0%
 Final calibration reading 70%
 Final trip (low) 11%
 Final trip (high) 27%
 R.S.

Calibration went very smoothly.

6/26/00 Apparently the argon flow controller has been
 misbehaving. Unfortunately I quit logging the rest
 and read off stages a while ago. I don't know how
 long the mix has been bad. Replaced both flow
 controllers with ones calibrated more recently.
 These two were calibrated 9/17/99. After swapping the
 two flow controllers I was getting erratic readings off
 the ethane. I switched to "expert" mode and
 unplugged AC power to the Dynamarr rack unit.
 After plugging it back in (AC power) I left the unit
 alone for a while to autozero.

Also turned manual flow meters off to stop gas flow
 through the flow controllers.

6/27/00 We seem to have a bad gas bottle of ethane.
 It is showing ~700 PSI. The other cylinder
 shows ~1000 PSI. I switched the ethane over
 to the ~1000 PSI cylinder. Switched over the argon
 cylinder, also. Just for good measure.

~12:30 PM
 ~2:40 PM - chambers not showing signs of improvement.
 got an ethane cyl from Hall C and

put that online.

~3:30 PM Looking at the manual flow meters. Valves are wide open on them. On p. 38, I see some numbers for the bead positions when the gas is flowing. Right now I see

Argon 26.5 (center of SS bead)
Ethane 38 (center of black bead)

Mark Jones and I played with the settings on the flow controller display units. We adjusted the flow and cal values till we got

Argon 51 (center of SS bead)
Ethane 47 (center of black bead)

Argon flow is 97.7 ~~rate~~ cal is 1.00
Ethane flow is 62.0 cal is .50
Range for both is 100.0

The argon seems to be dropping. We readjust the ethane to a lower value. They are now reading

Argon	Ethane	
48 SS bead	39 black bead center	
96.2	56.1	SCCM
100.0	55.7	SCCM set value
100.0	100.0	range
100		
1.00	0.50	cal

The Fe^{55} pulse height on the scope is about 6 divisions for max amplitude. Pulse resolution is not too bad. Not a broad spectrum of pulse heights.

~~It would seem there flow~~ It's not clear to me what this says about these flow controllers.

6/27 7:20 pm

Argon	Ethane
44 SS bead	36 black bead center
90.5	51.7 SCCM
87.2	51.3 SCCM set

6/28	18:10	Argon 44ss bead 90.6	Ethane 36 bead 52.4
6/29	23:00	45 89.6	36 52.0

Argon alarm sounding!

7/3/00 The pressure in the line from the argon cylinders to the flow controllers was dropping at higher flow rates. I replaced the $\frac{1}{4}$ " line with a $\frac{1}{2}$ " line. Pressure still drops. I removed the excess flow valve by the regulator outside. The pressure now stays up when the gas is flowing. Present settings are

	flow set	Flow Readback	Middle of Black Bead "Pegged"	Middle of Stainless Bead
Argon	492	507		73
Ethane	300	311	67	30

↑ both ~~drop~~ drop a little bit below this

Drain monitor tube still showing small Fe^{55} pulse height. ctm going to take it apart.

9/28/00 9:30 AM

ARGON EMPTY, SWAP BOTH BOTTLES
PUT LEFT BOTTLE ON LINE JHM

10/11/00 Replaced the check valve on the left CO_2 cylinder of the Coleman grade CO_2 switchover setup.

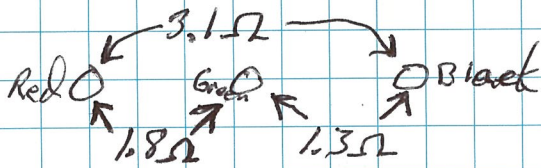
	flow set	Flow Readback	Middle of Black Bead "Pegged"	Middle of Stainless Bead
Argon	492	510		81.5
Ethane	300	312	72	32

10/13/00 The brass "T" holding the high pressure transducer on the Argon manifold developed a crack and began leaking. I replaced it.

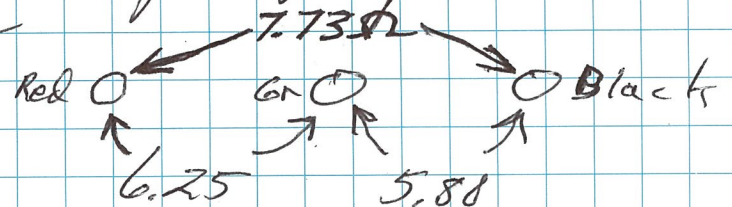
2/12/01 Calibrating the flammable gas sensor heads. New board installed in Gasmaster for the right arm. (Third card position in the Gasmaster)
At start the head volts read .775 V
Not sure what's up
Disconnecting the sensor & gasmaster from the 4-wire cable
Mike measured 2.75Ω from red to black at the sensor end. I measured 7.24Ω at the counting house end.
My guess was the pivot. Mike found a damaged section of cable in the tray at the nose of the spectrometer. Upon inspection it seems the cable was pinched at a point sufficiently to squeeze off the insulation on the wires. Thus the wires contacted each other. Mike spliced the cable back together.
Still getting resistance from red to black. Mike gets 3.25Ω in the hall. I get 5.76Ω in the counting room.

2/13/01 Mike re-did the splice on the cable. There was another short somewhere close to the first short. There does not appear to be any more shorts. But, still having trouble with the circuit.

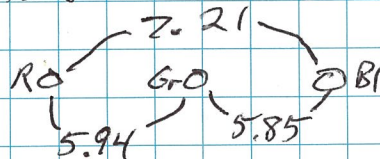
2/14/01 ~~Hooked~~ Hooked old sensor up in the right hut. Cable is disconnected in counting room. At the screw terminals inside the box in the hut I see



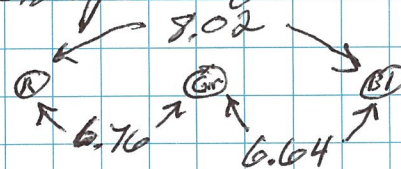
up in the counting room, at the screw terminals pulled out of the socket I see



I pull out the connector in the counting room for the left arm. I measure



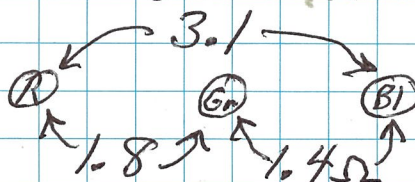
gas slip measures



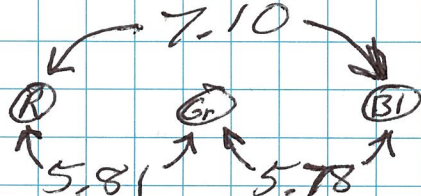
Going up to the right arm sensor, checked the resistances on the new replacement sensor which was lying around.



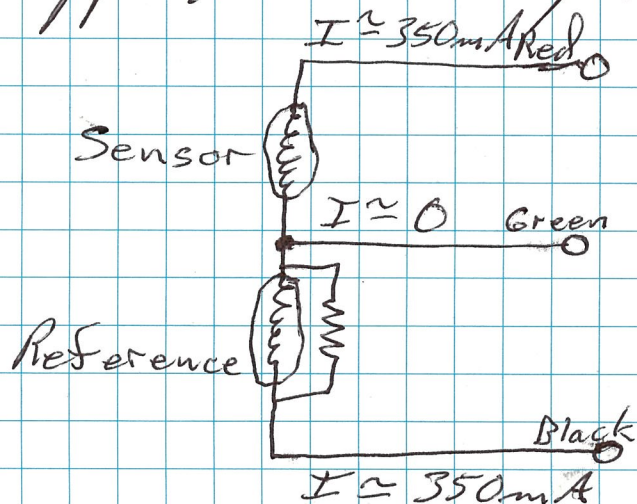
I disconnected the old sensor and measured the resistances for it.



I hooked up the new sensor. Upstairs in the counting room I see



Looking at Howard's notes in the Crowcon Instruction Manual for Gasmaster Systems he notes a current of approx. 350mA for the DI 9



to get 350mA on the 7.10 Ω noted immediately above, I will need 2.485 Ω from red to black at the connectors in the Gasmaster in the counting room.

Turning the "HEAD VOLTS" trimpot till I get $\approx 2.48V$ from red to black. The ZLH is (I forgot exactly) but the value does not change when I rotate the "ZERO" trimpot. The "HEAD VOLTS" trimpot is also rotated significantly more clockwise than the respective pot on the left arm or the Gas Shed. I pull the board and install the new board. Adjust "HEAD VOLTS" till I get 2.482V. The trimpot is now a little more CCW than the Gas Shed or Left Arm. I can adjust "ZERO" to get 0 on the display.

Mike went down in the hall. Head volts are 1.37V 45
Adjust "HEAD VOLTS" to 2.06V. Have to turn zero all
the way CCW to get to a display of 1. Set head
volts to 2.01V. Set -1 on display.

Mike applies gas. 89% after ~30 sec. Adjust "CAL" to
get a heading of 70%. Remove gas & off. 42% after ~1 min.
Set "ZERO" to get 0. Gas on. Read 74%. Set to 69%. Gas
off & remove. Read 1%. Set to zero. Gas on. Read 71.
Set to 70. Gas off & removed. Read 0.

We replace the old sensor which is still in the housing
with the new sensor, which was hooked up but
hanging loose.

Head volts are 2.01V. Leaving it at that.
After ~3 minutes it reads 0. Gas on. Reads 70.
Gas off & removed. Checked & adjusted HI and LO
trip points to 10 & 25%.

Going to left arm.

Head volts at 2.08V. Adjust "ZERO" to 0. Gas on
Reads 61. Set to 70. Gas off and removed. Reads 0.
Trip levels are at 11% and 26%. Left them as is.

Checking the trip levels for the gas shed they are at
10 and 26%. Head volts at 2.06V. Gas on.
Reads 59. Set to Tripset for "CAL" is at limit already.
Replace sensor.

Head volts at 2.47V. Set to 2.075. Can't set "ZERO"
to 0. Set head volts to 1.98V. Can't get "ZERO" below
5%. Set head volts to something lower. Gas on. Head
volts at 2.057V. Reads 98%. Set to 68%. Gas off and
removed. Reads 2. Set to 0. Gas on. Reads 71%. Set to 70.
Gas off & removed. Reads 0.

Calibration is finished.

2/26 The second new sensor failed late last week.
 I found an old DT9 head in the gas shed.
 Using the Fluke 8060A on the failed sensor I find
 in the counting room:

(black) $\leftarrow 104 \Omega \rightarrow$ (green) $\leftarrow 6.06 \Omega \rightarrow$ (red)

and 99 mA flowing on the black wire
 removing the sensor head I measured
 $\leftarrow 101 \Omega \rightarrow \leftarrow 1.72 \Omega \rightarrow$
 on the wires on the head.

Looking at card 2 of the Gasmaster I measure
 311 mA flowing on the black wire.

I hook the DT9 I found up to card 3 on a
 short cable. I measure ~ 300 mA on the "black"
 wire. I calibrated it and set it in the cable
 tray above the Gasmaster in the Counting Room A.

I am thinking the new sensors are not the
 correct type. We are looking to see how the DT9
 sensor fares on the new card in the third
 position.

5/16 Mike Wimbish replaced a section of the cable to the
 right arm sensor. The section across the pivot. We
 found a mashed section in the old piece which was
 cut out.

Connected the sensor to the Gasmaster board. Gave about
 45 min for the sensor to stabilize. Calibrated the sensor.
 "0" for final zero reading
 "70" for final calibration reading
 final head volts was 2.05V
 final low trip level is 10
 final high trip level is 25

This is all with a .05 Ω resistor in series with each
 leg going to the sensor. This is for monitoring with
 a WebDAQ scanning ADC.

11/26/01 Reconnected the gas gain monitoring tube I'd been working
 on before. Using the 100 nCi ^{252}Ff source. Spectrum
 on the oscilloscope did not look too good. Thought I'd
 swap out the flow controllers. Shut off the gas flow to the
 VDCs. FPP is already shut off. Bled down the system through
 the gain monitoring tube. Swapped out the controllers with
 one that had been sitting in the cabinet, all sealed up, and

one I'd been using for testing the RICH detector in the FEL. 47

When on the flow meters read Ar ^{522-start} 505 -
Ethane ^{316-start} 311
The manual rotameters read Ar - black bead pegged @ top
metal bead 67
(reading middle of beads) Ethane - black bead 61
metal bead 27.5

The ethane flow controller would not shut completely off. I swapped it out with the other controller I'd been using on the RICH setup. Ethane does seem to shut off. Flows are 492 and 307, after 25 min of running

Ethane	black	pegged
	metal	32.5
Argon	black	pegged
	metal	67

Comparing these to the readings on p. 42 from 10/12/00. Well, ethane ^(black) was not pegged on p. 42. ~~It~~ Choked back on the flow through the tube. Waited for zero flow. When flow started again the black bead did not peg at the top again. Black ~~bead~~ bead on Argon was stuck at the top. Tapped the flowmeter and it came down when no flow again. Ethane came up again with the black bead sticking to the metal bead. Went to zero flow. Ethane came back up with beads separated. The ~~the~~ system seems to be ok, now. Set flow through tube to cycle frequently (4:35 PM).

Now when the system is running

	black	metal	display	
Argon	pegged	6870	522	
Ethane	75	32.5	316	looks ok

Turning flow back on to the VDCs (Fe⁵⁵ looks ok on the tube) (4:59 PM)
Took a picture of the Fe⁵⁵ spectrum after things had settled down (5:24 PM).

2/3/02
JS

The VDC timing was off (TDC spectrum)
The recorded signals from the flow controllers showed full demand & output for about 3 hrs, starting well, the FPP flow went to 0 around noon. Full demand from the flow controllers since 8 AM, or something like that. Fooling around in the hall, I shut off all 4 FPP chambers. 1 & 2 exhaust meters read 0 flow. 3 & 4 read -166. Suction? i.e. reverse flow? Taking off the exhaust line going upstairs I still got -166 on 3 & 4 displays. Coming back up to the gas shed, I find the Argon flow controller is out of whack. The steel bead reads about the same as the ethane steel bead. ~35. I set Argon set point to 786 to get the steel bead at 67. That may still be a little low, as the system settles.

4:38 PM - system running ok

5:47 PM - went into hall & shut off FPP in gas shed first - vented VDC delivery line in the hall to purge the gas line to the VDCs - I shut off all the rotameters for the FPP (all 5 of them) - came up to the gas shed after I'd left the VDCs flow rate at ~50 on their rotameters - opened valve to the FPP line a little bit - pressure soon came up to 15 PSI for the whole system (FPP & VDC delivery lines) - I shut off the FPP valve @ ~5:51 PM

6:00 PM - opened FPP valve in gas shed. The FPP delivery line still had pressure in it. Some flow even went into the VDC delivery line. So, the FPP line to the shield house seems ok.

Some flow rates on the visual rotameters
Position of middle of metal bead

Ethane	Argon
27	56
26	55
27	56
27	56

Readjusting the flow rates

we want to get $\sim \frac{67}{32.5} = 2.06$

★

Ethane set	Argon set	Ethane Read	Argon Figure Read	Ethane SS-bead	Argon SS-bead		$\frac{Ar}{Eth}$
290	792	304	831	27½	59½	6:40 PM	2.16
		306	834	27	59	6:44	2.18
295	792	309	828	30½	64	6:51	2.10
		311	835	27½	58	6:55	2.11
		308	826	29	60	6:56	2.07
		302	809	30	62.5	6:57	2.08
300-298	792	316	834	30½	62½	7:00	2.05
		316	835	30½	64	7:01	2.10
		313	825	32½	66½	7:02	2.05

I am leaving it at this setting for now
 Bogdan still could not see any hits in the VDC. I went to check the gas cylinder. A nitrogen was connected to the argon!! Replaced with an argon cylinder. Flushing the system out using the FPP lines I can see the effect on the gas flow. Reset the flow controllers.

300	492	312	505	31	66		
Might as well try increasing the flow rate, also.							
500	820	522	837	60½	133½	7:42	2.21
500	805	522	822	58	123½	7:45	2.13
		530	850	51	113	7:46	2.22
500	795	525	821	56½	119	7:47	2.11
		522	811	56	116½	7:49	2.08
500	790	531	837	57	120	7:50	2.11
		528	822	57	118	7:51	2.07
		531	837	50	107	8:00	2.14
		528	822	55	117	8:01	2.13
		530	830	49	105	8:08	2.14
		526	818	56	118	8:09	2.11
		522	805	56	116½		2.08
		522	805	55½	115	8:12	2.07
		522	805	55	114½	8:14	2.08
		530	831	53½	120	8:41	2.24
		529	825	56	119	8:41	2.13
				55½	117	8:42	2.11

I'm leaving it at these settings for now

9 Feb 2002

02:40 AM

- 1) open right Argon bottle (was full but closed)
- 2) replaced empty left bottle by a full one

2/20/02 I replaced both flammable gas sensors in the shield huts. Scott and I then calibrated the sensors. After the heads were calibrated Scott recorded the voltages at the Farmer, for each detector head.

Gas Shed C1 3.63 volts
 Left Shield House C2 3.35 volts
 Right Shield House C3 3.39 volts

2/21 Upon visiting the gas shed I found the readback on the argon flow controller to be varying a LOT. Looking back in epics this seems to have been going on since we increased the gas flow in the hall. Checking, I find the set flows at 790 and 500. The setpoints are old. Starting at the cylinders, I note there is argon connected to the system. Good. But, the low pressure gauge on the regulator was reading a little under 40 PSI. I did not check the pressure on the gauge in the shed. I turned the argon regulator up a bit. The argon flow controller readback seems to be better, now. ~45 PSI on the pressure gauge in the gas shed.

bead		readback	
argon	ethane	argon	ethane
94	45	524	825
95	46	530	835

The ethane flow seems a bit erratic. I went out to try increasing the ethane delivery pressure. The low pressure gauge on the regulator read ~40 PSI. I could not increase it much before I hit a stop! I could decrease the pressure. Not sure what is up. The low pressure gauge in the shed shows ~45 PSI for the ethane.

I removed the handle from the regulator & reinstalled it so I could increase the ethane pressure. It is ~48 PSI in the gas shed. To me the ethane flow seems a little more stable. I set both argon and ethane to ~48 PSI in the gas shed.

The argon readback has been pretty steady since I increased the delivery pressure. Ethane seems a little improved, too. I am leaving it alone for now. 20:15 51

6/23 The argon flow has been erratic all night (since ~midnight). It looks like the pressure in the gas shed was just a little under 45 PSI. Boosting the argon pressure upset the ethane flow. I checked the Torrable presurizer for the ~~physical~~ flowmeters ~~and~~ (200 PSI) and flow controllers (40 PSI). I increased the delivery pressures to ~70 PSI in the gas shed. I don't know what this produces for a differential on the flow controllers. But, the flow readbacks seem stable at this pressure.

5/3/02 PS We're having problems with the VPC efficiency. Today I saw the argon flow controller running at a low value. I see the channel programmed for flow at 790. I set it to 820. It is still having trouble. It starts not flowing in the mid 600's and comes up to the mid 700's. After a few minutes more of running it seems ok. Argon is reading about 860 when running. Ethane about 530. It has been stable for about 15 cycles.

I replaced the Millipore flow controllers with the new Porter ones I got. They are 1000 sccm of N_2 . I did not change any of the DM-2401 settings. Still 500 and 820. After they have been running a little bit

Black Bead		readback	
argon	ethane	argon	ethane
22	9	838	521

When I opened the valve to feed the VDC's the pressure dropped to ~4 PSI. It has come up to 6 PSI. So it looks like the controllers can supply enough gas.

Once again I was not careful in bleeding down the system before swapping out the controllers. Ethanol was forced back into the system. I had to open the flow meters

to blow ^{argon} nitrogen through the lines to dry them out. Make sure everything is bled down to atmosphere when replacing a flow controller!!

5/5/02 Increasing set flow to 930 for argon
570 for ethane

The pressure is not building up in the delivery line to the hall. The controllers do not cycle off. The pressure seems steady at ~14 PSI.

Changed at 6:12 PM

readbacks are 956 for argon
570 for ethane

black beads
14 1/2
6 1/2
(center of bead)

Still the pressure does not rise.

The steel bead of the flowmeter going down to the VDC has its steel ball at ~14 (center of bead). Looking at the chart above the rotameters, this would indicate ~5 lph.

The readbacks show 956 ~~+570~~
+570

$$1526 \text{ sccm} \times 3.5 = 5341 \text{ sccm}$$

Perhaps the flow controllers are 1000 sccm rather than 1000 sccm, I can't see the label on them the way they are positioned.

The tubing on the ethane flowmeter is loose enough to rotate it. The label says 1 SLPM.

5/26 I (pierre) changed argon bottle (right side)

5/27 changed argon bottle (right-left side)

2/1/03 Today I noticed in the EPTCS ezlog data that both of the flow controllers for the VDC gas system were not functioning properly. I have replaced them with the two Agilent flow controllers. They are 0-2 slpm range. I changed the flow set points to 620 for argon and 380 for ethane. The 930/570 setting did not work well. The argon controller opened wide up and caused the ethane flow

to stop! At the moment things seem to be flowing ok. The controllers seem to have a bit of leakage when set to OV. Perhaps the valve seats just need a little time to set into place. This has happened before.

I tried setting the flows at 820/500. When the controllers would first turn on they would do ok. Then the Ethane flow would drop. It's not clear to me these controllers will do well.

After I started the VDC is flowing again, the flow controllers now seem to shift completely off at the OV setting.

Ethane flow started having problems again. I replaced the Argon regulator by the cylinders.

The Aalborg controllers are erratic.

I replaced them with two Porter 0-10 slpm controllers. The Porter controllers did not behave correctly.

I have re-installed the Porter 0-1 slpm controllers which were in place at the start of all this. I have set the flows to 820/500.

2/10/03 Set the Argon flow to 700 + Ethane flow to 427. Had a problem with the Argon regulator a little while ago. It had dropped down from 45 PSI to ~35 PSI. The flow controllers were not working correctly. Raised the pressure back up to ~45 PSI and things were again running OK. Today I see the Argon pressure has crept up just past 45 PSI.

11/24/03 I changed the filter cartridge on the Matheron 450B filter on the ethane line. I broke open the old filter and saw no obvious, gross signs of contamination. Filter material is beads with a cloth on each end to cover the in & out holes.

12/14/03 The new Crowcon Limbus flammable gas sensor system is operational. Today I checked the gas shed sensor. It reads 48 when the calibration gas is applied. The left & right shield hats were crudely checked with butane gas earlier in the week.

12/15/03 Ed Folts helped me check the right & left shield hat flammable gas sensors. They both read about 50% LEL of methane. The system is re-enabled.

4/2/04

JS

A couple of days ago I noticed the ethane MFC has been erratic for at least the last week. Looked at the FPC's data ~~logging~~ logging.

Replaced both argon & ethane MFC's. They were 1 SLPM and I have 2 of 2.5LPM, but not more 1.5LPM.

Unfortunately the MFC's (2.5LPM) behaved erratically. I tried shutting off the flow to the ball and leaving everything to rest for a while. When re-opening the valve to the ball, ethanol was sucked up into the MFC's. Have to open the system and drag stuff out.

I got the ethane line dried out & tried to get the MFC to run. It will not. Some ethanol still comes out of it. Out of the input when I tilt it. I got my 2 spare 2.5LPM MFC's. Hooked one up to the ethane DB9 connector. Let stuff sit for ~20+ minutes after power cycling the Dynamash. Switch in back in "expert" mode. When I come back Dynamash has the A program LED blinking. Push C program button. Nothing happens. 45 PSI of N_2 has been hooked directly to the MFC.

Coopps!!! Need to push the "enable" button. N_2 starts flowing. Good. Reconnect the MFC that had ethanol in it. Let warm up for ~10 minutes. No gas flows when C program entered. Readout is erratic. Settler to zero on the readout. Valve on N_2 regulator was turned off. Opened it up & tried again. When C program engaged there is a short burst of N_2 , then valve closes but still shows a flow rate on the panel. ~400 something. C program has flow set to 427 for ethane & 700 for argon.

Set ethane to 900 & try again. Set to 938. N_2 is flowing. Let flowing for ~10 min. Set to 427. Still flowing a little slower. Playing with the flow rate a bit it almost sounds like it is now behaving correctly. I will use the MFC's which didn't have ethanol sucked into them. I will try to use the ones which had ethanol sucked into them. Connecting the N_2 to the argon line. In C program some gas flow & the display reads ~740. Let run for ~10 minutes. Seems to run ok.

Reconnect everything in the mixing system. Set to C program. Flowing fine. Forget to open the purge valve in back. Closed it. Proportional tube flow is on. VDC flow is off. Still no pressure buildup. Coopps! Left MV22 & MV23 open. Closed them. Switch from "expert" to "auto" mode. When back pressure started building up the flow rates dropped to ~540 for argon and ~306 for ethane. Set to "expert" and put in D program. Closed valve

from gas mixing tank to ethanol bubbler!!! Opened purge vent in back. Opened cap on "T" for pressure relief valve, which is not installed. Remove argon MFC. Remove the MFC and checking the calibration data on the back side of it I see it is calibrated for N_2 with 45 PSI input and 15 PSI output. Yet when there is no back pressure the readback agrees with the set value. When back pressure increases the readback drops. Calibration value for argon is 1.45.

Set flows to 620 for argon and 380 for ethane.

Reconnect argon MFC. Started gas flow. C program. Put cap on "T" and closed purge valve. Again, with no back pressure the flow rates were about right. As back pressure increases both MFCs read low. ~555 and ~315. I backed off the argon regulator ~2 PSI. Now the MFCs are ~427 and ~411.

Argon ethane

Eventually the system goes to D program. When C program is then engaged the flow rates look reasonable, then drop. Bypass the ethanol bubbler. Overpressure alarm goes off. Open purge valve to drop the pressure. Cycle time is now short, but flows seem ok. Open VDC valve. Readbacks are 660 and 405. This is with low pressure in the output line. VDC line had bled down to ~0 PSI.

A valid flow setting would be argon 350 & ethane 213.

At 10 PSI in VDC line the readbacks are argon 639 & ethane 399.

Eventually switches to D program (no flow). Opened test tube valve and cracked purge valve. C program started. Closed purge valve. Flow rates look reasonable. Since it is 8 PM and the hall is open and the VDCs are off (no HV) I am leaving the ethanol bypassed and turning the test prop tube flow rate down a little. Leaving flow to VDCs on. I will check the flow history tomorrow.

I will leave the prop test tube valve closed. Only the VDC valve is open. So, the actual gas flow scenario.

4/3/04

Set the flow rates to argon 350 & ethane 213. Bled the system down first. Recharging the system. Flow rates look ok with ~5 PSI back pressure. Look ok with ~7 PSI back pressure. Look ok with ~12 PSI. Eventually switches to D program. Flow was ok the whole time. Open valve to VDCs. Switches to C program (gas flow on). Flows look ok. A little high. ~360 argon and ~224 ethane. I will let it run for a while. It is now 1:20 PM.

4:32 PM. Flow rates start up at ~360 argon ~223 ethane. Perhaps it will run, now.

4/16/04 The mass flow controllers are again having trouble with the pressure drop across the ethanol bubbler. I pulled the bubbler apart. Mark went off the 2 μ m filter and welded on a 7 μ m filter I had. I just put it all back together, re-filled the ethanol reservoir and am purging the gas system. It is presently 6:00 PM. The flow to the VPCs was increased down in the hall. I increased the MFC's flow settings to argon - 700 and ethane - 427. 6:20 PM gas is flowing to the VPCs. While taking the bubbler apart I cut the cable to the thermistor for the bubbler. The epoxy had let go of the buffer. So, presently no reading for the bubbler temperature.

9/3/04 There has been a small ethanol leak in the refrigerator. When I open the door I can smell ethanol and there is what seems to be an ethanol + water mix on the bottom of the fridge and in the groove in the top plate of the ethanol tank in the fridge.

Looking closer, I see some fluid on the copper tube fitting on the swagelok "T" on the top of the ethanol tank in the fridge. I tightened the fitting a little. Checked those fittings with "Snoop". Things look ok. Not sure where the leak was, or if it was the fitting I tightened. Will keep an eye on it.

9/14/04 Looking inside the ethanol refrigerator I find everything dry. No more puddles of water + ethanol. I'm assuming the fitting I tightened was leaking and everything is ok, now.

8/7/05 While playing around I happened to remove the CAV414 circuit I've been using to monitor the ethanol level. I found a bad electrolytic capacitor on the circuit. On the Creg pin. I removed it and put a ceramic 2.2 μ F in its place. I have re-installed the circuit.

10/1/07 I shut the gas system down this past weekend while VECO did work on the site's main power feed. Starting things back up I find the ethane channel on the DynaMass came back up at 0 flow. The visual flow gauges (rotameters set to full flow) show gas flowing in both argon and ethane lines.

When gas is flowing the argon channel (3) shows ~ 770 sccm.
Ethane channel (2) shows ~ 03 sccm.

Looking at the voltages on the back of the Dynaflex I see Channel 3 has a set voltage of $\sim 2.6V$ and a readback from the MFC of $\sim 2.6V$. Ok. I see channel 2 has a set voltage of $\sim 4.8V$ and a readback from the MFC of $0V$.

I created a fault and tripped off the gas shutoff valves on the argon & ethane lines. I let the system bleed down.

I closed the valves MV202 and MV212. I replaced the MFC for channel 2 with a spare MFC.

I cleared the false fault and hit the low pressure override button. With pressure from the cylinders on I first opened MV202 and then MV212. This provides pressure in the correct sense to prevent ethanol from the bubbler being blown backwards into the MFCs.
The flow rates are argon ~ 748 sccm
ethane ~ 462 sccm

I am leaving the system to run for now.

10/4/07

Things seem to have been running smoothly.

I set the switch in back of the crate to "EXPERT" and let the system run down to ~ 10 PSI. I then turned the flow on. When the pressure was up to ~ 13 PSI I measured the set and readback voltages to the MFCs.

Argon set $2.60V$
read $2.59V$

Ethane set $4.67V$
read $4.66V$

I turned off & removed the dynamars mix controller and installed the Gas Mixer Controller I built. I set the flows to Argon set $2.600V$
Ethane set $4.670V$

I let things run through a couple of cycles. Seems to be doing ok.

6/16/08 Turning the gas systems off for the summer.
We will flow inert gas through the VOLT, argon. We will flow nitrogen through the Gas Chromatograph. The Spray Tube chambers will have the gas turned off.
I have removed the 2 ethane cylinders and bypassed the ethanol bubbler. Valve MV277

was already open, as it is during normal operations.

Note: to bypass the ethanol bubbler

close MV271

close MV272

open MV273

open MV274

then you can bleed off the pressure in the ethanol bubbler

it then opened MV276 to bleed off the pressure in the ethanol bubbler.

The ethanol fill tank has a little ethanol still in it. The drain on it is up a bit from the bottom of the tank. It doesn't have a problem with that and left it closed up.

I closed MV276.

Waiting for the pressure to bleed down in the ethane delivery lines before I connect 2 argon cylinders to the ethane lines (10:02 AM)

I turned off the valves before the FPP Mass Flow Controllers (MV234 + MV235).

After the ethane lines bled down I removed the 2 filters from the high pressure side of the regulator and replaced them with a section of stainless tubing SANDVIK 02-04 CFSML3 4N 75351 SC LOT 310969 (NDE)

304 stainless $\frac{1}{4}$ " x .035" wall. I connected two argon cylinders to the ethane manifold and started gas flowing again (3:10 PM).

The FPP system has bled down completely and is shut off.

I replaced the filter in the Matheson Model 450B Gas Purifier. I ripped open the filter and found no noticeable contamination on the bead material inside nor on the felt plugs on each end. There was no strong odor.

I adjusted the SET voltage for the ethane on the VDC Gas Mixer Control box to 2.60 volts. The same as for the argon.

I do not have adapters for CGA580 to CGA320 so the CO₂ system will continue to flow CO₂.

9/20/98

59

I replaced the AC power cord on the +12V/+24V power supply. The +12V is used for a few of the high pressure transducers.

I replaced the 24V power supply in the gas system interlock chassis. The old supply was in bad shape. An audible buzz had been coming from the buzzer in the Counting Room chassis.

Both chassis are re-installed and seem to be working etc.

I wanted to put ethane cylinders back in the system. I re-adjusted the voltages of the gas mix controller. Argon was set to 2.5780V. Ethane was set to 4.6712V. I opened the valve by the VDC valve to bleed down the pressure in the system. I want the pressure as low as possible so that when I put the ethane cylinder on and open it up no argon bleeds back into the ethane cylinder. I did this for both cylinders. I think it went well.

~~I closed it~~ I opened the valve to atmosphere on the ethanol bubbler. This ensures the bubbler starts at atm. pressure. I closed that valve to seal off the bubbler from air.

~~I closed both valves~~ I opened the valve by the VDC valve to bring the pressure down near atmospheric.

I closed both valves on the bubbler bypass.

I opened the inlet valve to the bubbler and waited for 4 or 5 seconds.

I opened the outlet valve of the bubbler and let the system run for a minute.

I closed the valve by the VDC valve and let the system run.

I forgot to re-install the filter and purifier before the high pressure regulator.

I closed the valve to the VDCs. I opened the valve by the VDC valve. I set both ethane cylinders off-line to close the pneumatic valves. I closed the manual valve on the high pressure regulator. I removed the straight piece of tubing and re-installed the filter and purifier. I put one off the ethane cylinders on-line. I opened the manual valve on the regulator. I will let the system flush for a few hours before restoring flow to the VDCs.

I turned on the flow to the VDCs.

Argon SS ball ~10 Ethane Black ball is ~59 (middle of 5)

9/21/11

These are backwards!

Ar is ~59
Eth is ~10

2/19/10 Looking at the Matheson 8590 gas cylinder switchover controller for the Argon cylinders.

The right cylinder is empty, but the status is "READY" on the controller. This incorrectly indicates a full cylinder. It seems the check valves and the pneumatic valve leak slightly and allow the pressure to build up slightly in the empty line.

Open up the 8590 and look at the comparator board that is presently installed. Board is number 3.

On the channel that has the empty cylinder and is in the "READY" state I measured 1.213V on pin 2 of the comparator. I accidentally short pins 2 & 3 together (or some such thing) and the channel goes to "EMPTY". OK, I measure 1.503V on pin 2, now. The other channel, in "RUN" state, has 1.277V on pin 2 of its comparator.

I have spare board number 4 that I have increased the hysteresis on. The trip levels are 1.2V and 1.79V on it.

Replace installed card with card number 4.

The VDC mixer went through one cycle while the argon controller was turned off.

Both argon cylinders came up as "READY".

I switched the empty cylinder to "RUN".

Wait and see what happens when the empty cylinder goes to "EMPTY".

2/21 The "EMPTY" LED has stayed lit. I finally changed out the cylinder.

Earlier, the right N_2 cylinder ran out but the "RUN" LED stayed lit. Eventually the gas ran out for the pneumatic valves and the VDC mixer shut down.

I modified the comparator cards numbered 3 & 5. I am installing card number 3 in the nitrogen controller.

The comparator board removed is number 10. Looking at the thresholds on this bench I see on one side 1.212V and 1.699V while the other side has 1.218V and 1.708V.

I would expect to have problems with the replacement board, number 3.

The wires at the connector by the sensor in the

cable from the controller to the sensor, appear to be severely corroded and need to be repaired. Too much weathering.

2/13/11

Checking the thresholds on the CO₂ Matheson 8590 switch-over controller. I see 1.218 on the left side and 1.216 on the right side.

Yesterday I found both cylinders empty. I thought perhaps something had drifted or gone bad. It would seem the computers are doing OK.

The 8590 has been a little erratic about notifying when a cylinder is empty. It has been a while since we have run the system during "cold" weather. Perhaps we just need to remember how it operates at this time of year.

The right cylinder is in "RUN" and the left cylinder is in "READY".

10/2011 - Calibrate flammable Gas Sensors. GAS Shed - Appx. 50 (Low-12* HIGH-22)
 JB Left Shield Hut Appx. 50 (Low-12 HIGH-22) RIGHT Shield Hut Appx. 50
 (Low-12 HIGH-20)

5/19/2014 - INSTALL AIR LINE AND DRYER FROM COMPRESSOR TO GAS CYLINDER VALVES - DISCONNECTED NITROGEN BANKS NOW RUNNING DIRECTLY FROM COMPRESSOR.

RANGE 80 TO 115 PSI (LOWERED FROM 130 PSI)
 max
 max