



# LFL Troubleshooting Work Instruction—Line 6

October 30, 2014

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Name

Signature

Date

# LFL Training Manual

## Introduction

Wolverine's ovens are equipped with LFL monitoring units that measure the percentage of solvents or gases in the ovens to prevent any chance of an explosion.

\*LFL- Lower Flammable Limit

\*LEL- Lower Explosive Limit

Both LEL and LFL are considered the same in our application, and are defined as the point at which the amount of gas becomes capable of producing an explosion. Below this point, there is not enough gas to create an explosion.

The percentage of gas when it becomes dangerous to continue running the line is 50%, and the LFL units will shut the ovens down at this point. A warning light comes on at 40% LFL, at which time steps are taken to correct the situation.

This manual shows how to read, calibrate and troubleshoot our LFL monitoring units. There are (2) types of LFL units in our plants, a high temperature unit and a normal unit. The high temperature units are only used in the primer ovens.

## Initial Startup Procedure

### Normal LFL Temperature Units

1. Check the fuel pressure on the propane tanks. The propane needs to be between 20 and 25 psi at the unit. It will probably need to be set higher at the tank regulator (to approximately 40 psi) to provide the right psi at the device.
2. While at the tanks, turn on the span gas.
3. Go to the unit on the oven.
4. After opening the door, check:
  - heat (**must be 140 degrees to work properly**)
  - sample flow (5 SCFH)
  - cell vacuum (below 10 inches)
  - Air Bleed (10 psi)
5. If any of these are not correct, go to the troubleshooting guide.
6. Change the two paper filters and check the cell vacuum.

Close the unit and go to the readout.

1. Check the sensor current test point. Should be .51 VDC. Adjust the sensor current pot if needed.
2. Push alarm level to ensure danger level is set at 50% and warning level at 40%. Adjust pots if needed.
3. Push span gas and ensure the reading is 50%. If not, adjust pot.
4. Repeat this with the zero.
5. Go to the span tank and turn gas regulator off.
6. Check unit after 30 minutes to ensure it still reads 0% if no product is being run. LFL unit may read differently once air heats up.



# LFL Troubleshooting

## LFL Alarm and Warning Light become active when LFL reaches 40%

### Reaction Process for LFL Warning Light and Alarm

1. Reduce line speed to minimum SMP speed.
2. Notify maintenance to make repair. **\*see next page**
3. Verify that the LFL warning light and alarm are off. If LFL warning light and alarm continue to be active after slowing the line down to minimum speed, immediately notify the supervisor on duty.
4. If an LFL cleaning is needed, maintenance will do so using the attached LFL cleaning process. The LFL will be placed in bypass via the bypass key.
5. Await resolution from maintenance that LFL's are in normal/safe conditions.
6. After maintenance has signaled LFL's are in normal/safe condition bring line speed up by 1 fpm every 10 minutes until reaching desired/SMP max speed.
7. After desired speed is reached resume normal operations.

#### Cedar Run



#### Blacksburg



LFL  
Warning  
Lights

For Reference Only

## Temporary Process for Using the LFL Bypass System for Coating Line 6.

**WARNING: LFL Bypass System can only be used by maintenance or engineering personnel.**

1. Unlock the LFL Analyzer display window.
2. Insert bypass key into desired LFL Analyzer.
3. Turn bypass on, disabling the analyzer.
4. Perform the maintenance function desired i.e. LFL cleaning, spanning, troubleshooting.
5. After all maintenance is complete press the **Acknowledge** Button and **Reset** Button located at the LFL display.  
**\*\*\*Failure to follow Step 4 will result in the Analyzer signaling an oven shutdown\*\*\***
6. Close and lock the LFL Analyzer display window.
7. Turn bypass off, the analyzer is now enabled and monitoring.

**These steps can be used on all nine LFL Analyzers on Line 6.**

**\*\*\*Do not Attempt to bypass more than one LFL Analyzer at a time. This will trigger an oven shutdown\*\*\***

For Reference Only

## LFL Calibration Procedures

1. Check to see if flow is adequate (done in the LFL box at the ovens):

Flow tube—Adjust from min to max capacity. If it goes above **9 SCFH**, flow is ok. If it will not go above 9SCFH, remove aspirator and clean venturi orifice. The cleaned orifice hole size should be approx. that of a #56 drill bit. Once cleaned, reset to the default flow rate.

Magnahelic gauge—Remove supply tube and cover with finger. The gauge should max out. If it does not max out, then check the low flow switch (LFS). Check ALL filters first and clean if needed. If this does not solve the problem, remove the LFS so the bottom is accessible, carefully remove the bottom cap (it is spring loaded!) and remove the stem assembly. The O-ring is typically the cause of the problem and should be replaced. When replacing the stem assembly, tighten all the way and then back out 1¼ turn. (Verify that the problem was with the LFS by removing the bottom two tubes from it and splicing them together, using vinyl tubing or something similar. This should cause the magnahelic gauge to max out.)

2. Set the flame (done in the LFL box at the ovens):

The RTD should have a readout value of 0.62 volts. If it is not close to this and needs adjusting, first pull the box and filter assembly covering the RTD. Make sure the RTD, gas tube and igniter probe are aligned. **DO NOT BEND THE RTD!!** If it is not in a straight vertical position, loosen the RTD nut, reposition it and retighten the nut. Square the gas tube and igniter probe with the RTD leaving a gap of ¼" between the RTD and the igniter probe. The gas supply tube should be as close as reasonably possible to the igniter probe **WITHOUT TOUCHING IT**. Replace the box and filter assembly. Next, loosen the cover to the wiring terminal strip. Using a volt meter set to DC volts, put the meter probes on the top two RTD wire terminals. Adjust the gas regulator until the volt meter reads 0.62 volts.

3. Set the ZERO and SPAN values (this requires 2 people, one at the ovens and the other at the LFL controller):

Turn ON the Pass fans (exhaust, circulation, and combustion). Using two-way radios, have 1 person press the zero button at the LFL controller, hold for 1 second, let go for 1 second: repeat this several times, while the other person watches to see what position the gauge goes to at the ovens. (This identifies the default position of the float or needle.) The person at the LFL box adjusts the zero needle valve to the mag gauge until the reading on the tube is at the default value (typically 5-6 SCFH). Do the same with the span—1 person presses the span button at the controller and the other adjusts the valve till the gauge is at its default value.

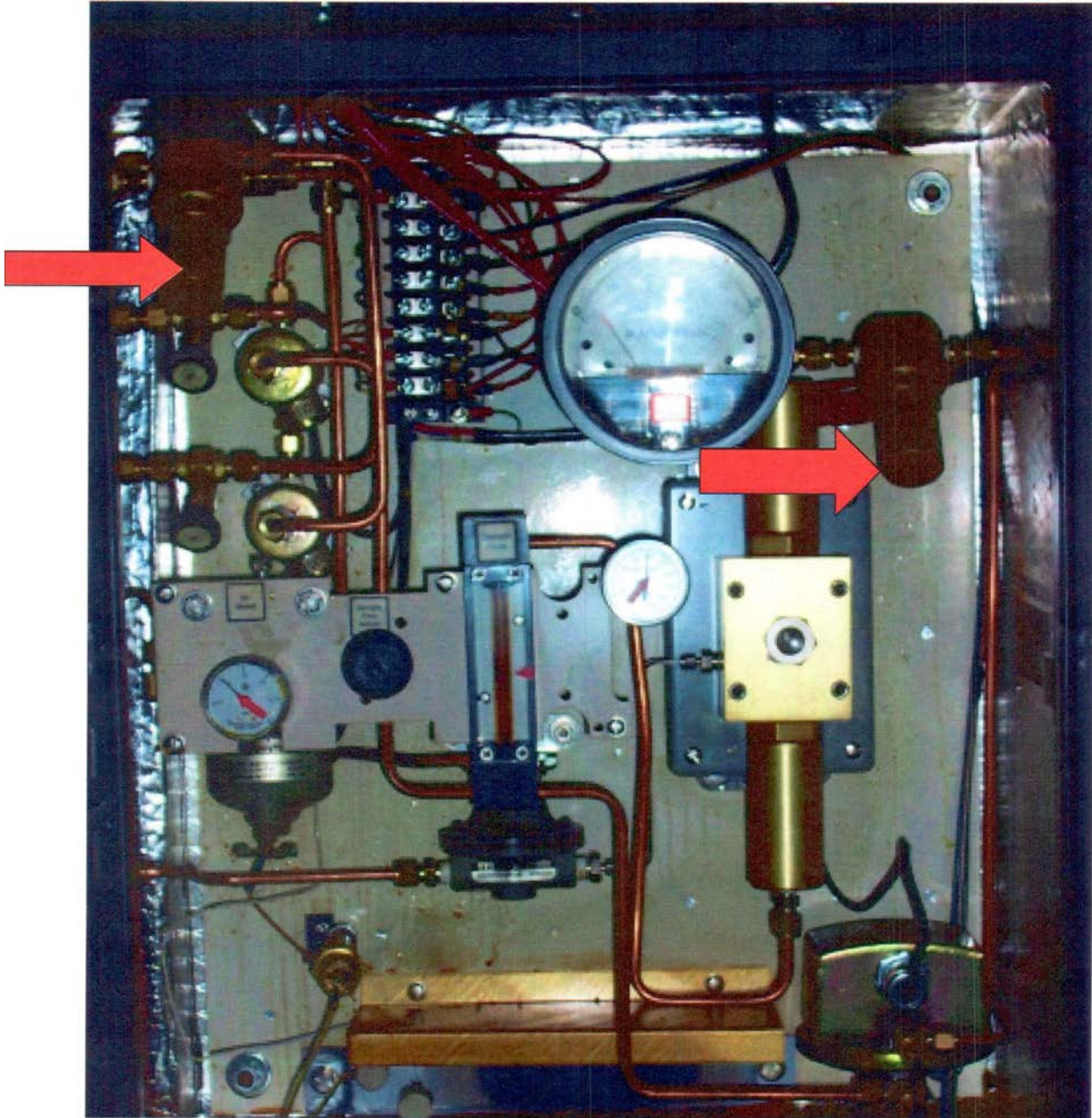
When this is done, THEN adjust the zero pot at the LFL controller so the indicator shows a value of 0. Adjust the span pot so the indicator reads 50% (our default max value).

4. Verify the sensor value (set at the LFL controller):

Using a volt meter set to DC volts, put the meter probes in the two SENSOR test points inside the LFL controller. The volt meter should have a reading of 0.51 volts. If the reading is off, it may be necessary to go back and recalibrate the flame in the LFL box. (Sometimes all other calibrations, if significant, will affect this setting.)

**Notes For Testing**

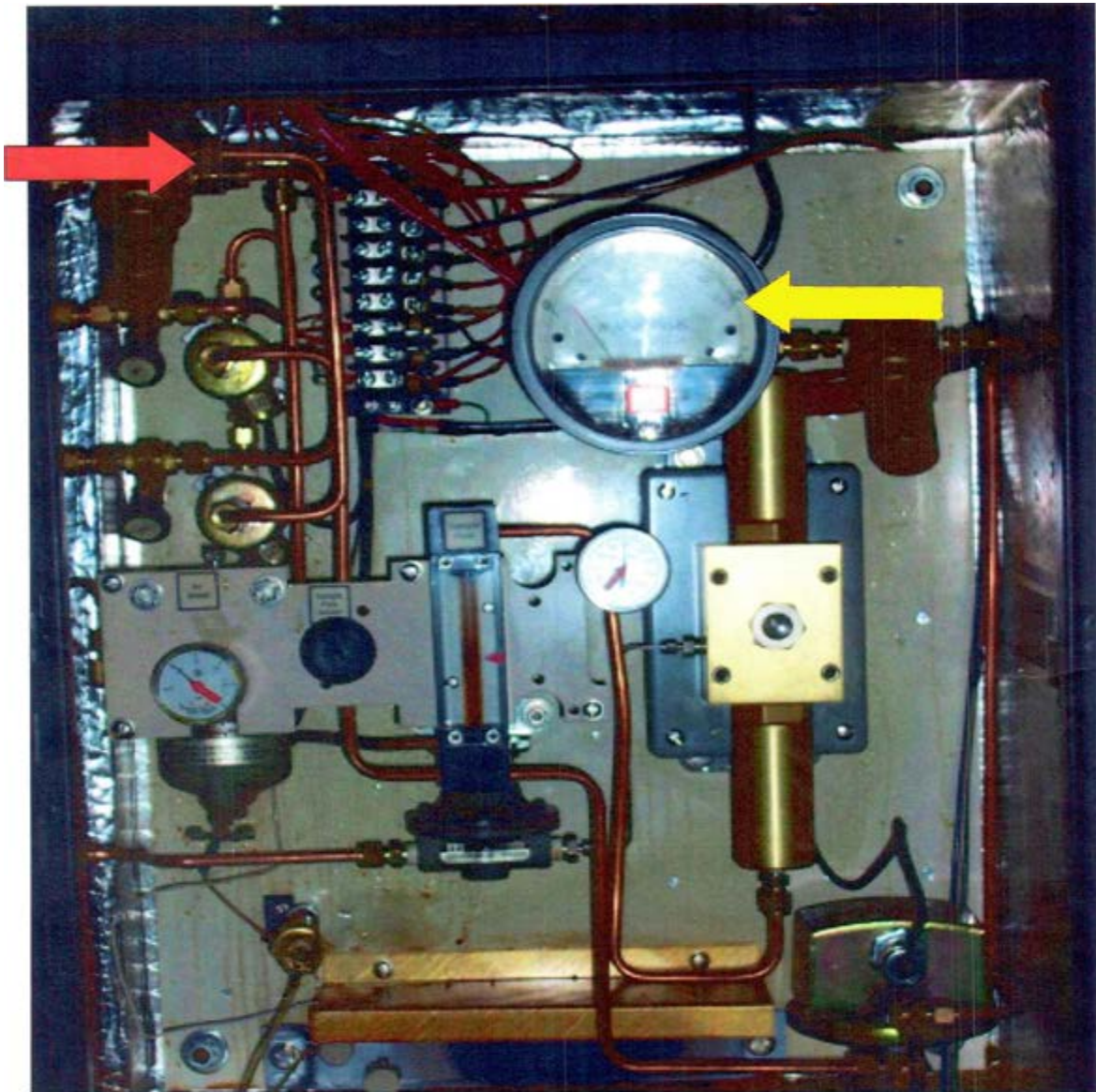
1. The METER test points at the LFL controller are not used in our setup.
2. To bypass the RTD (**for testing ONLY!**), put a precision (1%) 1 watt 5-6 ohm resistor across RTD wires 1 & 2 and another across wires 2 & 3. This creates a balanced voltage divider across the RTD.
3. A good flux cleaner is the cleanser **Fantastic**.

**PAPER FILTER CHANGE**

These are the paper filter locations. The first step is to change these filters. Unscrew the housing and replace filter. Hand tighten.

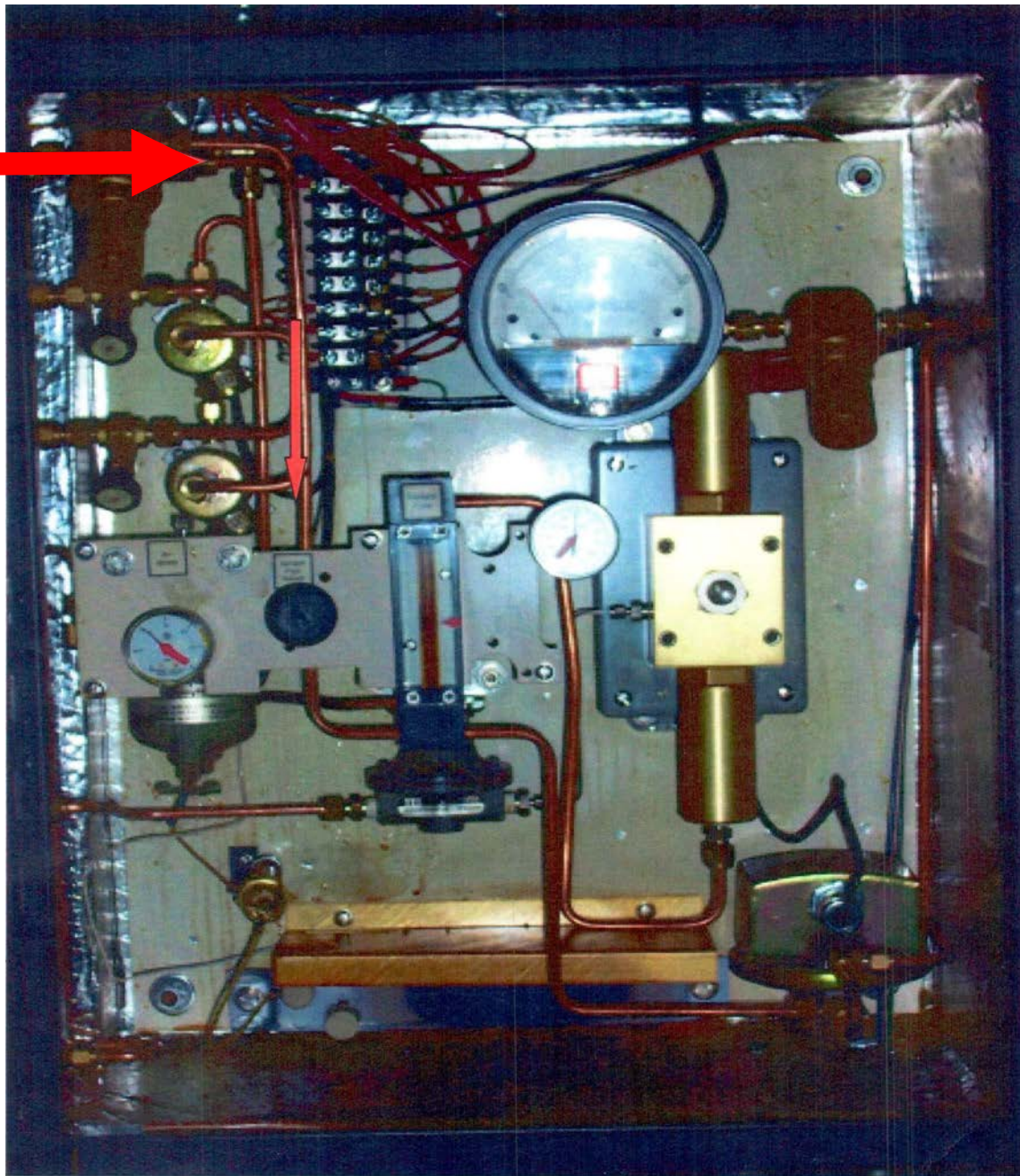


## CLOGGED TUBES



The next step is to check the system for a blocked aspirator or clogged lines. Take the copper tubing off this filter housing (red arrow). Cover the copper tubing with your thumb. The magnehelic (yellow arrow) will peg out past 50 if there is no blockage. If it doesn't peg out, there is a blockage.

## ASPIRATOR



The basic area for the aspirator is at the red arrow. The aspirator has three (3) tubes going into it. Remove all three (3) tubes to take out the aspirator. See the next page for directions on how to clean the aspirator.



### ASPIRATOR MAINTENANCE

- The aspirator should be disassembled for cleaning. Use a cleaning solution or solvent such as acetone, toluene or alcohol. Ultrasonic cleaning is also acceptable.
- Do NOT use heavy abrasives or wire brushes to clean the aspirator!!
- Use Teflon tape on threads during re-assembly of the aspirator.
- Dirty buildup on the outside of aspirator cone indicates process contamination.
- Dirty buildup on the inside of aspirator cone indicates dirt or oil in compressed air.

### ASPIRATOR ASSEMBLY P/N ASP001 (Nozzle & Spacer Inducted)

**EXHAUST OUT**

**4,6 THROAT**

**Dirt Buildup Areas**

**VACUUM PORT :**

**f30" H2O Neg.**

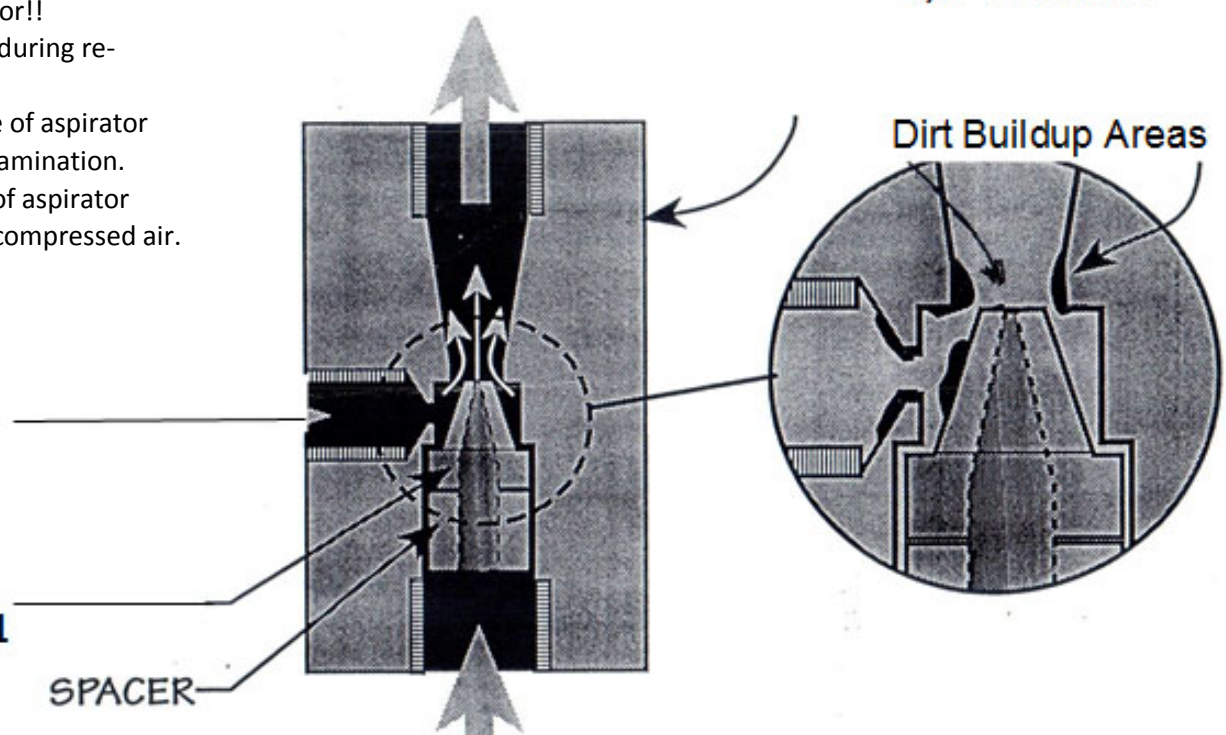
**200 mbar**

**NOZZLE P/N NZL001**

**SPACER**

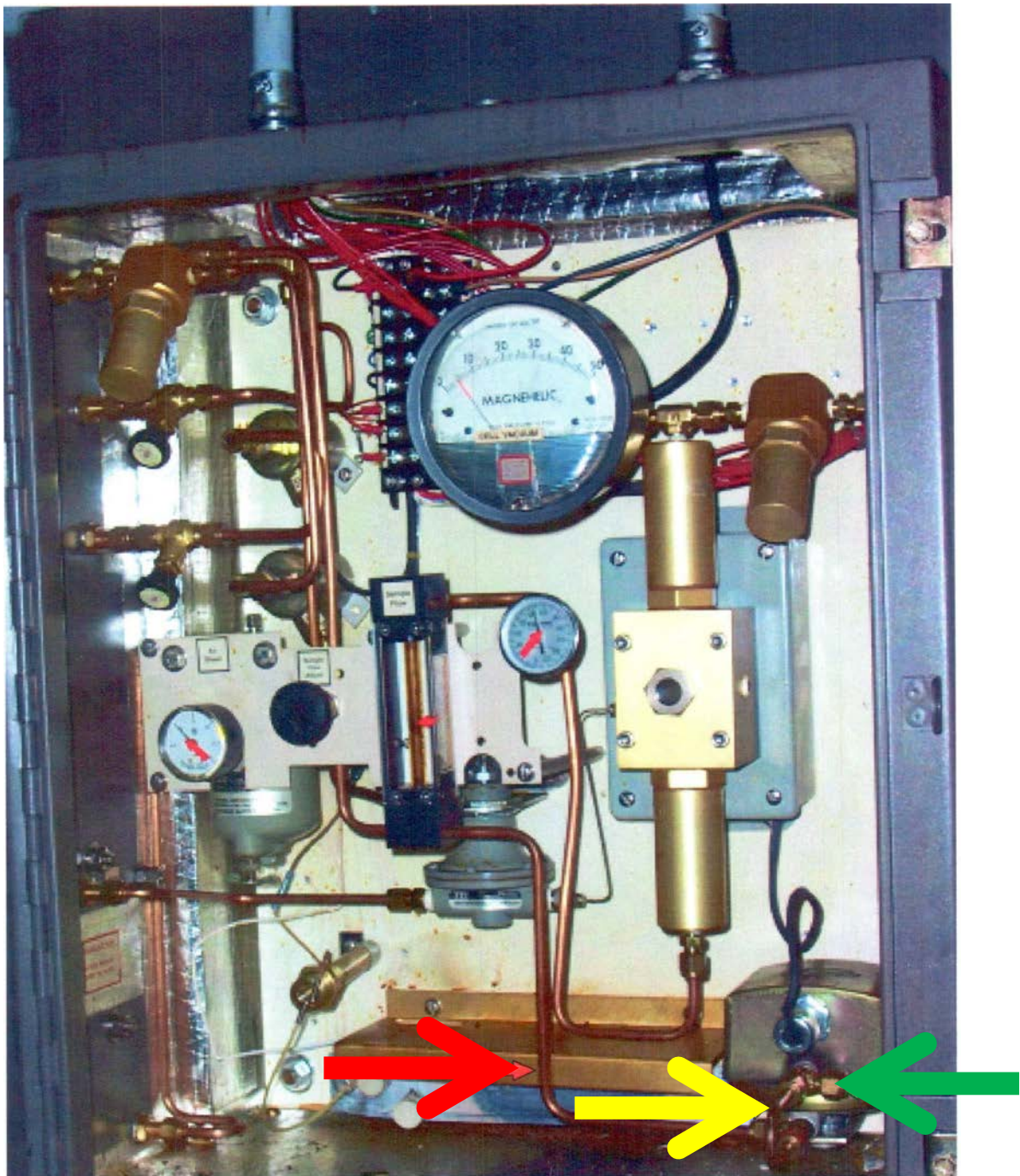
**COMPRESSED AIR IN:**

**10-15 psi, 0.7-1.0**



SLD102

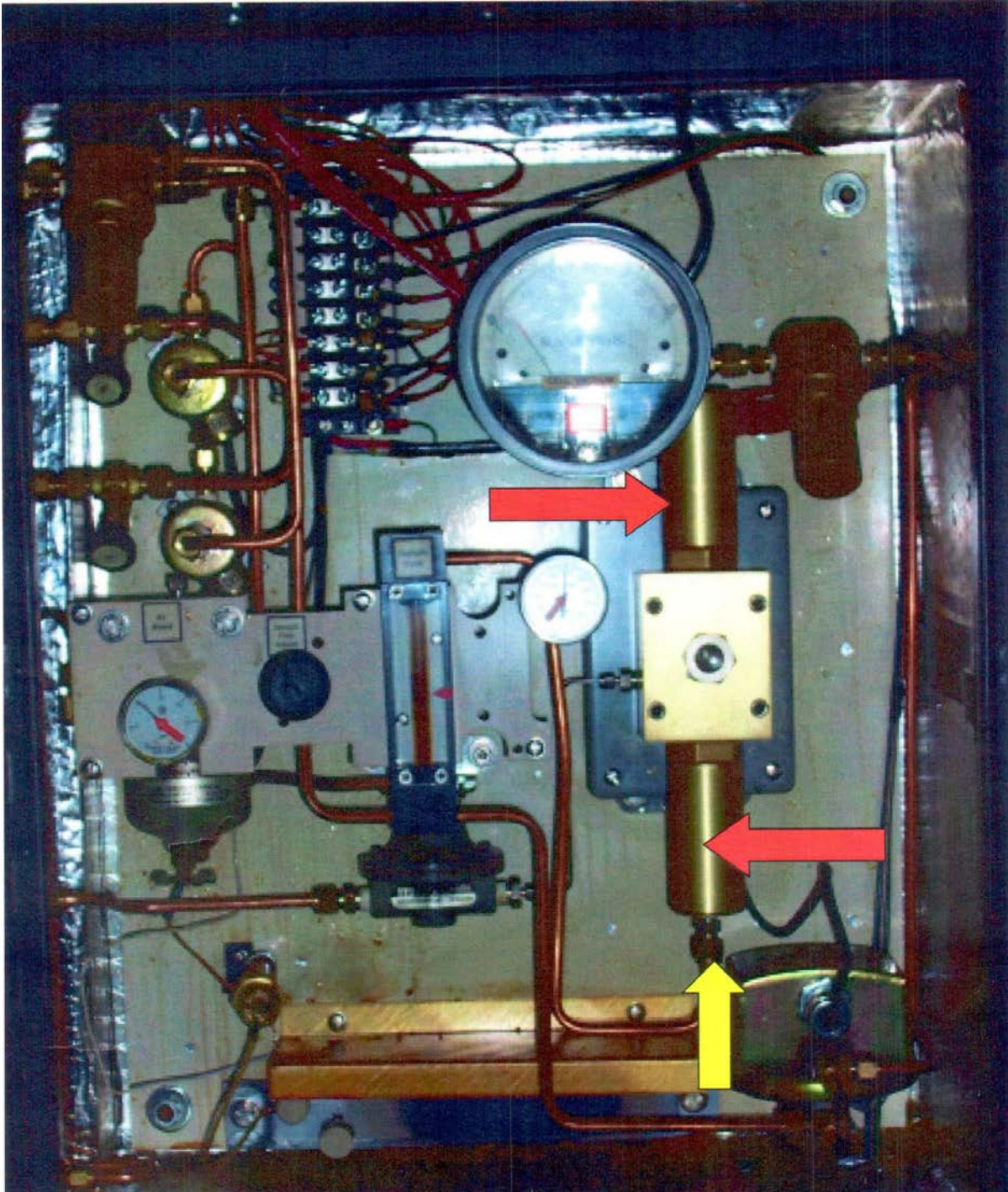
## TUBING



After taking out the aspirator, remove this tubing (red arrow) and blow it out. Set it to the side. Next, take out the jumper tubing (yellow arrow) and blow it out. Set it to the side. Take the fitting off (green arrow) and remove the ffa sensor/pressure switch. In the bottom of the sensor, there will be a screw held in by a lock ring. Remove this screw and replace the O-ring with a #14 O-ring. After putting the screw and lock ring back, turn the screw all the way in. Then turn it back out 1 1/4 turns. Put sensor back in unit.



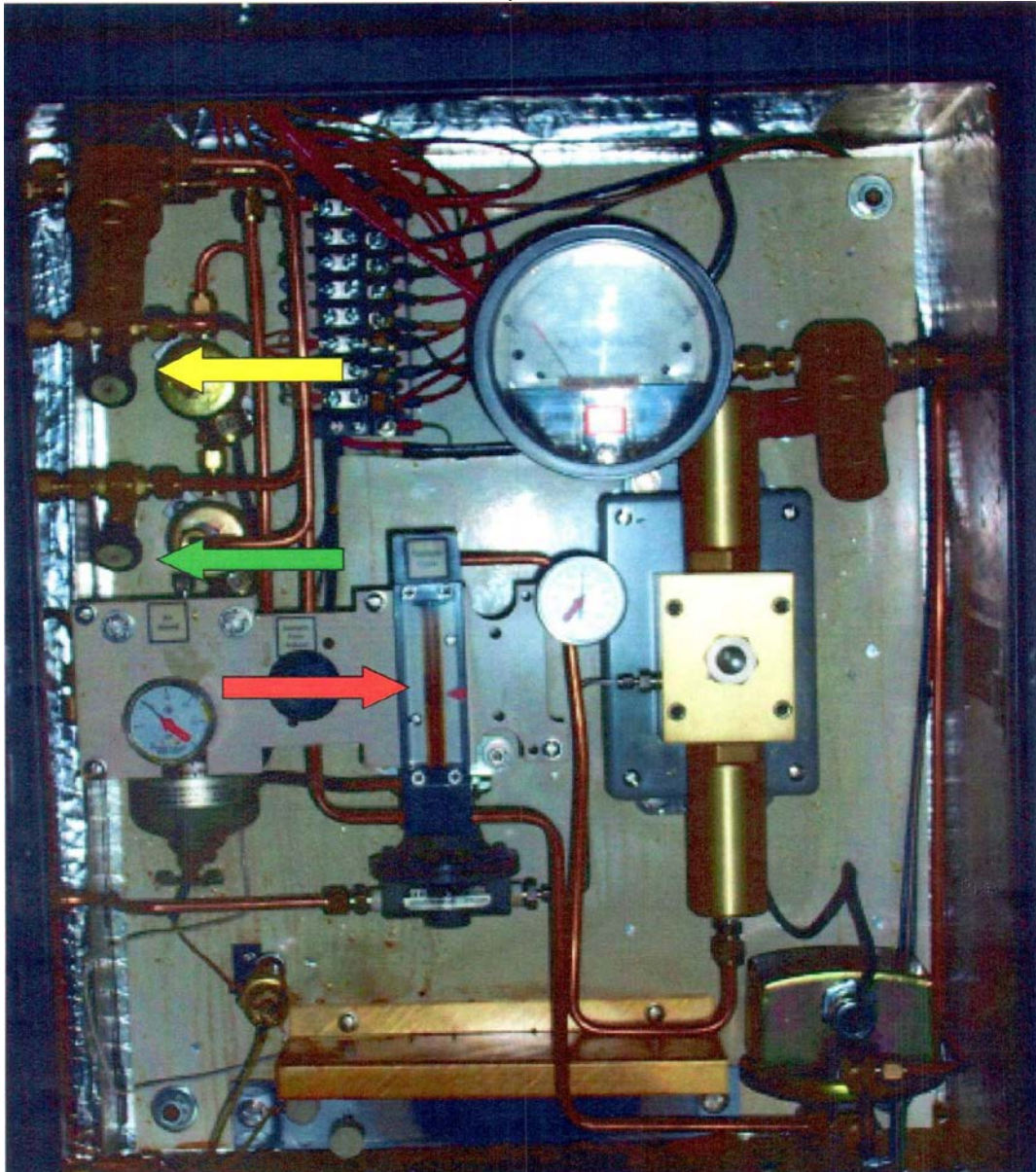
## FILTER HOUSING AND MAGNEHELIC



Next, remove the paper filter housing and magnehelic. Then remove this fitting (yellow arrow) and blow air into the fitting to clean. After removing tubing and fittings, unscrew the screen filter housings (red arrow). Clean in ultrasonic cleaner. Reinstall all fittings, tubing, and magnehelic.

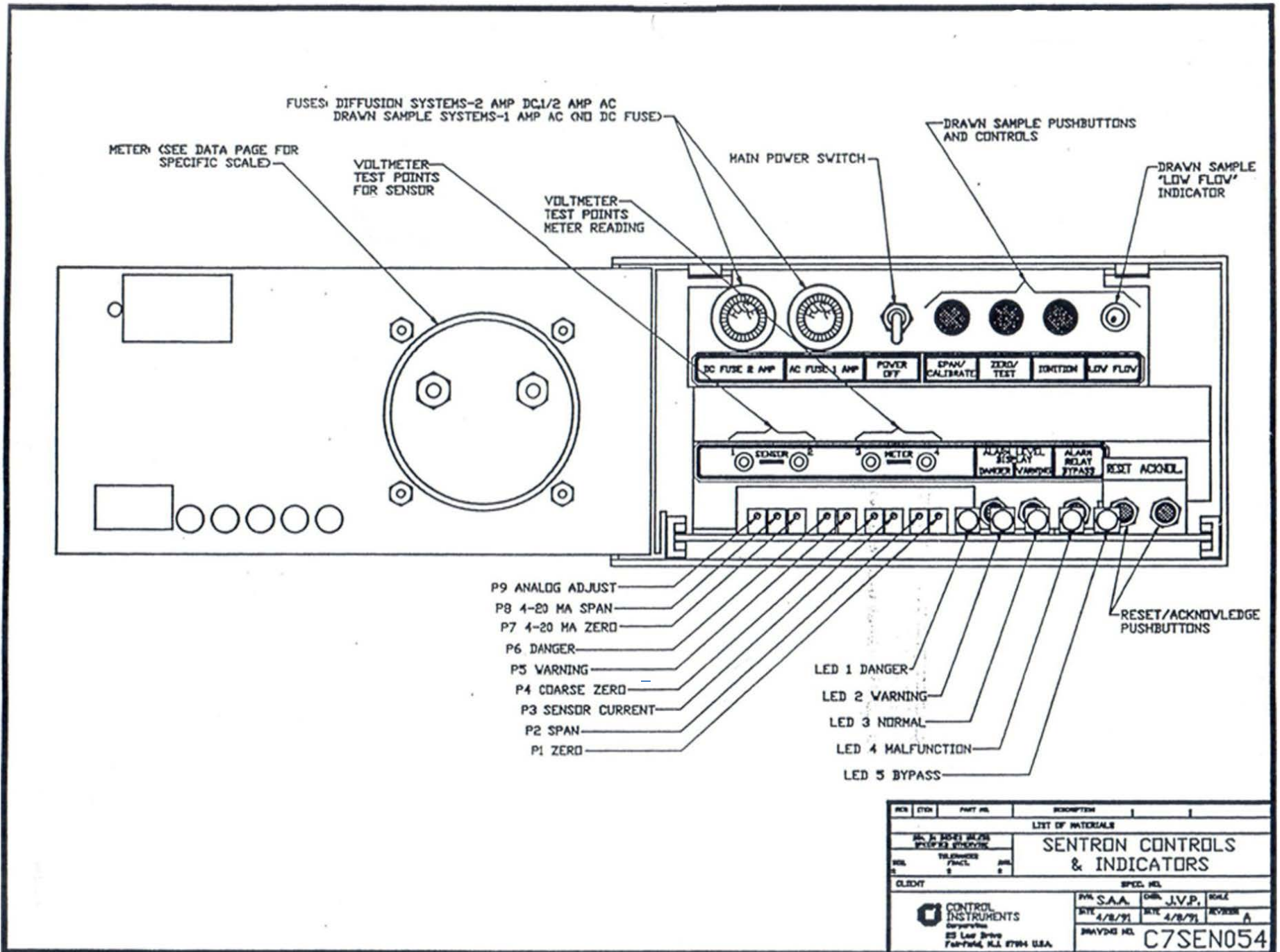


## BALL VALVE AND TRIM VALVE ADJUSTMENTS



Adjust the ball level with the red arrow on the glass (red arrow). Repeat the step to check for clogs. If everything is o.k., set the span and zero. Note the reading on the magnehelic. At the LFL Sentron controls, push the zero button (shown on the next page). The reading should match the original reading noted. If not, adjust. Zero adjust (green arrow above). Span adjust (yellow arrow above). Repeat process for span.

**Trim Valve Adjustment Procedure:** Adjust trim valves on zero & span as follows:  
1. Open trim valve completely in Counter Clockwise direction. 2. Adjust flowmeter to 6.0 scfh using sample flow adjust valve. 3. Press the zero test solenoid to introduce fresh air or test gas. 4. Slowly turn trim valve until flowmeter reads just under 6.0 scfh--leave trim valve in this position. 5. Adjust flowmeter to 5.0 scfh using sample adjust hand valve.

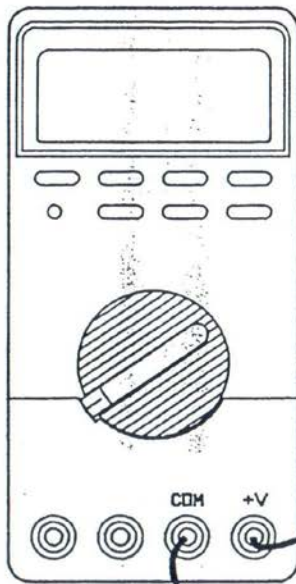
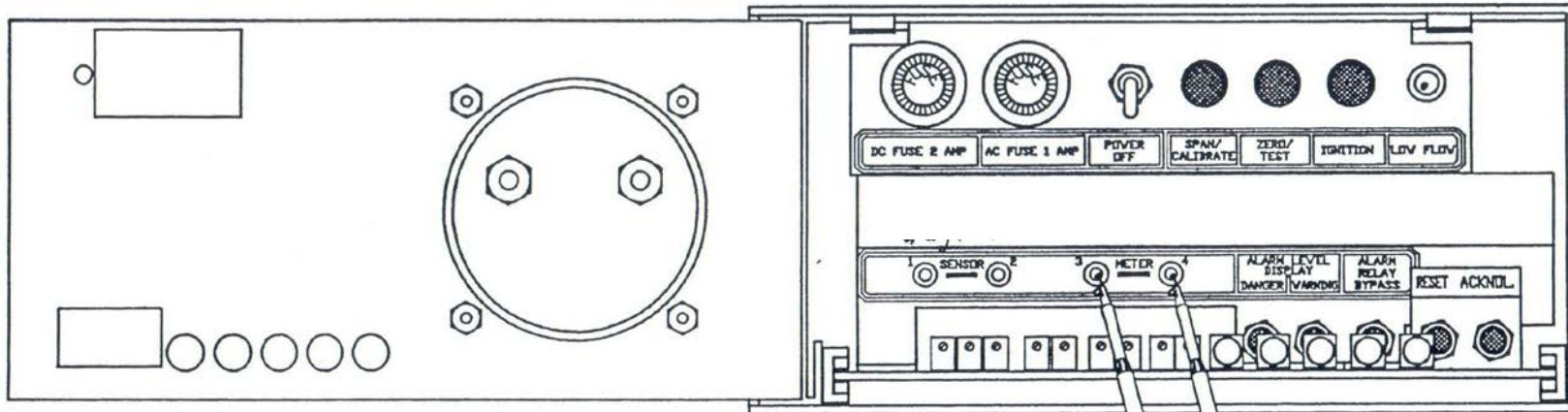


## **Adjust the Sensor Current**

The next step is to adjust the sensor current. Go to the control unit and measure the DC voltage at the sensor port. This is shown on the next page. The voltage should be .510 +/- .005 VDC. If not, adjust it by turning the pot called sensor current (P3).



C7SEN082



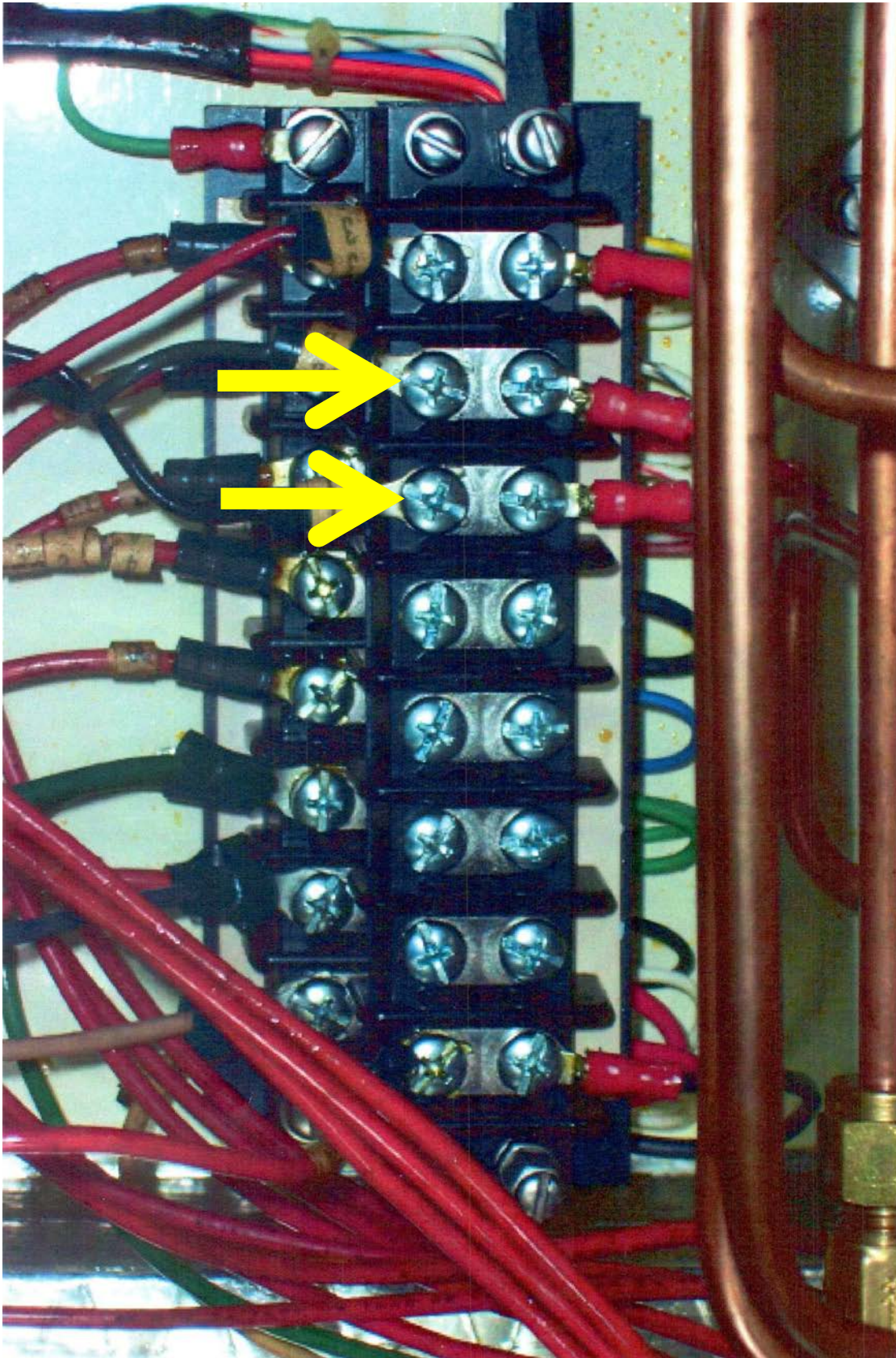
NOTES:

- 1. 0-5 VOLTS ON THE METER INDICATES 0-100% ON THE SENTRON METER.

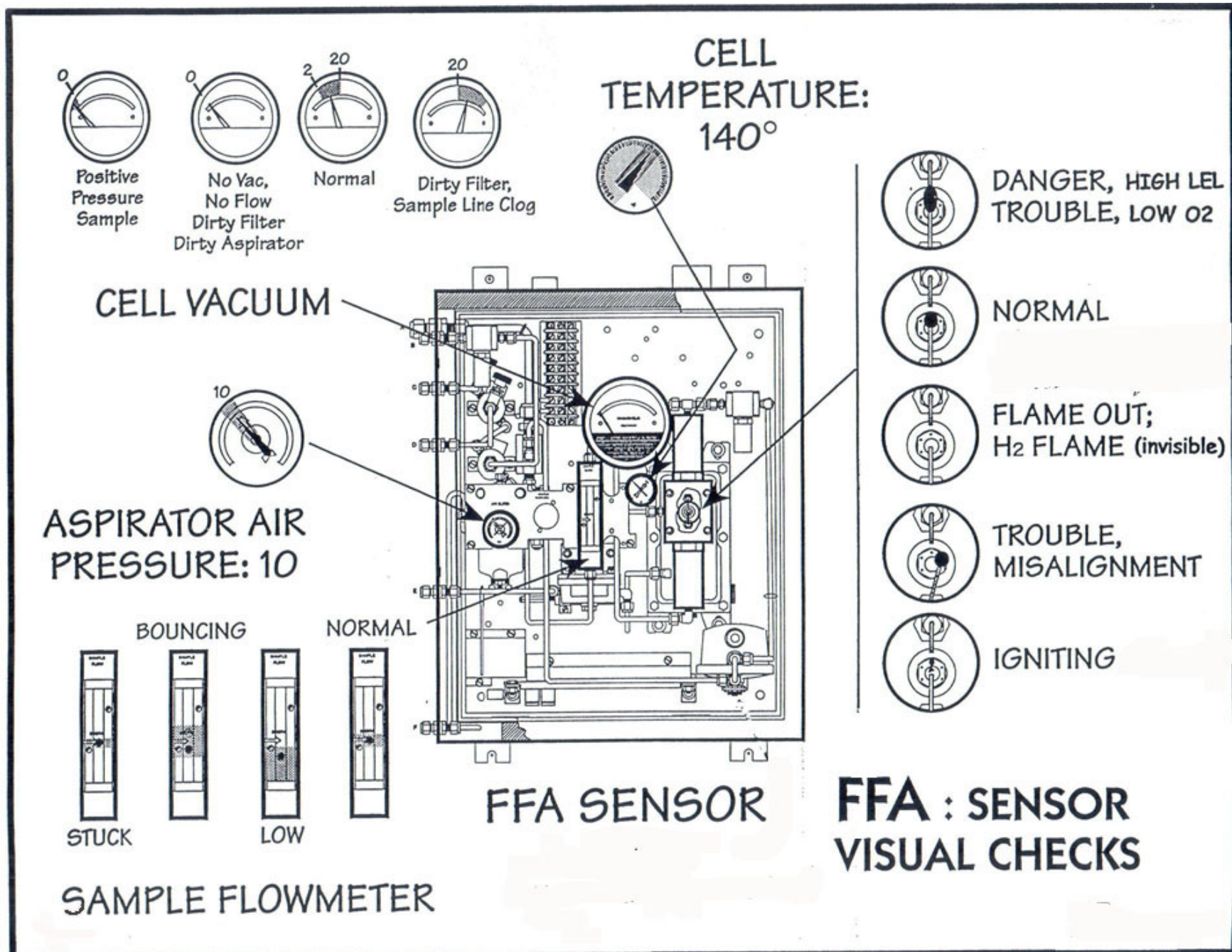
REV	ITEM	PART NO.	DESCRIPTION
LIST OF MATERIALS			
DIM. IN INCHES UNLESS SPECIFIED OTHERWISE TOLERANCES: FRACTIONS DECIMALS ANGLES ALL 1/16 1/32 1/64 1/2 1/4 3/4		<b>METER HOOK-UP ILLUSTRATION</b>	
CLIENT 3M COMPANY			SPEC. NO.
<b>CONTROL INSTRUMENTS</b> Corporation 85 Lee Drive Fairfield, N.J. 07004 U.S.A.		PWA PJM DATE 3-3-93 DRAWING NO.	DWR TDA DATE 3-3-93 REVISED <b>C7SEN082</b>

## **Measure RTD Volts**

Next, go to the unit and measure the RTD volts. This is measured on the brown and red wires TS-2 #6 #7. The voltage should be .62 +/- .005 VDC. If it is not, the burner set up is wrong or dirty. If the voltage is not correct, take the cover off of the burner. Make sure the RTD and burner are aligned and are 1/4 inch apart. Clean both pieces. Be careful with the RTD. Put it back together and light the burner. See the Sensor visual check drawing for what the flame should look like. There is an alignment tool.



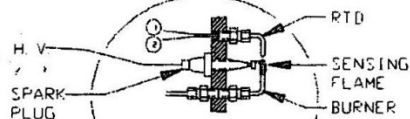




B7FFFA109

SYN	DATE	BY	REVISIONS
B	5/24/91	PS	CORRECTED SPELLING ERROR
C	6/4/98	GDW	REMOVED FUEL CAPILLARY

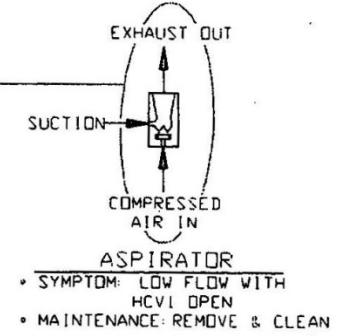
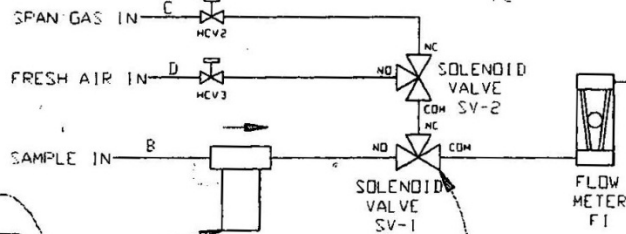
- FLAME CELL**
- SYMPTOM: ERRATIC OR FULL-SCALE READING
  - MAINTENANCE: REPLACE RTD
  - SYMPTOM: NO SPARK
  - MAINTENANCE: CHECK/REPLACE IGNITOR
  - SYMPTOM: NO FLAME
  - MAINTENANCE: (A) CHECK FUEL PRESSURE (30 - 35 PSI REQ'D)
  - MAINTENANCE: (B) CHECK FOR FAILED O-RINGS & LEAKING



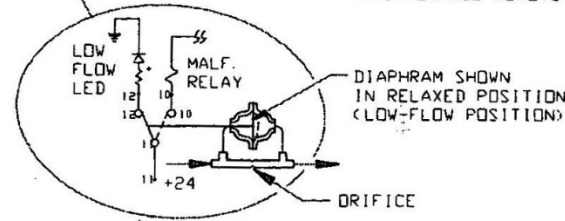
- CELL VACUUM GAUGE VI**
- SYMPTOM: HIGH READING, LOW FLOW
  - MAINTENANCE: REPLACE AF-1 ELEMENT
  - SYMPTOM: LOW READING, LOW FLOW
  - MAINTENANCE: REPLACE AF-2 ELEMENT, CLEAN ASPIRATOR

- FLOW CONTROL VALVE HCV1**
- SYMPTOM: LOW FLOW WITH VALVE FULLY OPEN
  - MAINTENANCE: REMOVE & CLEAN

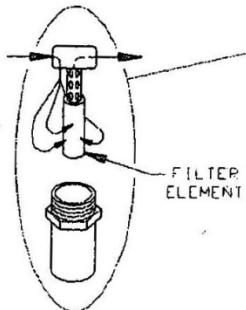
**TRIM VALVES**  
HCV2 AND HCV3  
ADJUST SO CELL VACUUM READING DURING TEST MODE MATCHES NORMAL SAMPLE VACUUM READING



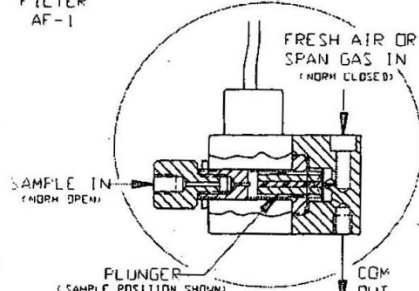
- ASPIRATOR**
- SYMPTOM: LOW FLOW WITH HCV1 OPEN
  - MAINTENANCE: REMOVE & CLEAN



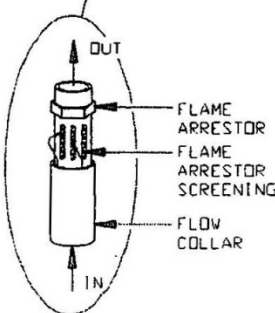
- LOW-FLOW SWITCH AND ORIFICE**
- SYMPTOM: TRIP POINT ERROR
  - MAINTENANCE: (A) CLEAN DRIFICE
  - MAINTENANCE: (B) ADJUST SET SCREW
  - MAINTENANCE: (C) REPLACE FLOW SWITCH



- SAMPLE FILTER AF-1**
- SYMPTOM: HIGH CELL VACUUM
  - MAINTENANCE: REPLACE ELEMENT
- EXHAUST FILTER AF-2**
- SYMPTOM: LOW FLOW, WITH HCV1 OPEN
  - MAINTENANCE: REPLACE ELEMENT

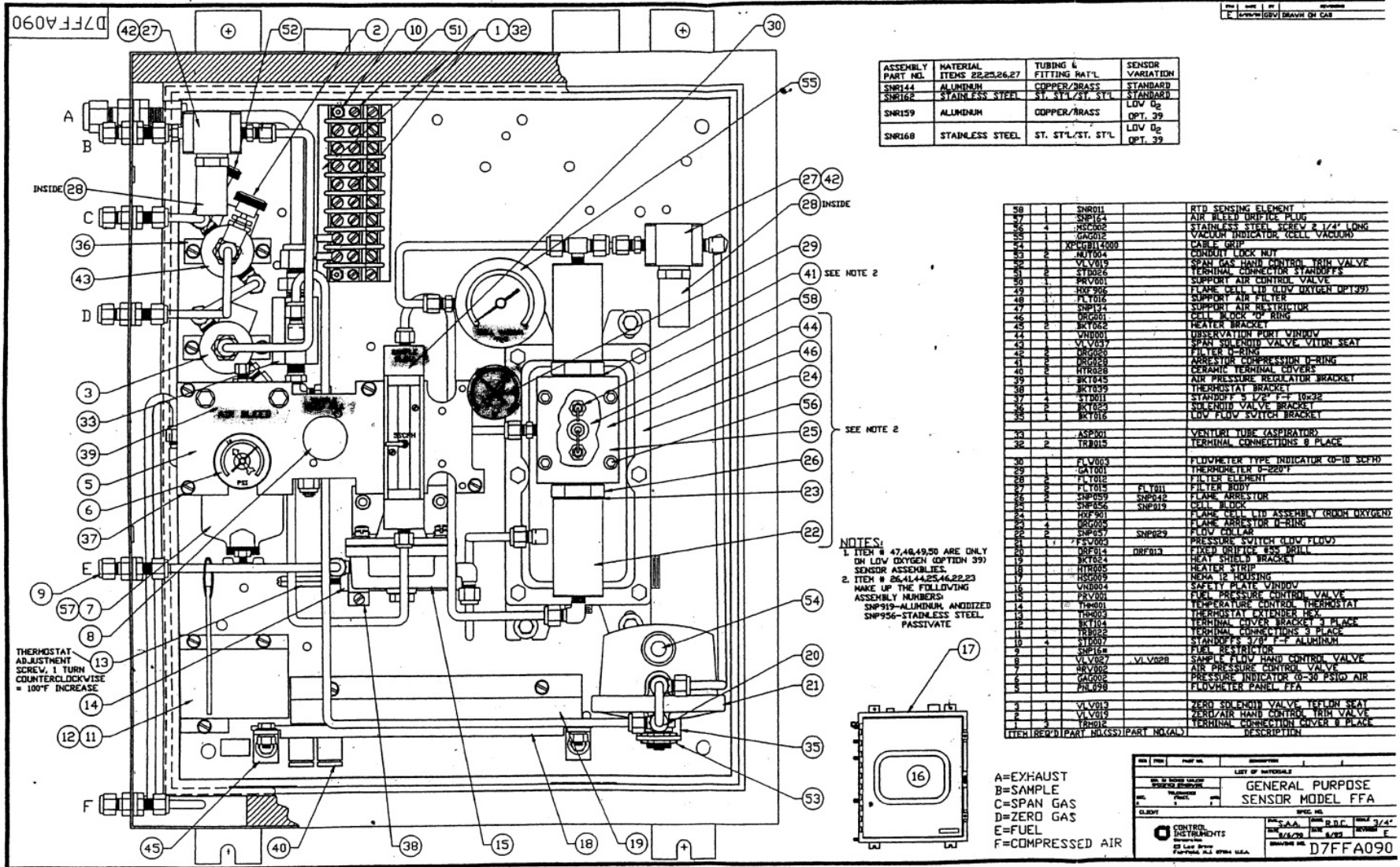


- SOLENOID VALVE SV-1 & 2**
- SYMPTOM: WILL NOT ACTIVATE
  - MAINTENANCE: CHECK COIL FOR OPEN (NOTE: DIODE COIL)



- INLET FLAME ARRESTOR**
- SYMPTOM: CLOGGING
  - MAINTENANCE: REMOVE, WASH IN SOLVENT, BLOW OUT, REPLACE O-RINGS
  - NOTE: OUTLET FLAME ARRESTOR, SAME, BUT WITH REVERSED FLOW

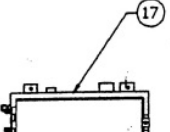
REQ	ITCM	PART NO	DESCRIPTION
LIST OF MATERIALS			
FFA SAMPLE FLOW DIAGRAM			
DIM. IN INCHES UNLESS SPECIFIED OTHERWISE		TOLERANCES FRACT. ANG.	
CLIENT		SPEC NO	
CONTROL INSTRUMENTS Corporation 25 Low Drive Fairfield, N.J. 07004 U.S.A.		DWN RRL	ENGR PS SCALE
DATE 8/4/89		DATE 8/3/89	REVISION C
DRAWING NO		B7FFFA109	



ASSEMBLY PART NO.	MATERIAL	TUBING & FITTING MAT'L	SENSOR VARIATION
SNR144	ALUMINUM	COPPER/BRASS	STANDARD
SNR152	STAINLESS STEEL	ST. ST'L/ST. ST'L	STANDARD
SNR159	ALUMINUM	COPPER/BRASS	LOW O <sub>2</sub> OPT. 39
SNR168	STAINLESS STEEL	ST. ST'L/ST. ST'L	LOW O <sub>2</sub> OPT. 39

58	1	SNR011	RTD SENSING ELEMENT
57	1	SNP164	AIR BLEED DRIFICE PLUG
56	4	HSC002	STAINLESS STEEL SCREW 2 1/4" LONG
55	1	GR0010	VACUUM INDICATOR (CELL VACUUM)
54	1	XPC0011000	CABLE GRIP
53	2	HT004	CONDUIT LOCK NUT
52	1	VLV019	SPRINT GAS-DRAW CONTROL TRIM VALVE
51	2	STD024	TERMINAL CONNECTOR STANDOFFS
50	1	PRV001	SUPPORT AIR CONTROL VALVE
49	1	HZF006	FLAME CELL LID (LOW OXYGEN OPT.39)
48	1	FLT016	SUPPORT AIR FILTER
47	1	SNP124	SUPPORT AIR RESTRICTOR
46	1	DRG001	CELL BLOCK O-RING
45	2	RYT022	HEATER BRACKET
44	1	VND001	OBSERVATION PORT WINDOW
43	1	VLV037	SPRINT SOLENOID VALVE, VITON SEAT
42	1	DRP050	FILTER O-RING
41	2	DRP050	ARRESTOR COMPRESSION O-RING
40	2	HTR008	CERAMIC TERMINAL COVERS
39	1	RT045	AIR PRESSURE REGULATOR BRACKET
38	1	RYT039	THERMOSTAT BRACKET
37	1	STD011	STANDOFF 3/16" 1-2 10x32
36	2	RYT029	SOLENOID VALVE BRACKET
35	1	RT016	LOW FLOW SWITCH BRACKET
34	1	ASP001	VENTURI TUBE (ASPIRATOR)
32	2	TR0015	TERMINAL CONNECTIONS 8 PLACE
30	1	FLV003	FLOWMETER TYPE INDICATOR CO-10 SOFHD
29	1	GAT001	THERMISTOR 0-220°F
28	2	FLT016	FILTER ELEMENT
27	2	FLT016	FILTER HOOD
26	2	SNP042	FLAME ARRESTOR
25	2	SNP056	CELL BLOCK
24	1	HZF001	FLAME CELL LID ASSEMBLY (ORION DRYGREN)
23	4	DRG004	FLAME ARRESTOR O-RING
22	2	SNP057	FLOW COLLAR
21	1	FSV023	PRESSURE SWITCH (LOW FLOW)
20	1	DRF014	FIXED DRIFICE #35 DRILL
19	1	RYT024	HEAT SHIELD BRACKET
18	1	HTR005	HEATER STRIP
17	1	HSS039	HEAT IS. BRASSING
16	1	VND004	SAFETY PLATE WINDOW
15	1	PRV001	FUEL PRESSURE CONTROL VALVE
14	1	TR0001	TEMPERATURE CONTROL THERMOSTAT
13	1	TR0004	THERMOSTAT EXTENDER HSA
12	1	RT014	TERMINAL COVER BRACKET 3 PLACE
11	1	TR0022	TERMINAL CONNECTIONS 3 PLACE
10	2	STD027	STANDOFFS 7/16" 1-2 ALUMINUM
9	1	SNP164	FUEL RESTRICTOR
8	1	VLV027	SAMPLE FLOW HAND CONTROL VALVE
7	1	VLV002	AIR PRESSURE CONTROL TRIM VALVE
6	1	GA002	PRESSURE INDICATOR 0-30 PSID AIR
5	1	FLV008	FLOWMETER PANEL FFA
4	1	VLV019	ZERO SOLENOID VALVE, TEFLOON SEAT
3	1	VLV019	ZERO/AIR HAND CONTROL TRIM VALVE
2	1	TR0012	TERMINAL CONNECTION COVER 8 PLACE
1	1	TR0012	TERMINAL CONNECTION COVER 8 PLACE

NOTES:  
 1. ITEM # 47,48,49,50 ARE ONLY ON LOW OXYGEN (OPTION 39) SENSOR ASSEMBLIES.  
 2. ITEM # 25,41,42,54,55,56,57 MAKE UP THE FOLLOWING ASSEMBLY NUMBERS:  
 SNP919-ALUMINUM ANODIZED  
 SNP956-STAINLESS STEEL PASSIVATE



A=EXHAUST  
 B=SAMPLE  
 C=SPAN GAS  
 D=ZERO GAS  
 E=FUEL  
 F=COMPRESSED AIR

REV.	DATE	BY	DESCRIPTION
1			GENERAL PURPOSE SENSOR MODEL FFA

CONTROL INSTRUMENTS  
 23 East 20th Street  
 Farmingdale, N.Y. 11735 U.S.A.

DATE: 8/2/79  
 DRAWN BY: RJC  
 CHECKED BY: RJC  
 PART NO.: D7FFA090