STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX J

# BENDIX MODEL 8202A REACTIVE HYDROCARBON ANALYZER

MONITORING AND LABORATORY DIVISION

DECEMBER 1995

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APPENDIX J.1

STATION OPERATOR'S PROCEDURES

FOR

BENDIX MODEL 8202A REACTIVE HYDROCARBON ANALYZER

MONITORING AND LABORATORY DIVISION

DECEMBER 1995

## J.1.0 GENERAL INFORMATION

### J.1.0.1 THEORY OF OPERATION

The Bendix Model 8202A reactive hydrocarbon analyzer uses gas chromotography and a flame ionization detector (FID) to provide quantitative analysis of ambient levels of methane ($CH_4$ ) and total hydrocarbon (THC). This appendix supplements the manufacturer's manual with instructions for servicing and troubleshooting. It should be noted that these instructions may differ from the manufacturer's manual due to analyzer modifications incorporated in the Model 8202A (CARB modification).

### J.1.0.2 ANALYTICAL CYCLE

The cycle begins with the actuating of valve 1 causing the sample loop to be purged by dry carrier air (Figure J.1.0.1). The sample volume (approximately 8cc) is moved by the carrier air to a tee where the sample is split into THC and $CH_4$ sample volumes. The THC sample volume moves through a flow balancing capillary to the FID whose output at any time is proportional to the carbon atoms present. The $CH_4$ sample volume moves through valve 2 (off position) to the analytical column which separates the heavier hydrocarbons from the methane. The methane sample volume flows through a delay column to the FID. After the methane component is analyzed, the AUTO ZERO mode occurs. The AUTO ZERO measures the baseline voltage and subtracts it from the FID voltage output during the THC and $CH_4$ modes of the following analytical cycle. After the AUTO ZERO, valve 1 is turned off and valve 2 is turned on (Figure J.1.0.2). In the valve 1 off position, the sample loop is purged with sample air. In the valve 2 on position the analytical column is backflushed with clean air to remove the heavier hydrocarbons that were separated from the methane. At the end of the cycle, valve 2 is turned off in preparation for the start of a new cycle (Figure J.1.0.3).

The electronic output of FID is amplified, corrected by the AUTO ZERO voltage, and fed to the integrator which totals the FID output during each analysis mode. Just after valve 1 is actuated, a timing signal is sent to the THC memory card, which allows the output of integrator to be accepted. The voltage output of the integrator is stored in the memory card. The THC mode ends before the methane sample reaches the FID. Before the $CH_4$ sample volume reaches the FID, the integrator discharges to zero and a timing signal is sent to the $CH_4$ memory card, which allows the output of the integrator to be accepted. After the $CH_4$ mode is complete, the integrator discharges to zero. The memory cards amplify, hold, and output the signal to their respective THC and $CH_4$ recorder outputs and the front panel meter selector switch.

J.1.0.3 CAUTIONS

1. The Bendix 8202A uses compressed hydrogen gas. Extra caution should be used to prevent hydrogen leaks from occurring and ignition of the hydrogen if they do occur.

2. Adhere to general safety precautions when using compressed gas cylinders (e.g. secure cylinders, vent exhaust flows).

3. Use only clean regulators with teflon or stainless steel diaphragms and seats to prevent contamination of the compressed calibration gases.

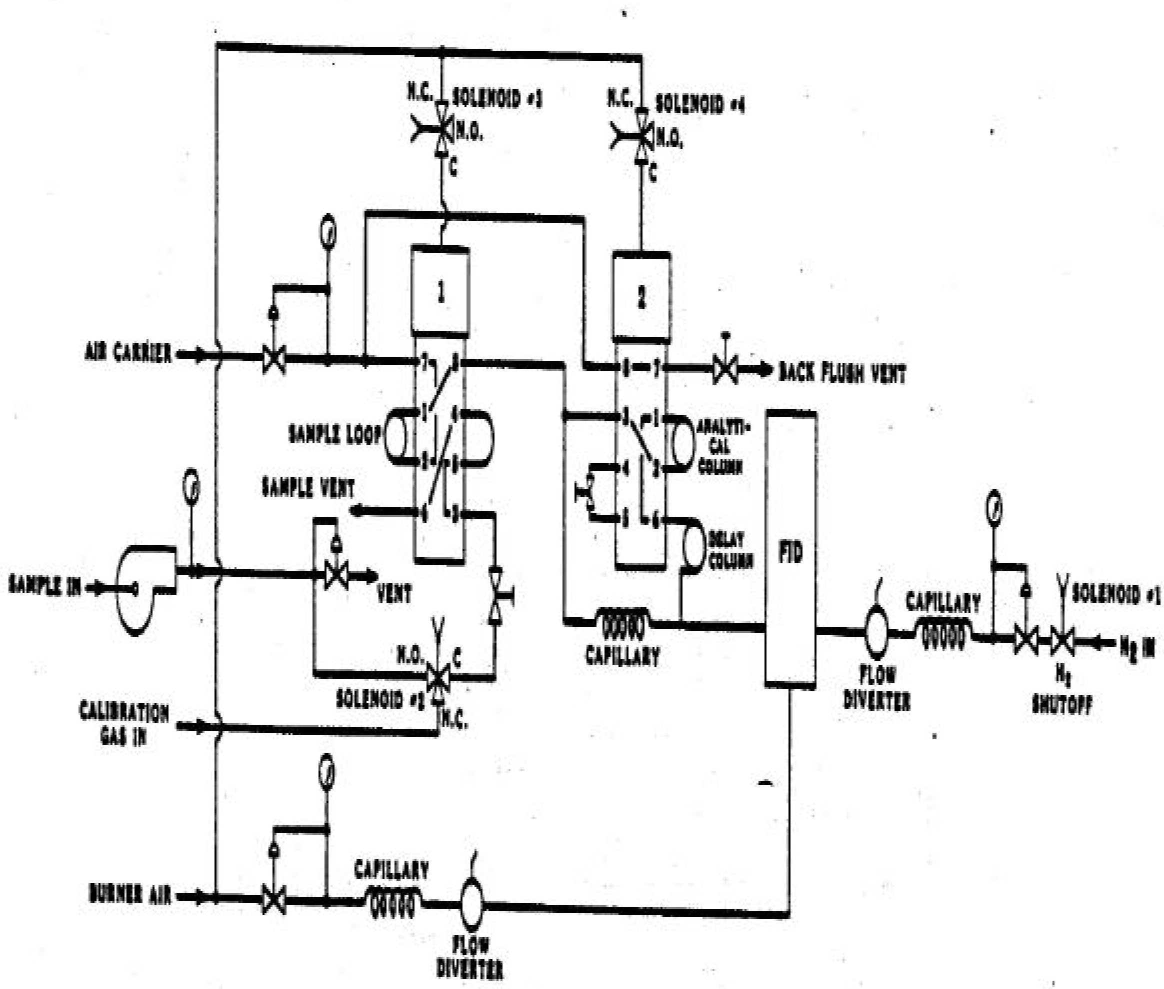


Figure J.1.0.1
Sample Inject - Valve 1 On, Valve 2 Off

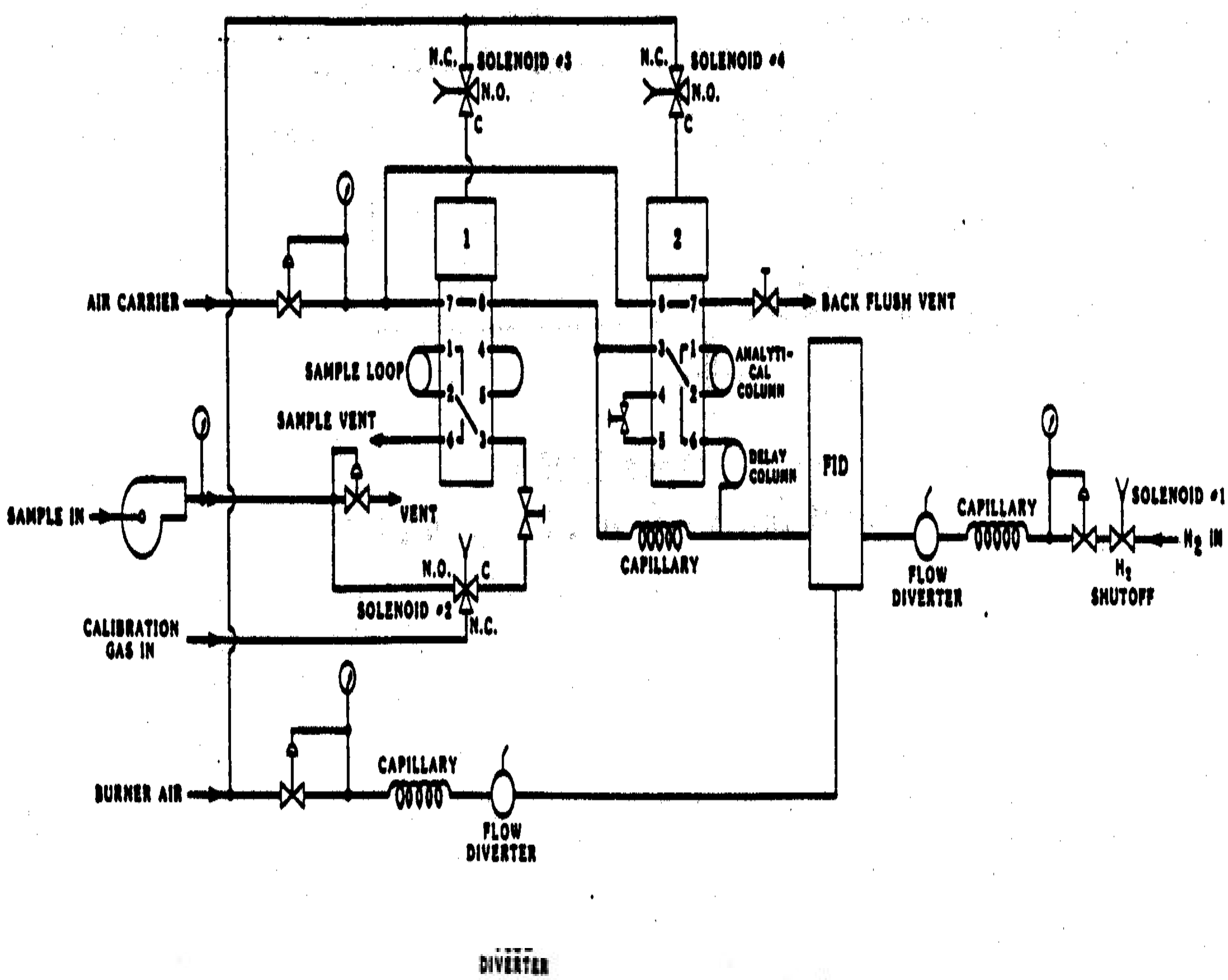


Figure J.1.0.2
Backflush - Valve 1 Off, Valve 2 On

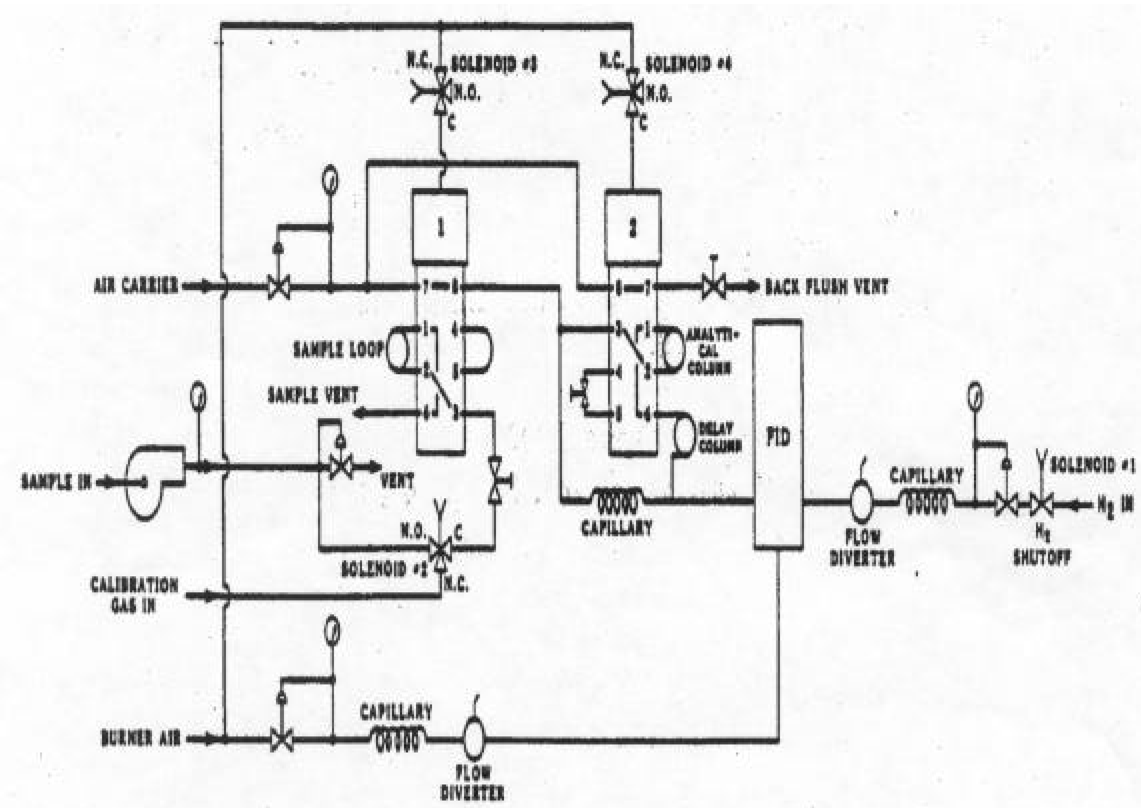


Figure J.1.0.3
Static Zero - Valve 1 Off, Valve 2 Off

# J.1.1 INSTALLATION PROCEDURES

## J.1.1.1 PHYSICAL INSPECTIONS

1. Unpack the analyzer and check it for shipping damage.

2. Remove the analyzer cover and circuit board cover. Check that all the circuit boards are seated in their connectors.

3. Check that oven temperature is set to 80EC (see Figure J.1.1.1).

## J.1.1.2 INITIAL SET-UP/INSTALLATION

1. Using copper or teflon line, connect the zero air supply to burner air/carrier air inlet (the two inlets are teed to a 7- micron filter; if the analyzer is not configured this way, install this configuration before proceeding). If the zero air supply is the 8202A Support Module, see Section J.4 of this manual for its installation instructions. Leak check all connections using leak detection fluid.

2. Connect the hydrogen generator or instrument grade hydrogen cylinder to the hydrogen inlet using copper tubing. Leak check all connections using leak detection fluid.

3. If the 8202A Support Module is not used, connect a MB-21 pump to the sample inlet and to the station sample manifold using 1/8" teflon line from the pump to the analyzer and 1/4" teflon line from the sample manifold to the pump. If the 8202A Support Module is used, see Section J.4 of this manual for the interconnection of the sample line.

4. Connect the power cord to a 117 VAC outlet, and place the front panel switches in the following positions:

   Ranges: THC/$CH_4$ = 20ppm NMHC = 10ppm

| | |
|---|---|
| Valve #1 | OFF |
| Valve #2 | OFF |
| $H_2$ | AUTO SHUT OFF |
| Timer | MANUAL |
| Sample Pump | OFF |
| Power | ON |

5. Connect THC, $CH_4$ , and NMHC analog signal outputs to recording and data logger systems.

6. Allow analyzer to warm up for at least four hours before proceeding.

J.1.1.3 ANALYZER ALIGNMENT

Perform the following:

1. Flow Adjustment: See Section J.1.3.1

2. Balancing Flows: See Section J.1.3.2

3. Chromatogram: See Section J.1.3.5

4. Timing Adjustment: See Section J.1.3.3

5. Zero and Span: See Section J.1.3.4

6. Place the front panel switches in the normal operating positions.

Ranges: THC/$CH_4$ = 20ppm NMHC = 10ppm

| | |
|---|---|
| Valve #1 | AUTO |
| Valve #2 | AUTO |
| $H_2$ | AUTO SHUT OFF |
| Timer | AUTO |
| Sample Pump | ON |
| Power | ON |

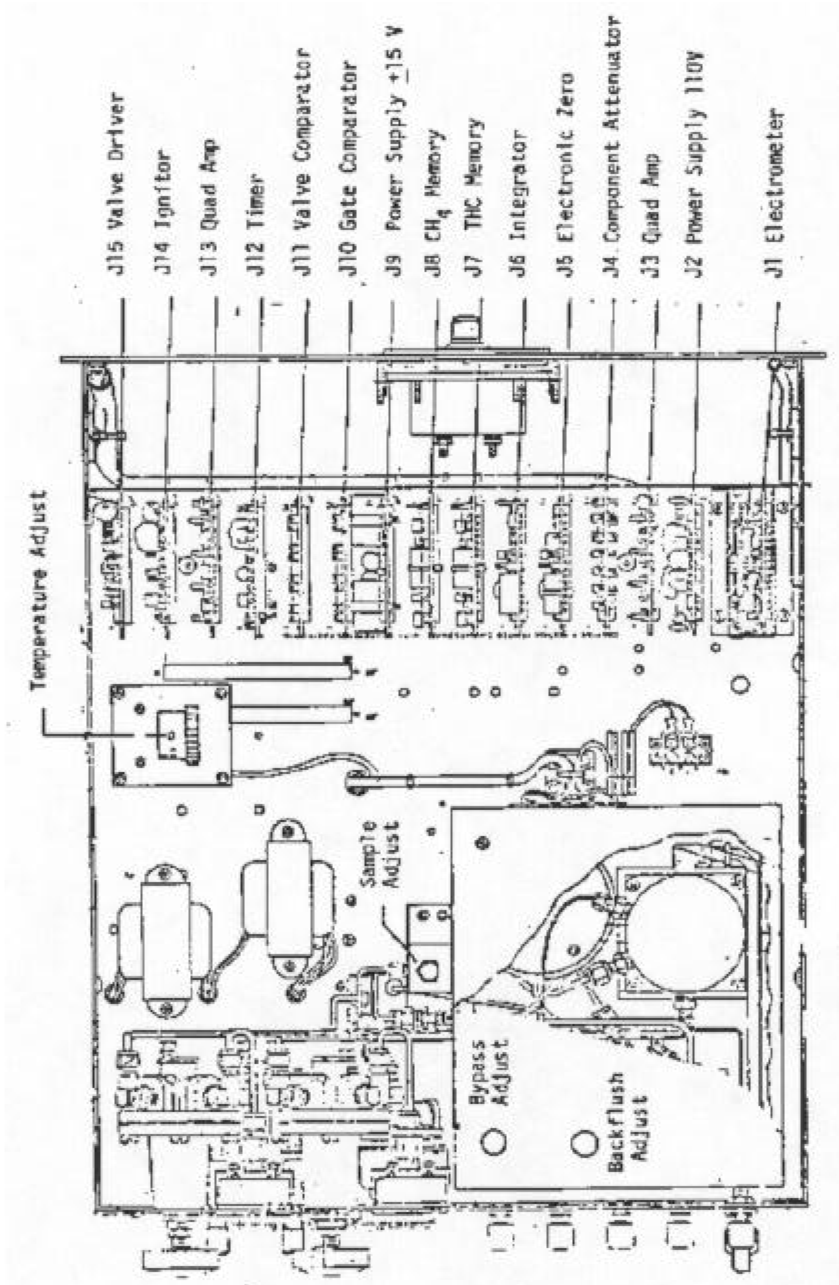


Figure J.1.1.1
Top View - Analyzer Interior

## J.1.2 ROUTINE SERVICE CHECKS

### J.1.2.1 GENERAL INFORMATION

Perform the following routine service checks using the attached schedule (Figure J.1.2.1) and the procedures documented below and in Section J.1.3. Checks may be performed more frequently, but should be performed at least at the prescribed intervals. Attached is a copy of the Monthly Quality Control Maintenance Checksheet (Figure J.1.2.2) which you should fill out weekly and forward monthly to your supervisor.

### J.1.2.2 DAILY CHECKS

1. Check hydrogen, burner air, and carrier air pressure gauges for any change in pressure.

2. Place meter switch in "electrometer" position and observe the meter reading while valve 2 is on. This should match the electrometer baseline reading previously observed (any change indicates possible supply air contamination).

3. If applicable, check previous night's auto-calibration $CH_4$ /THC responses for any change.

4. Check previous day chart traces for reasonableness. Minimum reading for THC and $CH_4$ should not be less than 1.5 ppm. Troubleshoot analyzer and/or supply air if chart response is less than 1.5 ppm.

### J.1.2.3 WEEKLY CHECKS

Perform the following checks and record the as found and final readings in adjacent columns on the Monthly Quality Control Maintenance Checksheet (Figure J.1.2.2).

1. Zero Check - Place valve 1 in the off position until a stable zero trace is observed (at least three cycles). Turn valve 1 back to AUTO.

2. Span Check - Introduce span gas through the span port by setting the front panel input selector to calibrate position. Adjust the span compressed gas cylinder regulator to the pressure determined in last flow check or measure the flow at sample vent (60 $\pm$ 10 sccm). While waiting for a stable trace, run a chromatogram. Return all switches to normal (see paragraph J.1.1.3.6) positions, after a stable trace is obtained.

3. Chromatogram - See Section J.1.3.5.

4. Baseline - Record the baseline electrometer meter reading while valve 2 is on and using normal supply air. If the supply air is not a certified zero air compressed gas cylinder, disconnect the supply air and connect a certified zero air compressed gas cylinder with a stainless steel regulator (a three-way brass valve simplifies this check and may be requested from the Sacramento Support Facility). Record the baseline while the supply air is a certified zero air compressed gas cylinder. An increase in the baseline reading indicates contaminated supply air (contact your supervisor for corrective action). See Figure J.1.0.2 for three-way valve configuration. Switch back to normal supply air.

5. Monthly, forward the chromatograms and the monthly check sheet to your supervisor.

## J.1.2.4 MONTHLY CHECKS

1. At least monthly, replace the in-line teflon sample particulate filter. Note the filter cleanliness and, if necessary, increase the replacement frequency.

2. Measure all flows and record on monthly checksheet. The following is an abbreviated instruction set; for complete instruction set, see Section J.1.3.1.

    a. Burner air and $H_2$ diverter valves pulled out.

b. Auto $H_2$ switch in Auto ignition position.

c. Attach $H_2$ flowmeter to the $H_2$ diverter valve, record flow, and adjust if not 45 $\pm$ 1 sccm.

d. Attach air flowmeter to burner air diverter valve, record flow, and adjust if not 400 $\pm$ 20 sccm.

e. With both diverter valves pulled out and #1, #2 and $H_2$ valves off, measure air carrier at cell vent and record. If not 55 $\pm$ 1 sccm, adjust the air carrier regulator. Using procedures outlined in Section J.1.3.2, adjust bypass flow valve for no change in baseline when valve 2 is actuated.

f. With valve 2 on, measure backflush and flow, and record. Adjust if not 35 $\pm$ 5 sccm.

g. With valve 1 off, measure sample flow and record. Adjust if not 60 $\pm$ 10 sccm.

h. Push in diverter valves, turn front panel selector switch to electrometer position, and place $H_2$ switch and valves 1 and 2 in AUTO. After ignition takes place, place $H_2$ switch in shutoff position.

i. If any of the flows were adjusted, zero, span, and record the new baseline readings. Run a new chromatogram to check the timing as outlined in Section J.1.3.5.

## J.1.2.5 SIX-MONTH CHECKS

1. Replace the O-rings in valves 1 and 2 if output becomes noisy. See Section J.1.3.6 for detailed instructions.

2. Perform four-point linearity check and calibration.

3. Change supply air 7-micron filter.

**Bendix Model 8202A Service Schedule**

| | Daily | Weekly | Monthly | 6 Months* |
|---|---|---|---|---|
| $H_2$ Pressure | X | X | | |
| Burner Pressure | X | X | | |
| Carrier Pressure | X | X | | |
| Baseline (Meter) | X | X | | |
| $H_2$ Flow | | | X | |
| Burner Flow | | | X | |
| Carrier Flow | | | X | |
| Backflush Vent Flow | | | X | |
| Sample Vent Flow | | | X | |
| Run Chromatogram | | | X | |
| Zero and Span | | X | | |
| Change Sample Inlet Filter | | | X* | |
| Change Burner/ Carrier 7-Micron Filter | | | | X |
| Linearity | | | | X |
| Calibration/NMHC Efficiency | | | | X |

* or when required

Figure J.1.2.1
Bendix Model 8202A Service Schedule

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET
BENDIX MODEL 8202A HYDROCARBON ANALYZER

Location________________ Month/Year____________
Station Number________________ Technician____________
Analyzer Property Number________ Agency____________

| DATE | | | AS IS | FINAL | AS IS | FINAL | AS IS | FINAL | AS IS | FINAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ZERO | CH4 | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| | THC | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| | NMHC | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| SPAN | CH4 | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| | THC | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| | NMHC | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| HEX. GAS | CH4 | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| | THC | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| | NMHC | Dial | | | | | | | | |
| | | DAS ppm | | | | | | | | |
| BASELINE (Meter) | | Supply | | | | | | | | |
| | | Cylinder | | | | | | | | |
| HYDROGEN | | Pressure | | | | | | | | |
| | | Flow(45 ±1) | | | | | | | | |
| BURNER | | Pressure | | | | | | | | |
| | | Flow(400±20) | | | | | | | | |
| CARRIER | | Pressure | | | | | | | | |
| | Flow | Valve 2 off | | | | | | | | |
| | | Valve 2 on | | | | | | | | |
| Backflush (35 ±5) | | | | | | | | | | |
| Sample (60 ±10) | | | | | | | | | | |

Zero air cyl.#_______ Span cyl. #_______ Hex. cyl.#_______ppm
Zero cyl. Conc. _______ppm Span Conc. _______ppm Hex. Conc. _______

1. Daily checks: Carrier, Burner and H2 Pressure; Baseline.
2. Weekly Checks: As-Is static zero & dynamic span. Record baseline readings.
3. Monthly Checks: Change particulate filter. Measure all flows, record, and adjust if necessary. Zero and span analyzer if flows are adjusted. Run chromatogram.
4. Six Month Check: Change burner/carrier filter, linearity/calibration/NMHC efficiency. Date of last calibration __________.

| Date | MAINTENANCE |
|---|---|
| | |
| | |
| | |

Reviewed by: ________________ Date: __________

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Figure J.1.2.2
Monthly Quality Control Maintenance Checksheet

## J.1.3 DETAILED MAINTENANCE PROCEDURES

### J.1.3.1 SETTING FLOWS

The flows must be checked whenever the instrument is relocated, semi-annual checks performed, or when there is a suspected flow problem. Sufficient time must be allowed for the oven to reach operating temperature of 80EC. If this is not done, the flows will change as the oven heats up. It takes approximately four hours for the oven to equilibrate, so allowing the instrument to operate overnight before setting the flows will insure that the oven is at operating temperature. The following procedures are used in checking the flows. Refer to Figure J.1.3.1 and J.1.3.2 for front and rear panel layout.

1. Burner air and $H_2$ diverter valves pulled out. These will stay out until you are instructed to push them in.

2. Auto $H_2$ switch to "Auto Ignition".

3. Attach a flowmeter that is calibrated for hydrogen to the $H_2$ diverter valve, and adjust $H_2$ regulator for a flow of 45 $\pm$ 1 sccm.

4. Attach a flowmeter that is calibrated for air to the burner diverter valve, and adjust burner regulator to 400 $\pm$ 20 sccm.

5. On the instrument front panel, turn off both #1 and #2 valves, and turn Auto $H_2$ switch to "Shutoff". Attach an air flowmeter to the cell vent, and set carrier airflow to 55 $\pm$ 1 sccm with the carrier regulator. Then switch #2 valve "on" and see that the flow matches the flow with the valve "off". If the flow changes, balance the flow as follows:

    a. Slide instrument out of its case far enough to remove insulated oven cover.

    b. At the back of the metal oven cover are two holes (Figure J.1.1.1). Insert a common screwdriver (#2) into the right-hand (from analyzer front) hole and engage screwdriver into the slots of the bypass valve adjustment knob within the oven.

c. Adjust the bypass valve for air flow as near as possible to the #2 valve "off" flow (55 ± 1 sccm) measured at the cell vents.

d. Replace insulated oven cover and push instrument back into case.

The above adjustment is a coarse adjustment. Paragraph J.1.3.2 will give a balancing procedure using a recorder connected to the 10 MV output. Perform this procedure at the completion of this section, and before proceeding to Section J.1.3.3 (Checking and Setting of Valve and Gate Timing).

6. With #2 valve on, set backflush flow by inserting a common screwdriver through the left-hand hole (Figure J.1.1.1) in the metal oven cover and engage the slotted knob on the backflush valve in the oven. Adjust flow to 35 ± 5 sccm measured at the backflush fitting located on the back panel of the instrument.

7. Place the input selector switch to the ambient position and set the flow to 60 ± 10 sccm at the sample vent fitting located on the back panel of the instrument.

a. If the instrument is connected to a support module, turn the sample regulator (refer to Figure J.1.3.2), adjusting screw fully clockwise to decrease bypass flow from the regulator to a minimum. Then set sample vent flow using the sample vent control adjustment on the support module. If there isn't enough flow adjustment on the support module, adjust the sample flow needle valve (Figure J.1.1.1) to the right of the oven for the desired adjustment range.

b. If the instrument is to be run using an MB-21 sample pump, turn the sample regulator adjusting screw five turns counterclockwise from full in. This allows the regulator to bypass some air when the input selector switch is in the calibrate position. After adjusting the sample regulator, use the sample flow needle valve set desired sample vent flow.

c. When a span cylinder is connected to the "Calib. Gas" inlet, select the calibrate position on input selector switch, then use the cylinder regulator to set the sample vent flow to 60 ± 10 sccm.

8. Push in both $H_2$ and burner air diverter valves and switch the meter selector switch to the "electrometer" position. Place the $H_2$ shut off switch in auto ignition position and note that there is an upscale deflection of the meter and the "flame out" light goes out. After the flame has stabilized, place the $H_2$ shut off switch to "off". This will insure that if the flame goes out, the $H_2$ will not continue to flow. Switch #1 and #2 valves to the auto position.

9. Record flows and regulator pressures on Monthly Quality Control Maintenance Checksheet (Figure J.1.2.2).

**NOTE:** Whenever flows are changed, the valve and gate timing must be checked. Refer to Paragraph J.1.2.3 (Checking and Setting of Valve and Gate Timing).

**CAUTION: Do not have the insulated oven cover off any longer than necessary, as flows will be difficult to set.**

## J.1.3.2 BALANCING FLOWS

This is the fine flow adjustment procedure for setting the bypass flow adjust valve. This procedure will be performed with the diverter valves in, and the hydrogen flame lit.

1. Turn off #1 and #2 valves, using the switches on the front panel.

2. Connect a recorder to the 10 MV recorder output on the front panel and select "electrometer" position on the front panel selector switch. Set recorder input to 10 MV and chart speed to 1" per minute.

3. Start the recorder and establish a baseline with both #1 and #2 valves off. Switch #2 valve to "on" and observe a change in the baseline. If the baseline change is greater than one-quarter division from valve "off" baseline, the bypass flow adjust valve must be adjusted.

4. Adjust the flow as follows:

    a. Slide instrument out of its case far enough to remove the oven insulation cover.

    b. At back of the metal oven cover will be two holes (Figure J.1.1.1). Insert a common screwdriver into the right-hand (from analyzer front) hole and engage the screwdriver into the slot of the bypass valve adjustment knob in the oven.

c. With #2 valve "on", adjust bypass valve until recorder baseline is as near as possible to the #2 valve "off" baseline. The adjustment and switching of the #2 valve "off" and "on" may have to be repeated several times before the flow is balanced.

If the baseline becomes erratic, allow the instrument to operate normally through several cycles, allowing the baseline to stabilize. Then continue the adjustment procedure until the flow is balanced.

5. Install the oven insulation cover and the instrument cover, slide instrument back into the rack, and continue normal operation, insuring that #1 and #2 valve switches are in "Auto".

## J.1.3.3 CHECKING AND SETTING OF VALVE AND GATE TIMING

**CAUTION: The gate timing should not have to be adjusted in normal operation. Gating problems can usually be traced to changes in carrier flow and/or oven temperature. Before making any gating adjustments, make sure that the analyzer is otherwise operating properly and contact your area supervisor for approval.**

1. Before any gates are adjusted, the cycle time must be checked; any change in cycle time will give the illusion of a flow change. Check the cycle time as follows:

   a. Place the Timer switch on Manual.

   b. Turn the Manual cycle pot to Zero.

   c. Place the Front panel meter selector on Timer position.

   d. Connect a 10 MV flatbed recorder to front panel 10 MV output and set chart speed to 1"/minute.

   e. With recorder running, place the Timer switch in "Auto" as the recorder chart passes a timing mark.

   The recorder trace will gradually ramp upscale from zero, and at the end of the cycle, will return to zero. The cycle should be 200 $\pm$ 1 seconds (3-1/3 inches of chart paper at 1 inch per minute). If the cycle time appears to be incorrect, refer to the manufacturer's instrument operator's and service manual, Paragraph 5.5.1, for proper adjustment procedures.

2. Run a chromatogram as per Section J.1.3.5.

3. On Figure J.1.3.4, the gate "on" and "off" numbers denote the Manual Cycle Timer dial settings. The valve and component gate adjustments are located on the comparator cards (refer to Figure J.1.1.1 for card location and Figure J.1.3.3 for adjustment pot location). If needed, adjust the valves and gates in the following sequence.

    a. Place Manual Cycle switch to Manual and panel meter to "Electrometer" position.

    b. Rotate the cycle dial to 25 and adjust R-66 on J-11 for #1 valve light "on". Check by rotating the cycle dial back and forth.

    c. Rotate the cycle dial to 26 adjust R-54 on J-10 to turn "on" THC gate light. Check by rotating cycle dial back and forth.

    d. Using the chromatogram that was run in Paragraph J.1.3.2.2., set $CH_4$ gate with R-66 on J-10 to turn "on" slightly before the start of $CH_4$ peak (Figure J.1.3.5). Check by rotating the cycle dial back and forth.

    e. Adjust R-76 on J-10 so that $CH_4$ light goes off after the end of $CH_4$ peak. Check by rotating the cycle dial back and forth.

    f. To set the THC gate off time, take the dial reading of the $CH_4$ gate "pn", and subtract 020 from this (see Figure J.1.3.5, $CH_4$ "on" 186-020 = 166 is THC "off") set with R-64 on J-10. This 020 between THC "off" and $CH_4$ "on" allows the electronics to zero before processing the $CH_4$ peak.

    g. Set the 2nd AUTO ZERO "on" time by adding 20 counts to the $CH_4$ "off" time (see Figure J.1.3.5, $CH_4$ "off" 260 + 20 = 280 is AUTO ZERO "on") and adjust R-29 on J-10 to turn the zero light on.

    h. To set the 2nd AUTO ZERO "off" time, add 20 counts to the AUTO ZERO "on" time and adjust R-39 on J-10 for the zero light to turn off.

    **NOTE:** The first AUTO ZERO has been eliminated before shipment to the field by turning R-52 on J-10 (AUTO ZERO 1 OFF) to a lower count setting than R-40 on J- 10 (AUTO ZERO 1 on).

i. To set valve 1 "off" time, add 5 counts to the 2nd AUTO ZERO "off" time and adjust R-76 and J-11.

j. Turn #2 valve on 005 counts after #1 valve is off, adjust R-40 on J-11.

k. Turn #2 valve off at 995, adjust R-52 on J-11.

l. Place Manual Cycle switch to Auto.

4. A typical timing cycle is:

| Cycle Dial | Event |
|---|---|
| 025 | Valve 1 on |
| 026 | THC on |
| 166* | THC off |
| 186* | $CH_4$ on |
| 260* | $CH_4$ off |
| 280* | ZERO on |
| 300* | ZERO off |
| 305* | Valve 1 off |
| 310* | Valve 2 on |
| 995 | Valve 2 off |

**NOTE:** Valve 2 on minus Valve 1 on must be less than 300 counts.

* Determined by chromatogram analysis.

5. Run a chromatogram (see Section J.1.3.5) checking the valves and component gating, and record the timing cycle. This information will be valuable in troubleshooting the instrument at a later date. After flows and timing have been adjusted, the instrument must be zeroed and spanned (see Section J.1.3.4).

## J.1.3.4 ZERO AND SPAN ADJUSTMENT

The adjustments for zero and span are on the instrument's front panel, plus a coarse span adjustment for THC and $CH_4$ on the component attenuator board (Figure J.1.3.4).

1. Zero the instrument by turning #1 valve off, then let instrument run through at least two cycles. With no sample inject, all outputs should go to zero. Set THC, $CH_4$ , and NMHC zero pots so that the recorder reads zero on each channel.

   **NOTE:** It is important to make the zero adjustments very carefully since a misadjustment may result in negative NMHC values.

2. Place #1 valve to "Auto".

3. Introduce zero gas and allow instrument to stabilize. If the zero gas is clean of all hydrocarbons, instrument responses should be the same as step "1", above. Do not readjust zero pots.

4. Introduce $CH_4$ span gas and allow instrument to stabilize. Adjust front panel $CH_4$ and THC span pots so that the recorder reads the desired span value. If you cannot adjust the response high enough, perform a coarse span adjustment as follows:

   a. Set front panel THC and $CH_4$ span pots to 500.

   b. Pull instrument out of the case so that the hold down cover for the circuit boards can be removed. See Figure J.1.1.1 for component attenuator board location.

   c. Refer to Figure J.1.3.4 for the location of the THC and $CH_4$ adjustment pots. Adjust the pots so that the recorder reads close to the span gas concentration. One cycle will have to be completed before the adjusted channel will update.

   d. Replace circuit board, hold down cover, and slide instrument back into the case.

   e. Using the front panel span pots, set each channel so that the recorder reads the desired span value.

5. Introduce NMHC span gas (Hexane) and allow instrument to stabilize. Adjust front panel NMHC span pot so that the recorder/DAS reads the desired NMHC span value.

## J.1.3.5 RUNNING A CHROMATOGRAM

A chromatogram is excellent for checking instrument performance and an invaluable tool for troubleshooting. Refer to Figure J.1.3.1 for front panel layout. See Figure J.1.3.5 for an example of a chromatogram.

1. Span the instrument with span gas so that there are well-defined peaks.

2. Plug a recorder into the instrument 10 MV recorder output.

3. Set recorder input for 10 MV and speed 1"/minute.

4. Set meter selector to electrometer position.

5. Set recorder attenuator to adjust peak height from 50% to 100% of scale.

6. Mark cycle timing events on the chart. (If 10 MV recorder has a zero momentary switch, it can be used.) Label timing events.

7. Allow at least one complete cycle (200 seconds) to be recorded.

## J.1.3.6 VALVES 1 AND 2 O-RING REPLACEMENT

(See Section 5.4.1 and Figure 5-2 in the Bendix Manual and Figure J.1.3.6 in this manual).

1. Turn off analyzer and disconnect or turn off the burner air/carrier air, hydrogen, and sample.

2. Remove analyzer cover, oven insulation cover, and oven cover.

3. Using two wrenches, carefully disconnect the air actuation lines on top of valves 1 and 2. Remove the air fittings from the stainless steel retainer on top of the valve. Remove the three screws from the bottom of the piston seal adaptor and then the piston seal shell, retainer, and seal.

4. Remove the stem assembly locknut and return stop washer while holding on to the top of the stem.

5. Pull the valve stem out of the valve.

6. Use a dry cotton swab to clean inside the valve. Inspect the valve interior. If worn or corroded, contact your supervisor.

   **NOTE:** Never use cleaning solvents on the valve stem or body.

7. Remove old O-rings from the valve stem and clean the stem with lintless cloth or chemwipe.

8. Individually lubricate the O-rings with Hi-Vac silicone grease and install on the valve stem using the Bendix installation tool. The lubricant should completely coat the O-ring **without any excess**.

9. Assemble the valves in reverse order of disassembly. After valve stem assembly is installed, push the valve stem down manually several times to make sure that the stem is not sticking in the valve body.

10. When installing the air actuation lines, hold the fitting body with a wrench when seating the ferrule. Failure to do this will cause the fitting to break off at the stainless steel adaptor.

11. Hookup burner air, turn on power, then place #1 and #2 switches on. This will actuate the valve so that the actuating lines can be leak checked.

12. Replace oven cover and oven insulation cover.

13. After the oven has warmed up for four hours, perform analyzer alignment as per Section J.1.1.3.

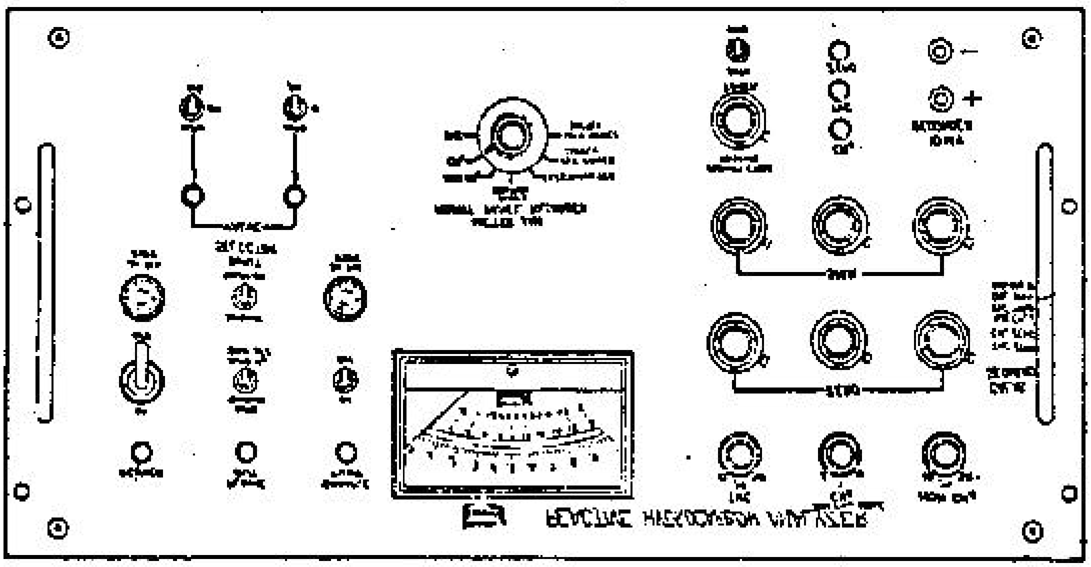

Figure J.1.3.1
Analyzer Front View

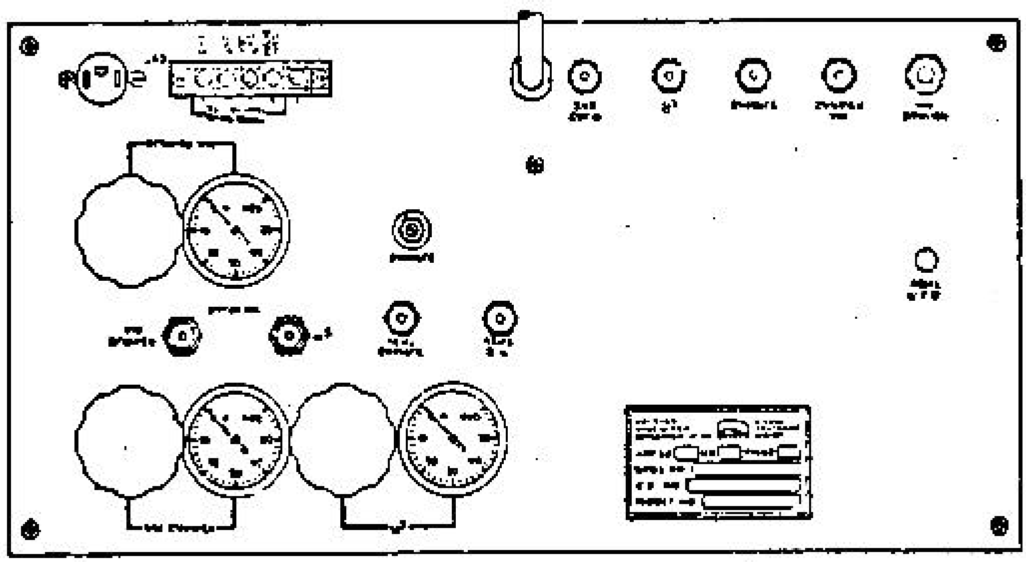

Figure J.1.3.2
Analyzer Rear View

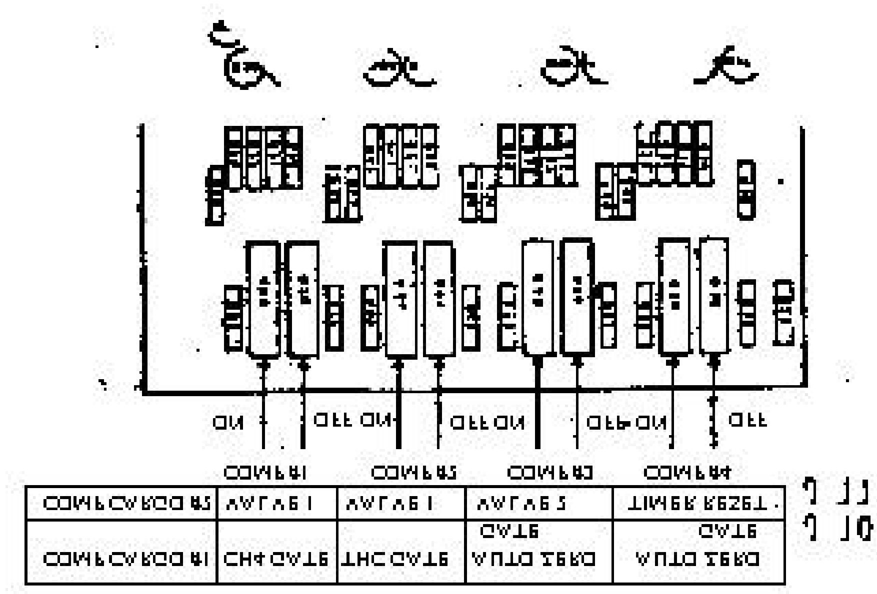

Figure J.1.3.3
Comparator Boards Potentiometer Adjustments

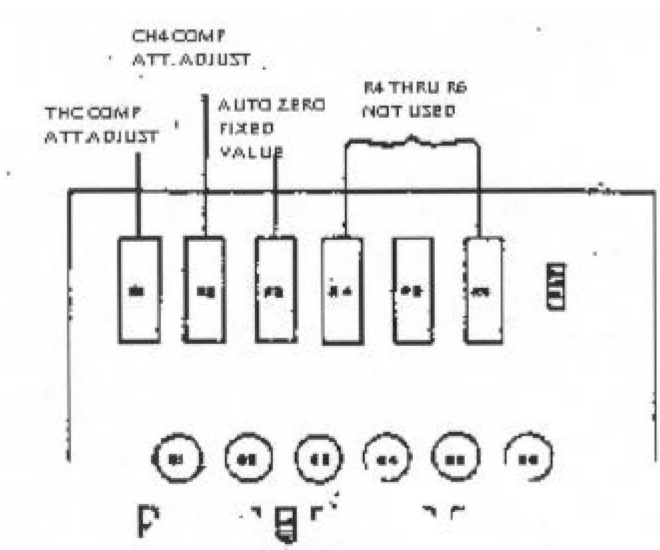


Figure J.1.3.4
Component Attenuator Board

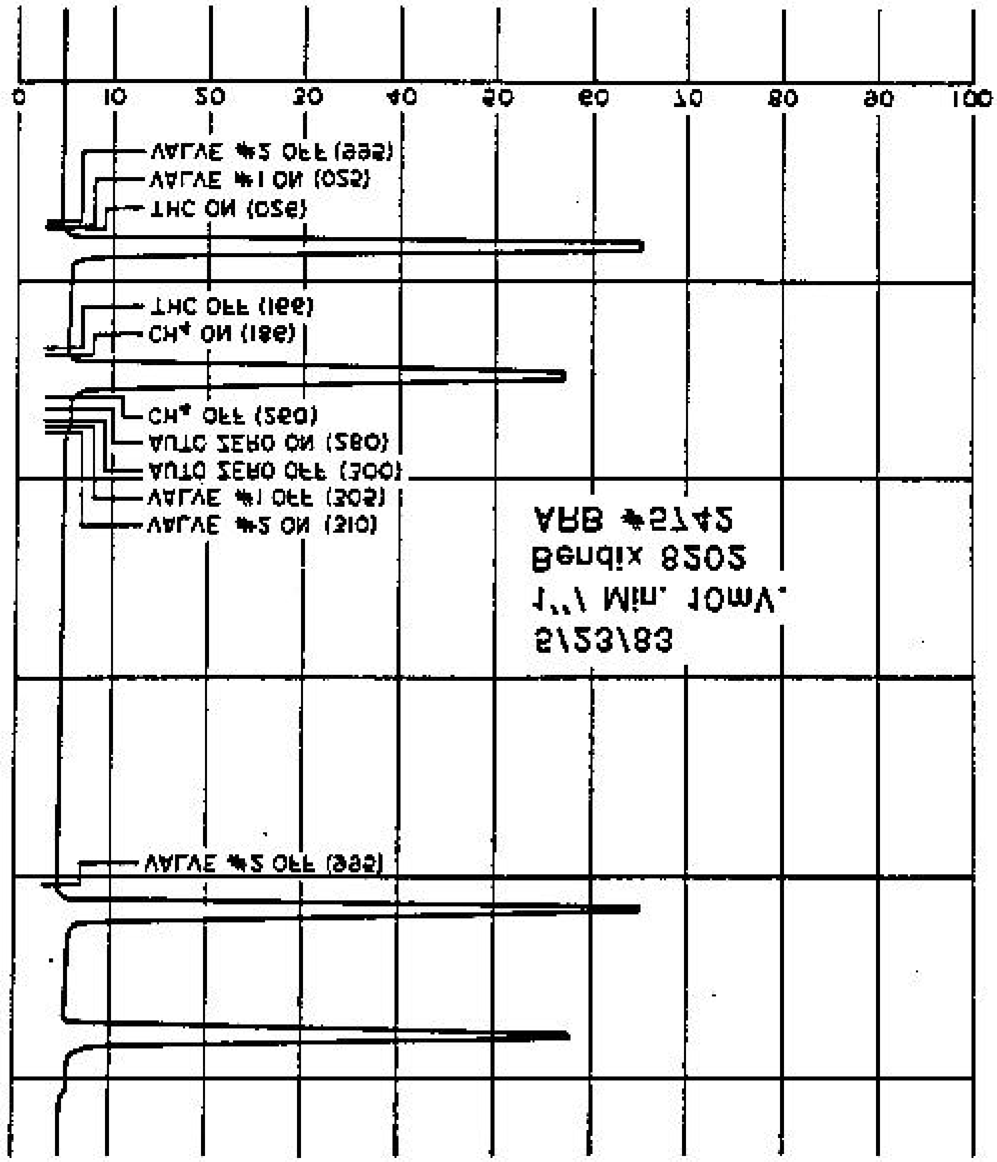

Figure J.1.3.5
Chromatogram

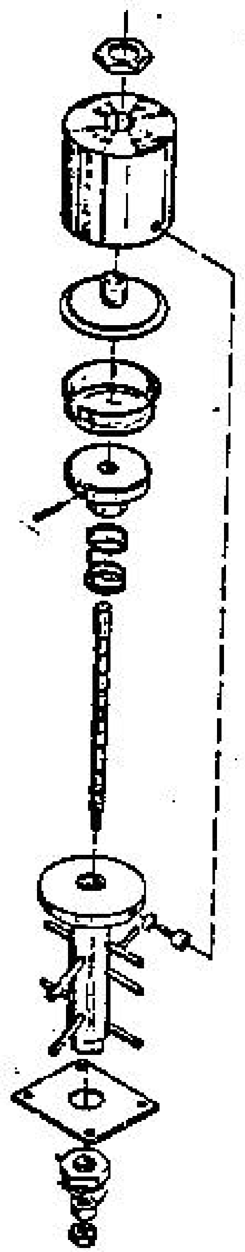

Figure J.1.3.6
Exploded View - Valves 1 and 2

## J.1.4 TROUBLESHOOTING

### J.1.4.1 CHROMATOGRAM ANALYSIS

Refer to spectrum (chromatogram) analysis in the Bendix Manual, Section 5.3.2.1, if your chromatogram does not look like Figure J.1.3.5. When interpreting their examples, note that their timing cycle is different from the CARB modification cycle.

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APPENDIX J.2

ACCEPTANCE TEST PROCEDURES

FOR

BENDIX MODEL 8202A REACTIVE HYDROCARBON ANALYZER

MONITORING AND LABORATORY DIVISION

DECEMBER 1995

# J.2.0 ACCEPTANCE TEST PROCEDURES

## J.2.0.1 GENERAL INFORMATION

The manufacturer's manual and Section J.1.0 of this manual should be read thoroughly before beginning the acceptance testing. In addition, initiate an Acceptance Test Log (Figure J.2.0.1) and an Acceptance Test "Mini" Report (Figure J.2.0.2). Record the dates of the individual tests, problems, contacts with the manufacturer, and any other pertinent information on the Acceptance Test Log.

## J.2.0.2 PHYSICAL INSPECTION

1. Check the power cord phasing. Standard wiring configuration has the black wire connected to the brass terminal of the plug, white copper and green to ground. Verify that the analyzer chassis is grounded to earth ground.

2. Perform a physical inspection to make sure that the analyzer is complete and undamaged.

## J.2.0.3 OPERATIONAL CHECKS

Perform the following checks and record the results on the Acceptance Test "Mini" Report (Figure J.2.0.2) and on the recorder charts, which will be retained in the Air Quality Surveillance files as a permanent record of the test performed. Unless otherwise noted, all tests will be performed in the 20 ppm full scale range for THC and $CH_4$, 10 ppm full scale for NMHC.

1. Initial Start-Up - See Section J.1.1.2.

2. Analyzer Alignment - See Section J.1.1.3.

3. Stability Tests (Zero and Span)

   a. Zero and span the analyzer - See Section J.1.3.4.

b. After 24 hours, repeat "a".

c. After 72 hours, repeat "a".

**NOTE:** "a", "b" and "c" may be performed using a dilution calibration system rather than span cylinders.

d. Record on the Acceptance Test "Mini" Report and recorder charts the results of the stability tests. The "zero" response should not change more than 1% in 24 or 72 hours. The span response should not change more than 1% in 24 or 2% in 72 hours.

4. Linearity Test - Using a dilution calibration system and a multi- mix cylinder, perform a linearity test at 80%, 40%, 20%, 10%, 8%, 6%, 4%, and 2% of scale. Use either a CO or NOx analyzer as a reference analyzer. The non-linearity in relation to 80% of full scale should not be greater than ±1% at any point.

5. Temperature/Voltage Stability

a. Install the analyzer in the environmental chamber with the power cord connected to the variable voltage source. Make sure that the analyzer is spanned and operating correctly.

b. Turn valve 1 off and perform a temperature/voltage test using Thermotron Program 7. The maximum deviation for 25EC ± 10EC is 1% full scale. After experiencing 25EC ± 20EC, the analyzer should return to the initial response within 1% full scale. Record the results of the tests on the Acceptance Test "Mini" Report. The response change to the voltage variation test (115 VAC ± 10 VAC) should be less than 1%.

c. Repeat the temperature/voltage test using a 16 ppm $CH_4$ span cylinder or 16 ppm $CH_4$ supplied by a dilution system (with a reference analyzer outside the test chamber in parallel). Adjust the front panel span controls to give chart responses of: THC - 80% (20 ppm range), $CH_4$ - 50% (20 ppm range), and non-$CH_4$ - 50% (10 ppm range). The maximum deviation for 25EC $\pm$ 10EC is 2% of reading. After experiencing 25EC $\pm$ 20EC, the analyzer should return to the initial response within $\pm$1% full scale. The response change to the voltage variation test should be less than 1% of reading. Record the results of the temperature/voltage tests on the Acceptance Test "Mini" Report.

6. Non-Methane Analysis Efficiency

   a. Using the 20 ppm THC/$CH_4$ range, zero and span the analyzer THC and $CH_4$ channels using NBS traceable $CH_4$ standards. The NMHC range should be set to 10 ppm FS and should read zero.

   b. Using an NIST traceable methane-propane compressed gas (approx. 12 ppm $CH_4$ and 3 ppm $CH_4$ ), determine the analysis efficiency for propane.

   $$\text{Propane analysis efficiency} = \frac{\text{(THC - CH}_4\text{) Response}}{\text{ppm CH}_4 \times 3} \times 100\%$$

   The propane analysis efficiency should be greater than 65%.

   c. Analyze a 1.0 ppm hexane/10 ppm methane gas blend and determine the hexane analysis efficiency.

   $$\text{Hexane analysis efficiency} = \frac{\text{(THC - CH}_4\text{) Response}}{\text{ppm hexane} \times 6} \times 100\%$$

   The hexane analysis efficiency should be 60-65%.

   d. Analyze a 1.0 ppm meta-xylene/4 ppm methane gas blend and determine the meta-xylene analysis efficiency.

$$\text{Meta-xylene analysis efficiency} = \frac{(THC - CH_4)\ \text{Response}}{\text{ppm meta-xylene} \times 8} \times 100\%$$

The meta-xylene analysis efficiency should be greater than 60%.

e. Report the results of these tests under the special tests section on the Acceptance Test "Mini" Report.

7. Review the tests and make comments as necessary. Make sure that the recorder charts are cut in 24-hour segments and each chart is dated, has analyzer serial number recorded, type of test performed, and traces labeled. Forward completed Acceptance Test "Mini" Reports and recorder charts to the Quality Assurance office for review.

Make_____________ Model_____________ Serial_______________

ACCEPTANCE TEST LOG

| Date | Action |
| --- | --- |
| | |
| | |
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Figure J.2.0.1
Acceptance Test Log

ACCEPTANCE TEST AMINI@ REPORT

Model________________ Date__________________
Make_________________ CARB#_______________ By____________________
Serial________________ Reviewed_____________

| | | Pass | Fail | Comments |
|---|---|---|---|---|
| I. | Physical Inspection | | | |
| | A. Shipping damage | ____ | ___ | __________________ |
| | B. Electrical wiring | ____ | ___ | __________________ |
| | C. Completeness | ____ | ___ | __________________ |
| II. | Operational Test | | | |
| | A. Translator | ____ | ___ | __________________ |
| | B. Linearity | ____ | ___ | __________________ |
| | C. Starting Threshold | ____ | ___ | __________________ |
| | D. Range | ____ | ___ | __________________ |
| | E. Accuracy | ____ | ___ | __________________ |
| III. | Special Test | ____ | ___ | __________________ |
| IV. | Maintenance Performed | ____ | ___ | __________________ |

LINEARITY FULL SCALE_____________

| %FS | True Voltage | Indicated Voltage | Diff. True-Ind. | Remarks |
|---|---|---|---|---|
| 0 | | | | |
| .25 | | | | |
| .50 | | | | |
| .75 | | | | |
| 1.00 | | | | |

Absolute Value Avg. Difference_______________
Abs. Value Average Difference must be less than 5% Full Scale (.05V)
Linear Regression Slope_____________ Intercept______________ Correlation_________

Figure J.2.0.2
Acceptance Test AMini@ Report

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VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX J.3

CALIBRATION PROCEDURES

FOR

BENDIX MODEL 8202A REACTIVE HYDROCARBON ANALYZER

MONITORING AND LABORATORY DIVISION

DECEMBER 1995

## J.3.0 OVERVIEW

A calibration includes adjusting zero and span to known concentrations traceable to NIST and a linearity test. An acceptable calibration will be stable and accurate to within ±0.5% of full scale and ±1.0% of full scale for each span point.

### J.3.0.1 CALIBRATION EQUIPMENT

1. A compressed gas cylinder containing < 0.1 ppm THC (zero gas).

2. Compressed gas cylinders containing known $CH_4$ concentrations, traceable to NIST-SRM.

3. Two-stage high purity regulators (metal or teflon diaphragm and seats) with 0-200 psig first-stage, one-quarter inch tubing and associated fittings for connecting calibration compressed gas cylinders to the analyzer.

### J.3.0.2 CALIBRATION

If the span deviation is greater than ±1.0% of full scale, determine the cause, repair or readjust as required, and repeat the calibration.

1. Place the sample selector switch to span.

2. Connect a line from the zero gas to the analyzer span inlet. Open the valve on the zero air gas cylinder and adjust the cylinder regulator to obtain a flow rate of 60 ± 10 sccm. Obtain a stable recorder trace (approximately 10 minutes).

3. Repeat step "2" for $CH_4$ and hexane concentrations representing 80%, 40%, 20%, and 10% of full scale.

4. After checking the last concentration, switch the sample switch to the sample position.

5. Mark each calibration step on the recorder strip chart and record all the data on the Monthly Quality Control Maintenance Checksheet (Figure J.1.2.2) under maintenance.

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FOR

AIR QUALITY MONITORING

APPENDIX J.4

STATION OPERATOR'S PROCEDURES

FOR

SUPPORT MODULE FOR BENDIX MODEL 8202

MONITORING AND LABORATORY DIVISION

DECEMBER 1995

## J.4.0 GENERAL INFORMATION

### J.4.0.1 THEORY OF OPERATION

The Bendix 8202 Support Module is composed of two systems: the Supply Air and Calibration Systems. The Supply Air System, when used with the methane reactor in the Aadco Model 737 pure air generator, or in series with any other methane reactor system, supplies clean, dry burner and carrier air to the Bendix Model 8202A reactive hydrocarbon analyzer. The system also monitors the sample vent flow of this analyzer. The calibration system controls sample, zero, and span gas for the Bendix 8202A reactive hydrocarbon analyzer and the Bendix 8501 carbon monoxide (CO) analyzer.

### J.4.0.2 SUPPLY AIR SYSTEM

The flow diagram of the supply air system is shown in Figure J.4.0.1. Ambient air is drawn in through the charcoal filter (F2), which removes contaminants which would damage the methane reactor in the Aadco. The air is then compressed by pump (PU2), cooled in the cooling coil (C1), and passed through the water trap to remove excess water. The air then passes solenoid valve (S4) which releases back pressure on the pump in case of power failure. The air then passes by relief valve (V2), which controls system high pressure to 50 to 60 psig for drying of the air to less than 4°C dewpoint. The system pressure is then dropped across valve V3 and regulated to approximately 30 psig by relief valve V4.

The air exits the support module and enters the Aadco pure air generator reactor or other methane reactor unit (see Figures J.4.1.1 and J.4.1.2) for removal of hydrocarbons. The check valves CV1 and CV2 control the flow of air, allowing the Aadco compressor to override the supply air pump during nightly calibration checks. The clean air supply exits the Aadco and flows to the Bendix 8202A.

### J.4.0.3 CALIBRATION SYSTEM

The flow diagram of the calibration system is shown in Figure J.4.0.1 and the wiring diagram is shown in Figure J.4.0.2. The monitoring station sample manifold is connected to the "SAMPLE" 1/4" swagelok bulkhead fitting on the rear of the support module by 1/4" teflon tubing.

With the "SAMPLE-ZERO-SPAN" switch (SW4) in the "SAMPLE" position, an air sample goes through an inline MSA filter (F1) and through the sample pump (P1). The system pressure at the outlet of P1 is indicated on the "SAMPLE PRESSURE" gauge (G1) and is adjusted by the "PRESSURE ADJUST" relief valve (V1) to 9 psig. The sample goes through the normally open (NO) and common (C) ports of the three-way solenoid valve (S3) to the "TO GO" (P5) and "TO 8202" (P4) outlet ports on the rear of the module. The sample flows to the CO and HC analyzers through teflon tubing to their respective sample inlet ports.

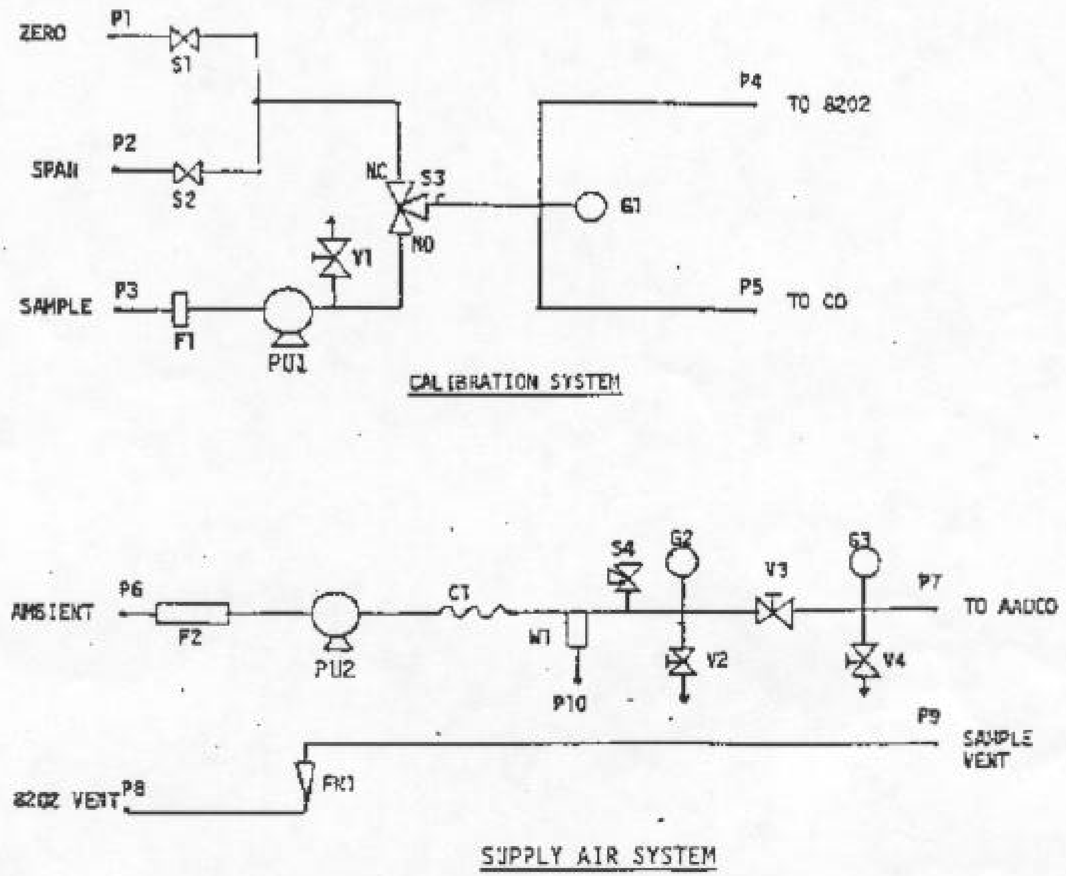
When the "SAMPLE-ZERO-SPAN" switch (SW4) is placed in the "ZERO" position, solenoid valves S1 and S3 are activated, causing solenoid valve S1 and the normally closed (NO) port of S3 to open. This allows Zero gas to flow to the CO and HC analyzers connected to the system.

When the "SAMPLE-ZERO-SPAN" switch (SW4) is placed in the "SPAN" position, solenoids S2 and S3 are activated, causing S2 and the NO port of S3 to open, allowing span gas to flow.

When conducting ZERO and SPAN tests, the system maintains proper flow. The second stage pressure regulators connected to the zero and span gas cylinders must be adjusted to the same pressure produced by the sample pump (PU1) and indicated by the "SAMPLE PRESSURE" gauge (G1).

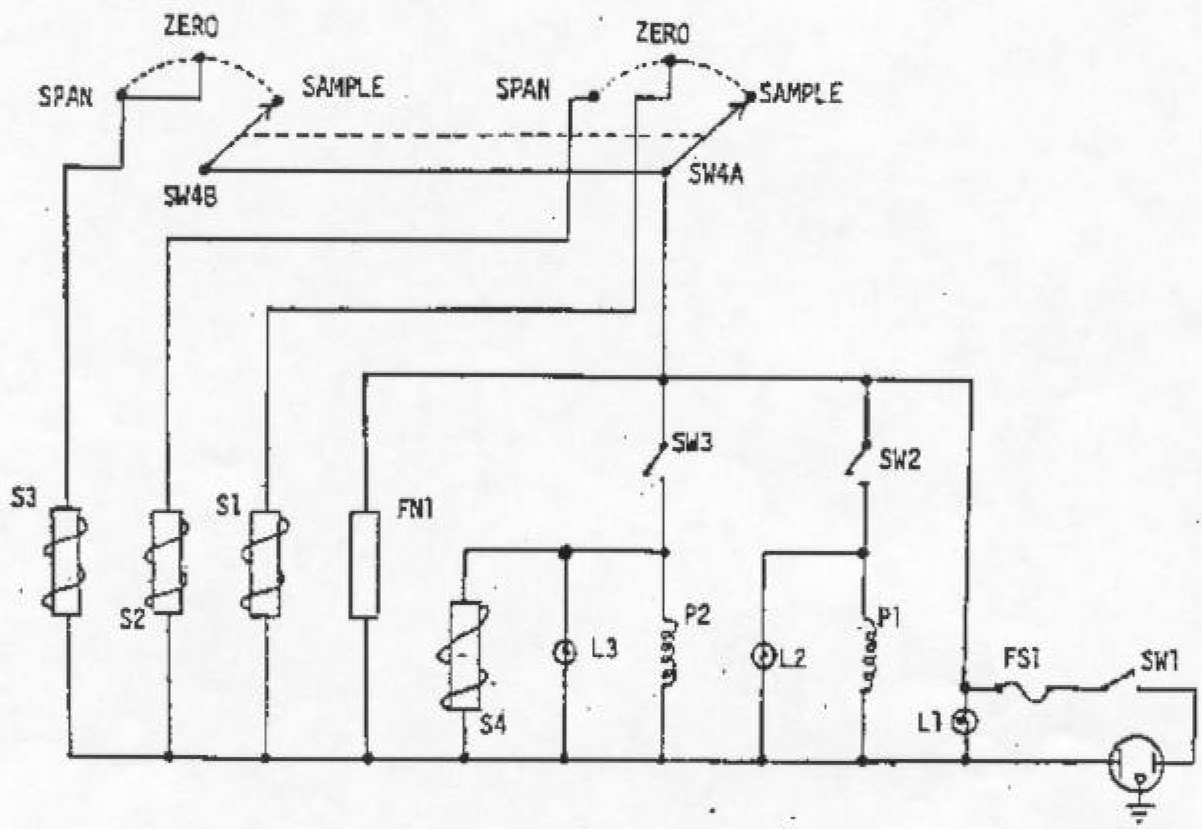
**NOTE:** Pressure upsets can occur in the system when it is switched from the sample to zero or span if proper pressure regulations are not adhered to.

BENDIX MODEL 8202 HYDROCARBON ANALYZER
SUPPORT AIR AND CALIBRATION MODULE
FLOW SCHEMATIC




| Part Description | Component |
|---|---|
| Two Way Solenoid Valve | S1, S2 |
| Three Way Solenoid Valve | S3 ,S4 |
| Pressure Gauge | G1, G2 ,G3 |
| Inline Particulate Filter | F1 |
| Needle Valve | V1, V3 |
| Charcoal Filter | F2 |
| Cooling Coil | C1 |
| Water Trap | W1 |
| Pressure Relief Valve | V2, V4 |
| Pump | PU1, PU2 |
| Flowmeter | FM1 |
| Inlet/Outlet Port | P1, P2, P3, P4, P5, P5, P7, P8, P9,P10 |

Figure J.4.0.1
Support Module Flow Diagrams




| Parts Description | Component |
|---|---|
| Rotary Wafer Switch | SW4 (A&B) |
| SPST Toggle Switch | SW1, SW2, SW3 |
| Fuse | FSI (5 AMP) |
| Pilot light (120 VAC) | L1, L2, L3 |
| Pump | P1, P2 |
| Solenoid Valve (Coil) | S1, S2, S3, S4 |
| Fan | FN1 |

Figure J.4.0.2
Bendix 8202 Support Module Wiring Diagram

## J.4.1 INSTALLATION PROCEDURES

### J.4.1.1 GENERAL INFORMATION

This section of the manual presents the procedure and material required to install the Bendix 8202 Support Module. It is advisable to read this entire section prior to the installation. The sequence of installation instructions is as follows: physical inspection, initial set-up/installation procedure, Aadco modification, Module Interconnection, and electrical connections.

### J.4.1.2 PHYSICAL INSPECTIONS

When the support module is received, verify that the package contents are complete. Inspect the instrument for physical damage such as broken knobs or connectors. Remove the top cover to check the interior. Visually check for loose or damaged components. To facilitate possible reshipment, keep the original packing until a satisfactory inspection of the instrument is completed. If damage is found, file a claim with the responsible carrier and/or call the Special Purpose Monitoring and Data Support Section at (916) 445-0616.

### J.4.1.3 INITIAL SET-UP/INSTALLATION

The Bendix 8202A Support Module is designed for bench top operation or installation into a standard 19" rack. Installation of the module includes the plumbing of connections on the rear of the cabinet for zero gas inlet, span gas inlet, ambient air inlet, sample air inlet, 8202A sample vent exhaust, and outlet tubing connections to either the Aadco pure air generator or other methane reactor system, the Bendix 8202A hydrocarbon analyzer, and a CO analyzer.

1. Aadco Modification

   To supply clean, dry hydrocarbon-free air to the Bendix 8202A Hydrocarbon Analyzer, the support module uses the methane reactor of an Aadco pure air generator. The Aadco is to have been previously modified to be controlled by a Dasibi, Model 1005C2, Automatic Calibration System. This modification (Model No. 737-1), allows the compressor in the Aadco pure air generator to be activated and deactivated by the Dasibi Automatic Calibration System.

   **NOTE:** Modification information may be obtained from the Air Quality Monitoring - North and Operations Support Section at (916) 327-4889.

To adapt the Aadco for use with the support module, another modification (Model No. 737-3) must be installed in the Aadco Reactor Unit.
Model No. 737-3 kit consists of two check valves, a swagelok tee, a 7 micron Nupro particulate filter, and 1/4" copper tubing. This modification permits the use of the methane reactor when the Aadco compressor is operating (~ 1 hour/day) as well as when it is turned off (~ 23 hours/day).

The modification (No.737-3) is illustrated in Figures J.4.1.1 and J.4.1.2.
The installation procedure is:

a. Drill a 29/64" diameter hole in the back panel of the Aadco generator unit, 2-1/2" from the top and 2-1/2" from the left side, and install a 1/4" swagelok bulkhead fitting.

b. Cut the 1/4" copper tube connecting the top of the flowmeter to the methane reactor, approximately 8" from the flowmeter.

c. Install a check valve (CV2) at the point the tubing was cut in step "b", such that it allows flow out of the top of flowmeter. (The arrow on the check valve should point away from the flowmeter.)

d. With 1/4" copper tubing, connect the other end of the check valve (CV2) to one branch of the 1/4" swagelok tee. Connect the methane reactor to the opposite branch of the tee.

e. Install a second check valve (CV1) in series with the bulkhead fitting installed in step "a", so that air may only flow away from the bulkhead fitting.

f. With 1/4" copper tubing, connect the "downstream" end of the check valve (CV1) to the remaining branch of the tee installed in step "d".

g. Install a Nupro 7 micron sintered particulate filter on the bulkhead fitting installed in step "a" on the exterior of the Aadco unit.

h. Mark the 1/4" bulkhead fitting installed in step "a" "SUPPORT IN" with Dymo tape.

2. Support Module/Bendix 8202A/Aadco Interconnection

After completing Aadco Modification No. 737-3, interconnect the support module, the Aadco and the Bendix 8202 hydrocarbon analyzer following the procedure outlined below. The interconnection of the units is illustrated in Figure J.4.1.3.

a. Supply Air Section

1) Place the support module on a level bench top or install in a standard 19” instrument cabinet using the slide rails provided.

2) Connect a 1/4" teflon tube from the port marked "TO AADCO" on the rear of the support module to the Nupro 7 micron particulate filter connected to the 1/4" bulkhead fitting marked "SUPPORT IN" at the rear of the modified Aadco generator unit.

3) Connect a 1/8" teflon tube from the Bendix 8202 "SAMPLE VENT" port to the rear of the support module marked "8202 VENT".

4) Connect a 1/4" teflon tube from the port marked "SAMPLE VENT" on the rear of the support module to outside.

5) Cut the tubing that connects the "PURE AIR" outlet port on the Aadco Reactor Unit to the "ZERO AIR" inlet port of the Dasibi "Auto-Cal" pneumatics chassis. Install a 1/4" swagelok tee in the tubing at the point of the cut (see Figure J.4.1.3).

6) Connect a 1/4" teflon tube from the remaining branch on the tee installed in "5" to the 7 micron sintered particulate filter connecting the BURNER AIR and AIR CARRIER ports on the Bendix 8202 hydrocarbon analyzer.

b. Support Module/Bendix 8202/External Methane Reactor Interconnection.

If an external methane reactor is used instead of an Aadco system, connect a 1/4" teflon tube from the port marked "TO AADCO" on the rear of the support module to the inlet of the reactor. Then connect a 1/4" teflon tube from the outlet of the methane reactor to the 7 micron sintered particulate filter connecting the BURNER AIR and CARRIER AIR ports on the Bendix 8202 hydrocarbon analyzer.

If the calibration section of the support module is to be used, complete the interconnection using the following steps:

1) Connect a 1/8" teflon tube from the two-stage regulator on a certified zero gas cylinder to the "ZERO" port on the rear of the support module.

2) Connect a 1/8" teflon tube from the two-stage regulator on a certified $CO/CH_4$ span gas cylinder to the "SPAN" port on the rear of the support module.

3) Connect a 1/4" teflon tube from the station sample manifold to the port marked "SAMPLE" on the rear of the support module.

4) Connect a 1/8" teflon tube from the port marked "TO 8202" on the rear of the support module to the "SAMPLE" port on the rear of the Bendix 8202A.

5) If it is desired to use the calibration section of the support module in conjunction with a carbon monoxide (CO) analyzer, connect a 1/8" teflon tube from the port marked "TO GO" on the rear of the support module to the SPAN port of the CO analyzer. (Disconnect the CO analyzer's sample pump.) The CO analyzer's mode selector valve must be left in the "SPAN" position at all times.

3. Primary Power Connections

The support module operates on 105 to 125 AC voltage, 60 Hz, single-phase power. The power required is approximately 450 watts. Prior to connecting the AC power cord to the power source, insure that the POWER switch is in the OFF position.

4. Supply Air Start-Up

After the support module, the Bendix 8202A and either a modified Aadco or an external methane reactor have been interconnected as per Section J.4.1.3, start up the Supply Air Section of the module using the following procedure:

a. Turn the Aadco compressor switch off (the methane reactor will remain heated and active). If an external methane reactor is used, turn its power switch on.

b. Power up the Bendix 8202A as appropriate.

c. Power up the support module and support pump by setting the "POWER" switch to the "ON" position and the "SUPPORT PUMP" switch to the "ON" position.

d. Close (fully clockwise) the High Pressure Relief (V2), interstage pressure (V3), and low pressure relief valves (V4) on the support module. Do not overtighten the interstage pressure valve.

e. See the support module's inlet pressure to 50 psig on the "INPUT" gauge (G2), using the High Pressure Relief valve (V2) (see Figure J.4.0.1).

f. Set the output pressure of the support module to 50 psig as read on the "OUTPUT PRESSURE" gauge (G3), using the Interstage Pressure valve (V3).

g. Adjust the support module's 'OUTPUT PRESSURE" gauge (G3) to 40 psig using the Low Pressure Relief valve (V4).

h. When a system is operating properly, a small air flow exiting the High and Low Pressure Relief valves on the front of the module should be evident by touch.

i. Check for air flow at the vent port marked "$H_2O$ DRAIN" at the rear of the support module. It is important that a constant flow of air (~ 400-500 cc/min) is present at all times to evacuate the water collected in the water trap separator. If there is no air flow from this port, investigate and correct the problem.

j. Check the Sample Vent flow rate from the Bendix 8202A on flowmeter (FM1) located on the front panel of the support module. The 8202A Sample Vent flow rate should be 50-70 cc/min.

k. If an Aadco system is used, turn on the compressor to verify correct system operation in the calibration mode. The Bendix 8202A should continue to operate normally, and second stage pressure on the support module as indicated on the "OUTPUT PRESSURE" gauge should be the same pressure as Aadco compressor output (40 psig).

5. Calibration System Start-Up Procedure

After the support module, the Bendix 8202A, and the Modified Aadco or an external methane reactor have been interconnected, start up the calibration section of the module using the following procedure:

a. Apply power to the CO and HC analyzers, as appropriate.

b. Apply power to the sample pump in the support module by setting the "SAMPLE PUMP" switch to the "ON" position.

c. Set the sample pressure by adjusting the by-pass needle valve (V1) marked "PRESSURE ADJUST" on the front of the support module so the "SAMPLE PRESSURE" pressure gauge (G1) reads 9 $\pm$ 1 psig (see Figure J.4.0.1).

d. Adjust the second stage pressure regulator connected to the certified $CH_4$ -CO span gas cylinder to 9 $\pm$ 1 psig.

e. Switch the "SAMPLE-ZERO-SPAN" switch on front of the support module to the "SPAN" position and adjust the Span Gas regulator so there is no pressure change on the "SAMPLE PRESSURE" gauge (G1) when switched from "SAMPLE" to "SPAN".

f. Adjust the second stage pressure regulator connected to the certified zero gas cylinder 9 $\pm$ 1 psig.

g. Switch the "SAMPLE-ZERO-SPAN" switch on the support module to the "ZERO" position and adjust the zero gas regulator so there is no pressure change on the "SAMPLE PRESSURE" gauge (G1) when switched from "SAMPLE" to "ZERO".

h. Set the "SAMPLE-ZERO-SPAN" switch to the "SAMPLE" position for normal ambient air monitoring.

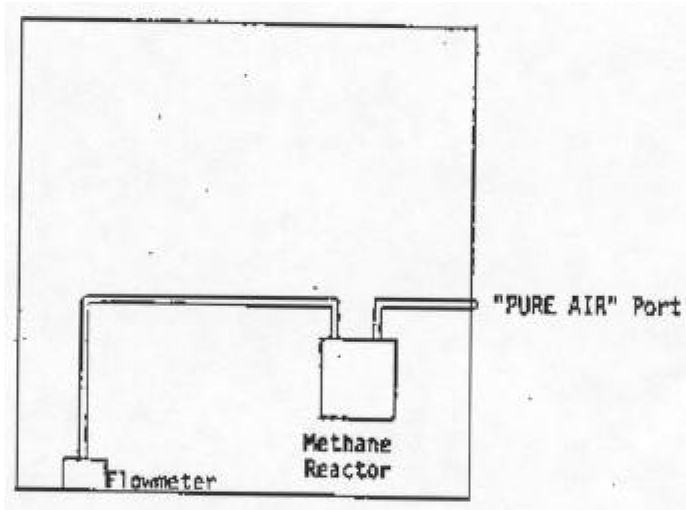



Figure J.4.1.1
Aadco 737-3 Reactor Unit Before Modification (Simplified Diagram)

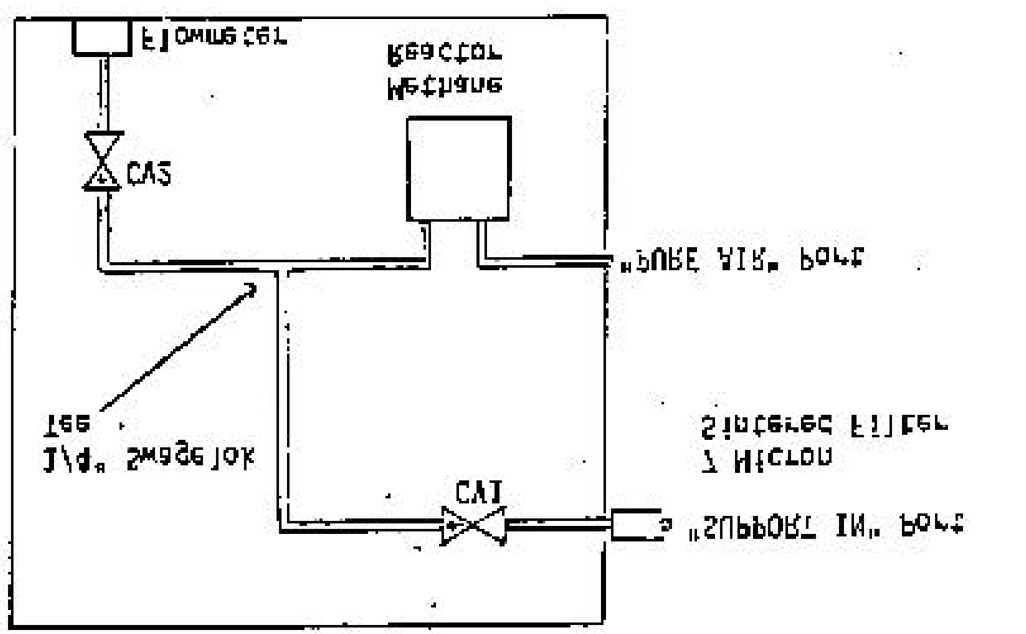


Figure J.4.1.2
Aadco 737-3 Reactor Unit After Modification (Simplified Diagram)

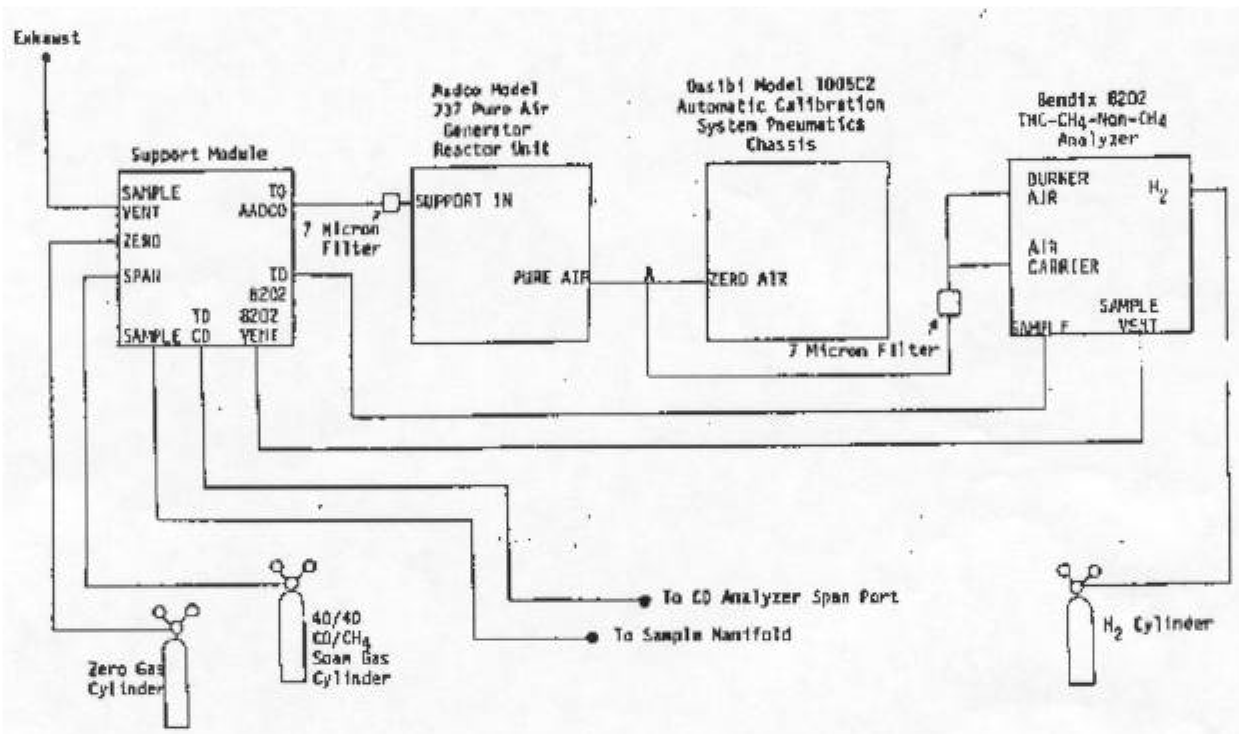



Figure J.4.1.3
Support Module Interconnection Diagram

## J.4.2 OPERATING PROCEDURES

### J.4.2.1 GENERAL INFORMATION

This section contains instructions for operating the Bendix 8202A Support Module. Also included is information on the controls, gauges, flowmeters, inlet and outlet ports, and start-up and shut-down procedures.

### J.4.2.2 CONTROLS AND INDICATORS

The controls and indicators of the support module front panel are described in Table J.4.2.1 and illustrated in Figure J.4.2.1. The back panel inlet and outlet ports are described in Table J.4.2.2 and illustrated in Figure J.4.2.2. Prior to energizing the equipment, it is recommended that the operator become familiar with the function of each control and indicator.

### J.4.2.3 ROUTINE PROCEDURES

Prior to operating the support module, the interconnection and start-up procedures must be performed as outlined in Section J.4.1.

1. During routine operation, the Supply Air Section should be periodically checked for stable, repeatable readings. Any change in pressure of flowrate should be checked.

   a. Input Pressure ~ 50 psig min.

   b. Output Pressure ~ 40 psig.

   c. Sample Vent Flowrate: 50-70 cc/min.

   Air flow must be maintained through the "$H_2O$ DRAIN" vent on the rear of the module to eliminate water from the system. During periods of high humidity, water will pass through this vent and drain into a bottle or jar.

2. During the operation, the calibration section should be periodically checked. Sample pressure should be 9 ± 1 psig.

   To monitor ambient air, set the "SAMPLE-ZERO-SPAN" switch to the "SAMPLE" position.

   To span the CO and/or HC analyzer(s) connected to the calibration section, switch the "SAMPLE-ZERO-SPAN" switch to the "SPAN" position. (When the span operation is completed, the switch must be returned to the "SAMPLE" position to resume ambient monitoring.)

   To zero the CO and/or HC analyzer(s) connected to the calibration section switch the "SAMPLE-ZERO-SPAN" switch to the "ZERO" position. (When the ZERO operation is completed, the "SAMPLE-ZERO- SPAN" switch must be returned to the "SAMPLE" position to resume ambient air monitoring. The system will not automatically time out.)

Table J.4.2.1
Support Module Front Panel Controls and Indicators

SUPPORT MODULE FRONT PANEL CONTROLS AND INDICATORS

| Symbol | Name | Function |
|---|---|---|
| G1 | SAMPLE PRESSURE Gauge | Indicates sample pressure of calibration system |
| V1 | PRESSURE ADJUST Valve | Adjusts sample pressure of calibration system |
| FM1 | Bypass Flowmeter | Indicates Bendix 8202 sample vent flowrate |
| SW4 | SAMPLE-ZERO-SPAN Switch | Selects operating mode of calibration system |
| L2 | Sample Pump Pilot Light | Indicated power applied to sample pump |
| SW1 | POWER Switch | Main power switch - applies power to module |
| FS1 | Fuse | 5 amp fuse for module power |
| SW3 | SUPPORT PUMP Switch | Applies power to support pump of support system |
| L3 | Support Pump Pilot Light | Indicates power applied to support pump |
| V2 | HIGH PRESSURE RELIEF Valve | Adjusts second-stage (output) pressure |
| V3 | INTERSTAGE PRESSURE Valve | Adjusts differential pressure between first and second stages |
| V4 | LOW PRESSURE RELIEF Valve | Adjusts first-stage (input) pressure |
| G2 | INPUT PRESSURE Gauge | Indicates Input Pressure |
| G3 | OUTPUT PRESSURE Gauge | Indicates Output Pressure |

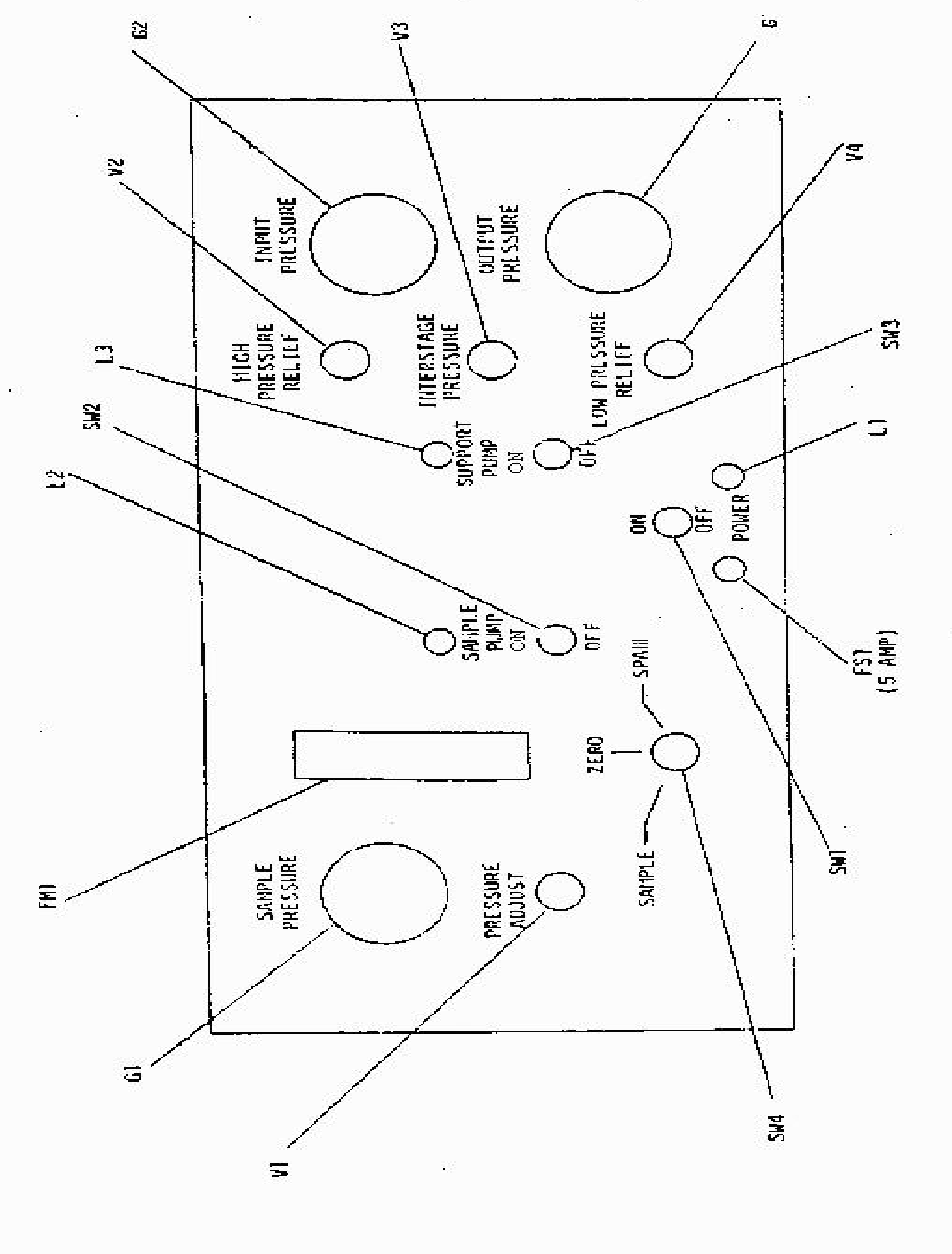



Figure J.4.2.1
Support Module Front Panel Controls and Indicators

Table J.4.2.2
Support Module Back Panel Input and Output Ports

SUPPORT MODULE BACK PANEL INPUT AND OUTPUT PORTS

| Symbol | Name | Function |
|---|---|---|
| P7 | To Aadco Port | Support system outlet port to Aadco or external methane reactor |
| P5 | Top CO Port | Calibration system outlet port to CO Analyzer |
| P4 | To 8202 Port | Calibration system outlet port to 8202 or HC Analyzer |
| P9 | SAMPLE VENT Port | Support system outlet port from flowmeter |
| P2 | SPAN Port | Support system span gas inlet port |
| P1 | ZERO Port | Calibration system zero gas inlet port |
| P3 | SAMPLE Port | Calibration system sample air inlet port |
| P8 | 8202 VENT Port | Support system 8202 sample vent flow inlet port to flowmeter |
| P6 | AMBIENT Port | Support system ambient air inlet port (room air) |
| FN1 | Fan | Support system cooling fan |
| F1 | Inline Particulate Filter | Calibration system MSA inline particulate filter holder |

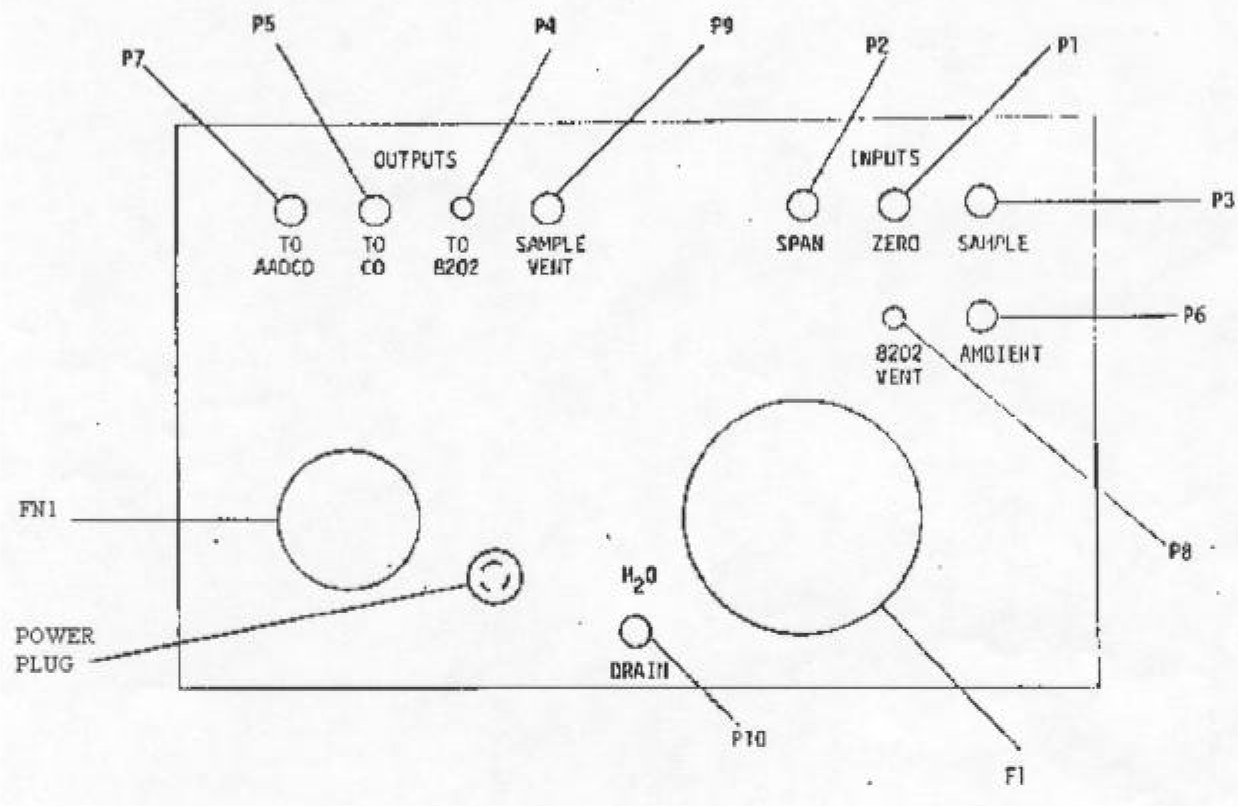



Figure J.4.2.2
Support Module Back Panel Input and Output Parts

## J.4.3 ROUTINE SERVICE CHECKS

### J.4.3.1 GENERAL INFORMATION

Periodic maintenance should be performed on the support module in order to reduce equipment failure and to maintain the calibration integrity of the instrument. The following instructions provide details for performing the needed maintenance procedures. Because of variations in climate and operating conditions at each monitoring station, it may be necessary to adjust the maintenance schedule.

### J.4.3.2 WEEKLY CHECKS

Check the water drain for airflow and evidence of purged water. The air flow rate through the water drain should be 400 to 500 cc/min during normal operation. If there is no airflow, turn the unit off, disconnect the power plug, and clean the capillary. The capillary can be cleaned by passing a small diameter wire through the opening to dislodge any contamination that may have clogged the exit.

### J.4.3.3 QUARTERLY CHECKS

Replace the charcoal inlet filter (F2) and sample inlet filter (F1) every three months (see Figure J.4.0.1).

### J.4.3.4 YEARLY CHECKS

Replace the sintered 7 micron particulate filter located at the "8202 Support" inlet port on the Aadco pure air generator.

## J.4.4 DETAILED MAINTENANCE PROCEDURES

### J.4.4.1 SAMPLE PUMP MAINTENANCE

The Metal Bellow (Model 41) sample pump utilizes stainless steel reed valves and hermetically sealed bellows. The pumping element and motor are sealed and require no lubrication. The bellows assembly and motor must not be disassembled in the field. However, if the pump performance degrades to the point that it will not maintain the proper pressure and/or flow rate, it may be caused by foreign particles under the reed valves. This problem may be cleared as follows:

1. Turn the pump power off and disconnect the power cable from the primary power source.

2. Disconnect the inlet and outlet tubing from the pump assembly.

3. Remove the four (4) screws from the pump head and remove the plate to expose the reed valve assembly.

4. Note the relative position of the scribed line that extends from the outer stainless steel casting into the teflon face of the reed valve assembly or sealing surface.

5. Remove the valve assembly by lifting it with your fingers. Do not pry the assembly out with any tool, due to the possibility of damage to the valve assembly or sealing surface.

6. Remove foreign matter from under the reeds, but be extremely careful not to distort them.

7. Reinstall the reed valve assembly, ensuring that the scribed lines are positioned properly.

8. Reinstall the plate on the pump head utilizing the four screws removed in step "3".

9. Reconnect the inlet and outlet tubing to the pump assembly and reapply the pump power.

10. Check the system operation.

## J.4.4.2 SUPPORT PUMP MAINTENANCE

The Gas Diaphragm pump utilizes a rubber diaphragm and interchangeable, stainless steel inlet and outlet leaf valves. Do not lubricate any of the parts with oil, grease, or petroleum products. Do not clean the pump with acids, caustics, or chlorinated solvents. If pump performance degrades to the point it will not maintain the proper pressure and/or flow rate, the diaphragm and valves should be inspected and cleaned and, if necessary, replaced. Replacement parts can be ordered from the Special Purpose Monitoring and Data Support Section at (916) 445-0616.

## J.4.4.3 CLEANING THE INSTRUMENT

The support module should be cleaned as often as the environmental conditions require. Accumulation of dust can cause overheating and component failure.

**CAUTION: Prior to cleaning the instrument, place the POWER switch to the OFF position, the PUMP switches to the OFF position, and unplug the power cord. Avoid the use of chemical agents which might damage the component parts of the instruments.**

Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or a small paint brush. Dust which remains can be removed with a soft cloth dampened in a mild solution of water and detergent. Abrasive cleaners should not be used.