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Conoco Chemicals
Continental Oil Company
P.O. Box 91, New Highway 25
Aberdeen, Mississippi 39730

May 9, 1977

United States Environmental Protection Agency
Suite 300
1421 Peachtree Street
Atlanta, Georgia 30309

Attention: Mr. Thommie A. Gibbs, Chief
Air Engineering Branch

Dear Sir:

Please find attached the Leak Detection Program description section of our Plant's Compliance Plan for control of Vinyl Chloride Emissions. This program is a resubmittal of our previously issued Leak Detection Program sent to your office on November 30, 1976.

It is our belief that the program as submitted on November 30, 1976 fully met the intent of the leak detection and elimination requirement of the National Emission Standards for Hazardous Air Pollutants (40 CFR, Chapter 1, Subchapter C, Part 61.65b, 8).

During April of 1977, the EPA reviewed our submittal. The program was found deficient in some aspects. The EPA requested resubmittal of the program.

Accordingly, we are now resubmitting the program. Hopefully, we have corrected all of the noted deficiencies pointed out by the EPA. The information is based upon our own knowledge of the equipment and on extensive conversations with the manufacturers. The proposed program meets the needs of the Leak Detection and Elimination Program, as described in the Federal Register. We ask the Administrator to review and approve this program. It will be fully implemented within 15 days of approval.

Doug Michels

Douglas E. Michels
Chief Process Engineer
Conoco Chemicals
Aberdeen PVC Plant

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Attachment

A

# LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

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# LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

### A. GENERAL

The emission standard for vinyl chloride requires the plant to develop and implement a formal leak detection program.

The Federal Register describes specific criteria which must be met within the program. This document describes the leak detection program. Each of the specific requirements will be met. Namely, this section describes:

The continuous VCM detection system which is used by the plant.

The portable hydrocarbon detectors which are used by the plant.

The calibration and maintenance procedures for the above equipment.

The location of the continuous monitoring points which are used for leak detection.

The action plan which will be used to eliminate a leak after it has been detected.

The criteria which will be used to identify the presence of a leak.

By developing, submitting and implementing this program on a formal basis, the plant will be in compliance with the requirements of the Federal Register. The plant, therefore, requests the approval of this program as meeting the requirements of paragraph 61.65, b, 8.

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# LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

## B. VINYL CHLORIDE MONITORING SYSTEM

### Introduction

The concentration of vinyl chloride in the atmosphere is continuously monitored by four flame ionization chromatographs, each of which is operated continuously. Each chromatograph is a Honeywell Model 1000 Process Gas Chromatograph manufactured by:

Honeywell Systems, Inc.
6625 McGrew Street
Houston, Texas

Each chromatograph sequentially measures, on a continuous basis, the vinyl chloride content in air samples taken from ten different locations. A total of forty (40) locations are monitored throughout the plant continuously and the concentrations at each point are recorded.

### Description

### Analytical Technique

The Flame Ionization Detector used in the Honeywell 1000 Process Gas Chromatographs can detect hydrocarbons on the order of a few parts per million.

The special-purpose elements of the FID chromatograph are a flame cell, an FID Electrometer Assembly, a Temperature Control/Inverter Assembly, and a plug-in FID Amplifier Module which mounts in the Control Section.

The flame cell consists of an ignitor wire, a hydrogen-fed burner, and an electron collector. Within the cell, hydrogen combustion occurs in an electrical field created by the voltage from the ionization inverter. Because of the carbon-free property of hydrogen, ionization occurs only when a carbon-bearing sample is injected into the flame. Ionization causes current to flow from the collector in direct proportion to the amount of the hydrocarbon elements present in the sample. The output current from the flame cell is routed through the Electrometer (Preamp) in the Analyzer, and is applied to the input of the FID Amplifier in the Control Section. The gain is made available for external recording.

The FID Electrometer Assembly is physically divided into two major subassemblies: the Power Supply-Electrometer P.C. Card Assembly, and the Electrometer P.C. Card Assembly. The electrometer power supply accepts ⊕ 20 volt inputs from the Control Section power supply, and produces regulated plus and minus 15 volt outputs for operation of the electrometer circuits and the inverter located on the Temperature Control/Inverter P.C. Card Assembly. The inverter output is a -100 volt ionization potential which is applied to the base (burner) of the flame cell.

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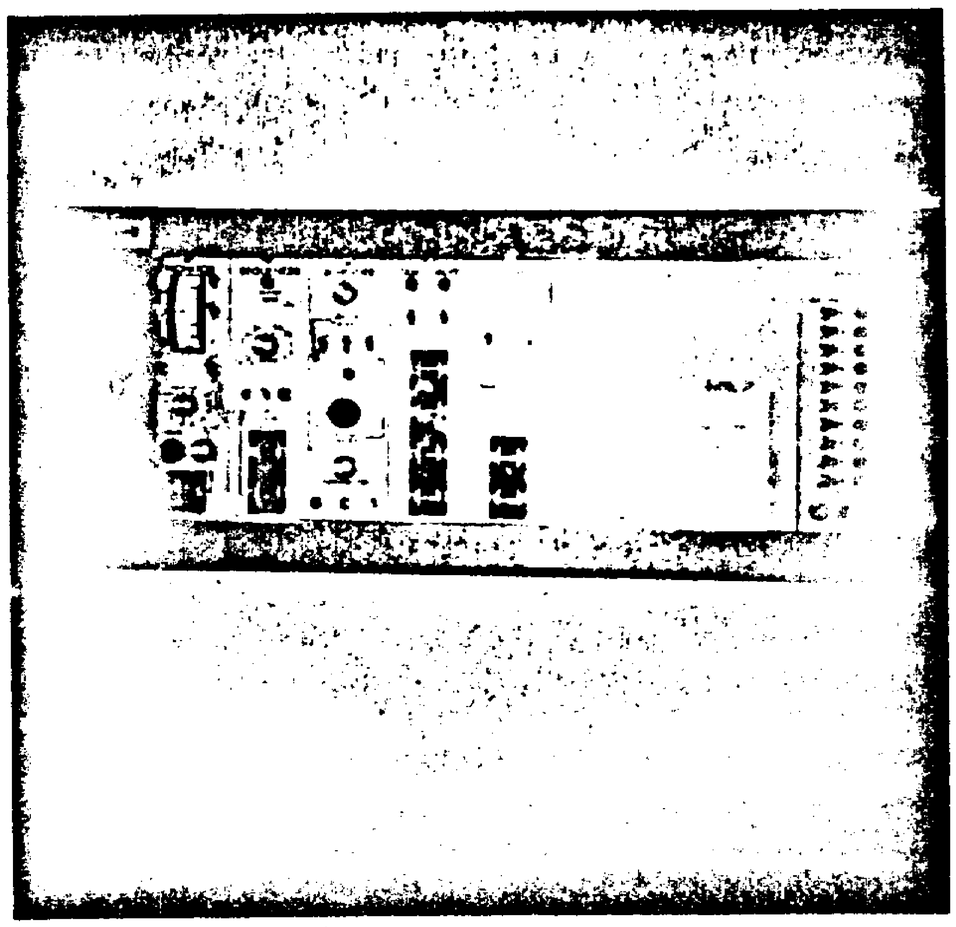
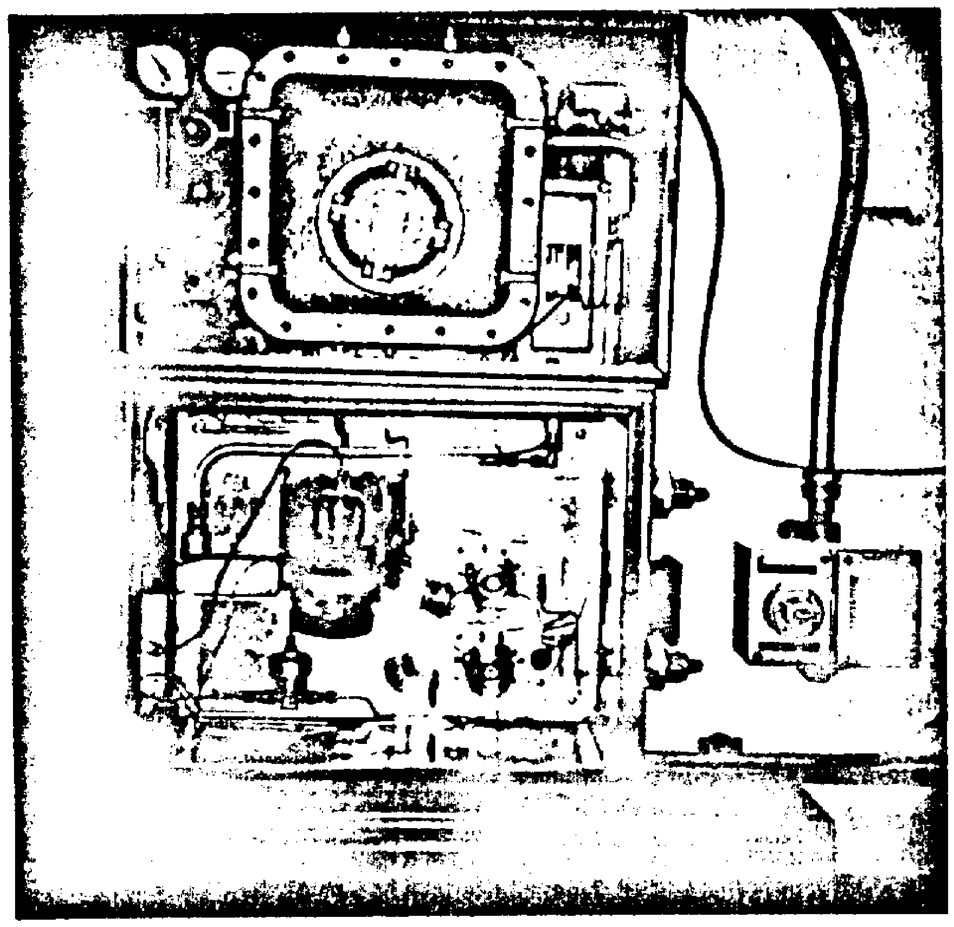


SEQUENCE
AND ANALYZER CONTROL
MODULE



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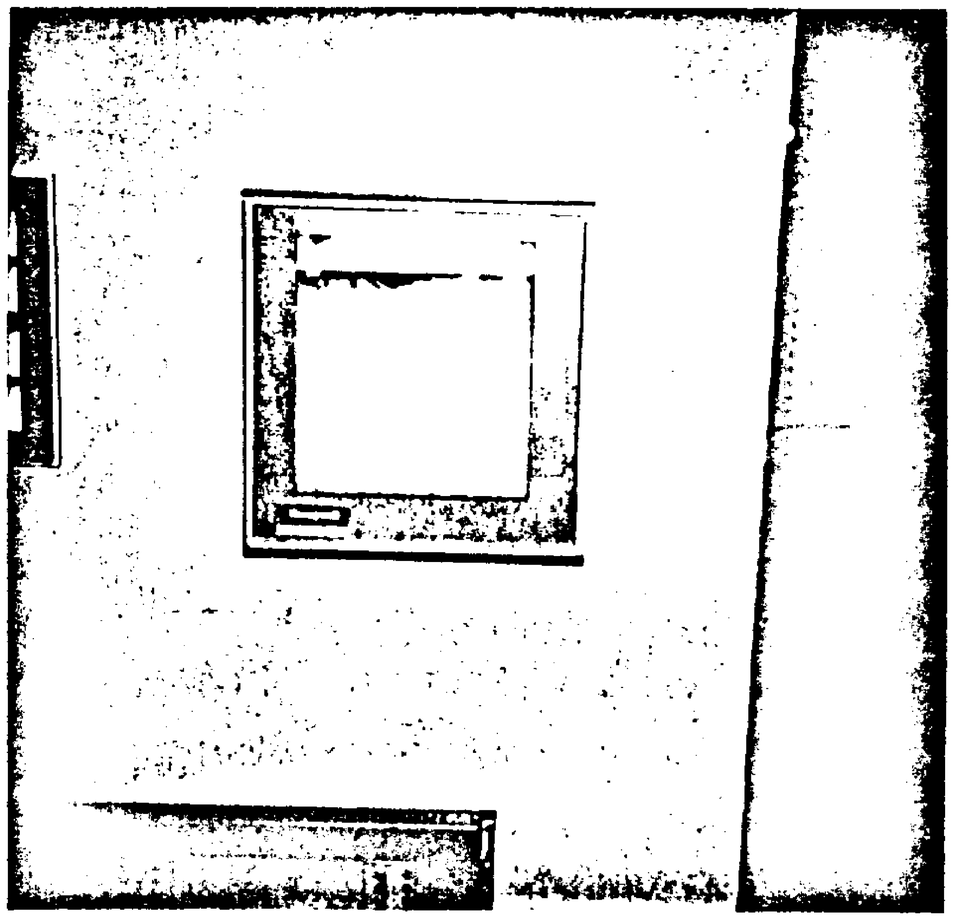

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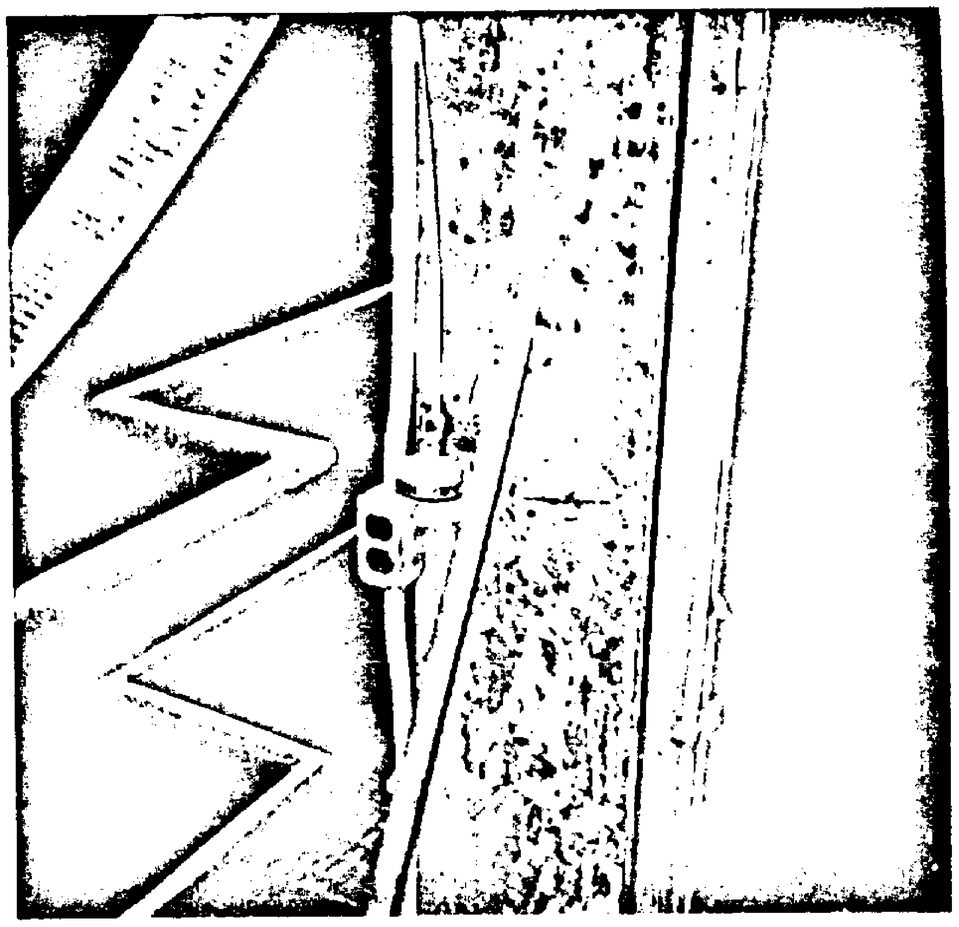
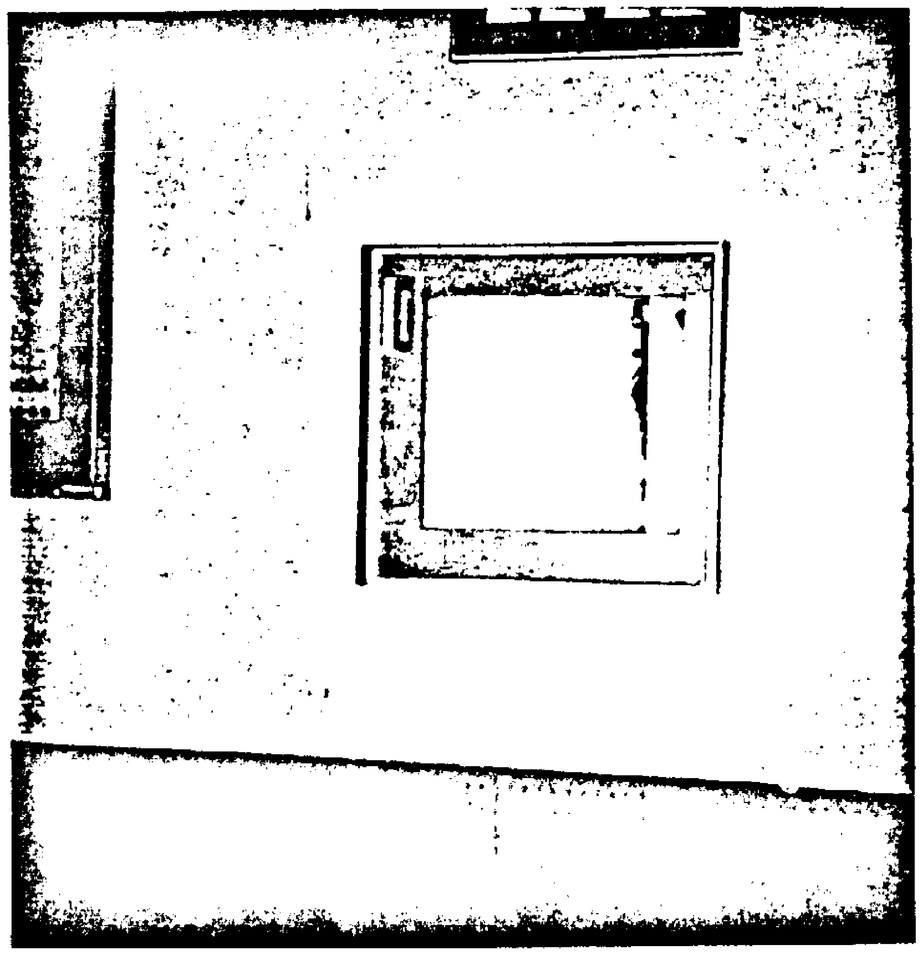
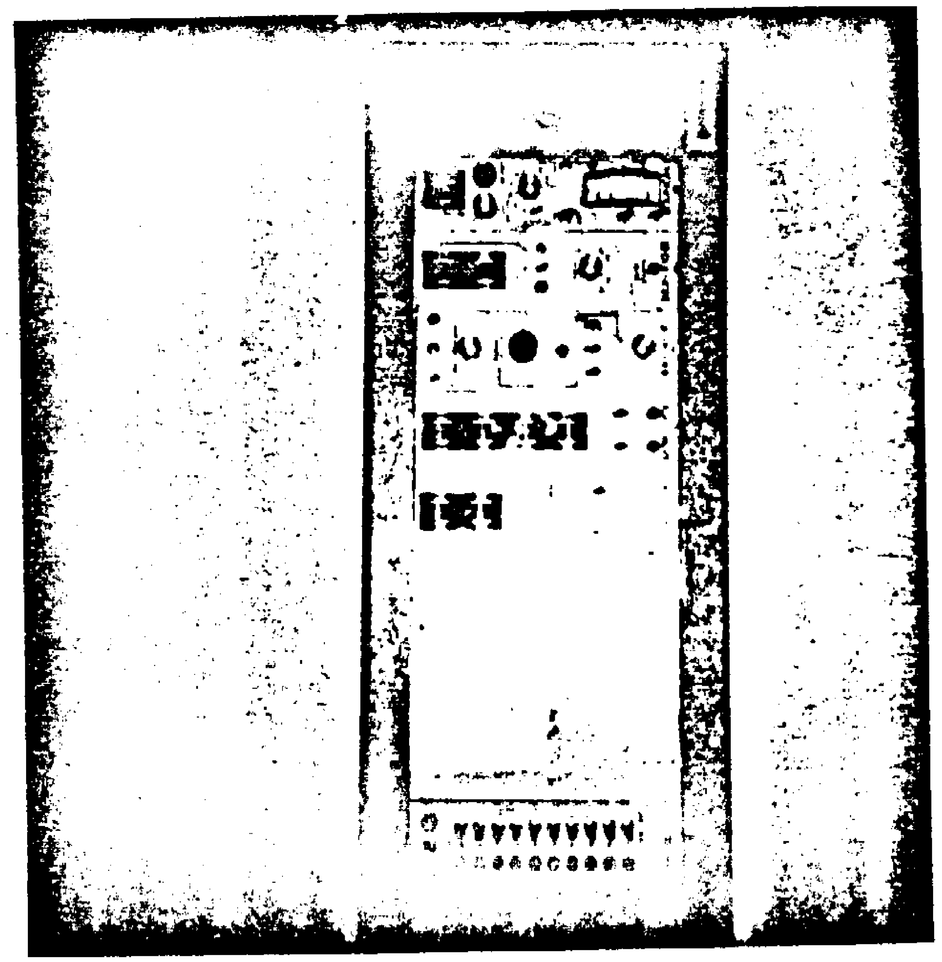
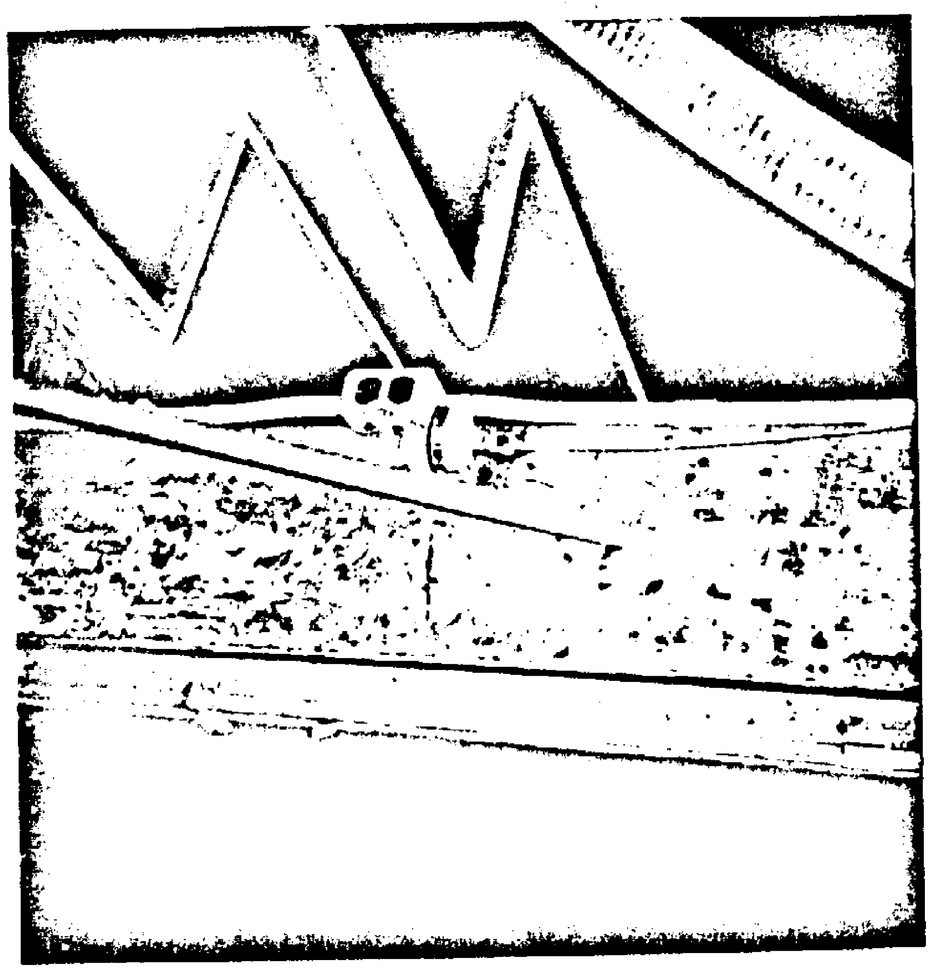
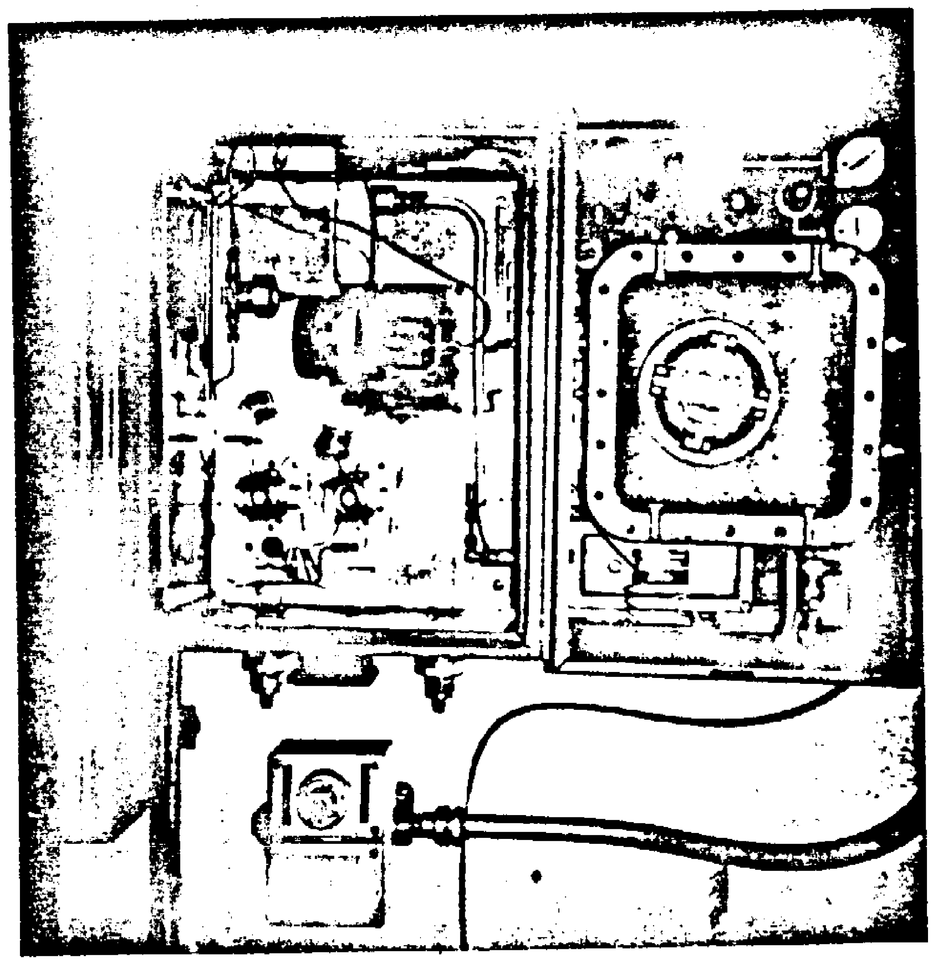


SAMPLE POINT









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Depressing the IGNITE pushbutton switch applies 115 vac to the primary of a transformer, which in turn produces approximately 2.2 vac across the ignitor coil inside the flame cell. Depressing the IGNITE pushbutton also produces a ground connection which enables the solenoid driver circuit to open the hydrogen shut-off valve. With 2.2 vac applied to the ignitor coil, and the hydrogen shut-off valve open, the flame will ignite within five to 10 seconds.

When the flame ignites, current flow from the flame cell collector is amplified by the electrometer circuit, the output of which is routed to both the Control Section FID Amplifier and to a level detect circuit on the Power Supply-Electrometer P.C. Card Assembly. When the level detect circuit senses an electrometer output of sufficient magnitude to indicate that the flame is lit, the circuit produces a logic level output which lights the FID Amplifier "FLAME ON" indicator. In addition, the circuit de-energizes a relay which extinguishes the analyzer "FLAME OUT" indicator, and provides a ground to the solenoid driver circuit so that the hydrogen shut-off valve will be maintained in the open position when the IGNITE pushbutton is released.

During sustained operation, the level detect circuit continuously monitors the output of the electrometer circuit, and any momentary output drop below a selectable threshold level will cause the FID Amplifier FLAME ON indicator to momentarily extinguish. If the reduced signal level continues beyond a selectable time delay, the level detect relay will energize, thus closing the hydrogen shut-off valve and illuminating the analyzer FLAME OUT indicator. If this condition occurs, the IGNITE pushbutton must again be pressed and held to re-light the flame.

Electrometer P.C. Card Assembly

The functional center of the electrometer circuit is a 3430J high gain integrated circuit amplifier. The flame cell collector current is brought into the circuit via resistor R1 and the divider network at the amplifier input. HIGH/LOW range selection is accomplished by a RANGE control input from the FID Amplifier. When LO range is selected, relay K1 is energized and R7 is placed in parallel with R8 to reduce the over-all sensitivity of the circuit.

The signal OUTPUT at pin 21 is routed to the FID Amplifier input in the Control Section, and to the level detect circuit on the Power Supply-Electrometer P.C. Card Assembly.

Power Supply - Electrometer P.C. Card Assembly

The Power Supply - Electrometer P.C. Card Assembly contains both the electrometer power supply and the level detect circuitry associated with monitoring the status of the hydrogen flame. The power supply (IC1, Q1, Q2, etc.) accepts plus 20 vdc and minus 20 vdc from the control section, and produces regulated plus and minus 15 vdc for the electrometer circuits and for the ionization inverter on the Temperature Control/Inverter P.C. Card Assembly.

The level detect circuit consists of the operational amplifiers in IC-2; the -LEVEL DET ADJUST control (R7); the associated decoding logic in IC's 3, 4, 5,; and the level detect relay, K1. The electrometer output is brought into the circuit at pin 21, and is routed through operational amplifiers IC 2-1 and IC 2-7 to the input of IC 2-10.

The level at IC 2-9 is set by R7, so that if the electrometer output drops below a selected threshold, the flame will be considered extinguished and a positive transition will occur out of IC 2-8. In practice, the threshold level is set just below the quiescent electrometer output when only air and hydrogen are passing through the detector.

If the output of IC 2-8 goes positive, signifying an inadequate signal level, the logic-0 at IC 4-6 illuminates DS2 on the electrometer front panel, and the logic-1 at IC 4-8 extinguishes the FID Amplifier FLAME ON indicator. In addition, any positive level out of IC 2-8 will also trigger adjustable one-shot IC 3, which produces a selectable time delay before energizing relay K1 and illuminating DS1 on the electrometer front panel. This delay, which is adjustable from 2 to 20 seconds, and optionally from 2 to 200 seconds, ensures that the relay will not be energized by transient conditions in the flame cell or electrometer.

If the IC 2-8 output is still positive when the selected delay is completed, the resultant logic-1 levels at IC 5-1 and IC 5-2 produce a logic-0 at IC 5-6 which illuminates DS1 and energizes K1. In the energized condition, the closed contacts of K1 illuminate the analyzer "FLAME OUT" indicator and the open contacts remove the ground to the solenoid driver circuit, thus closing the hydrogen shut-off valve.

Temperature Control/Inverter Assembly

The temperature control circuit in the FID chromatograph is identical to that of the TC system.

The inverter circuit is of conventional design, and operates from the plus 15 vdc regulated input provided by the electrometer power supply. Transistors Q3 and Q4 and the associated elements form a free-running oscillator, the output of which is coupled through transformer T1 to produce plus and minus 100 vdc at the output. The -100 vdc is the ionization potential which is applied to the base of the flame cell.

Amplifier Module

The FID Amplifier is essentially the same as the TC Amplifier, except for the addition of a HI/LO gain range switch concentrically mounted around the MANUAL RANGE switch, and the addition of a FLAME ON indicator to the front panel. The HI/LO range switch controls relay K1 in the FID electrometer, to change the divider resistance values at the electrometer input, thus changing the electrometer sensitivity.

The FLAME ON indicator is controlled by a logic level input from the Power Supply - Electrometer P.C. Card Assembly in the electrometer. No time delay is provided between the level detect circuitry and the FLAME ON indicator, thus ensuring that any transient "flame off" conditions will be seen on the indicator.

## Sample Routing And Specific Chromatograph Parameters

Sample routing is accomplished through a dual column with backflush. This column configuration insures that all the hydrocarbons drawn in during the sampling time interval (10 sec.) will be sensed at the same time, thus causing one recorder peak. This insures that the content of the sample stream will not be understated by the output to the recording transducers.

The sample is injected with the dual column valve energized (light on), and with the backflush valve in the foreflush position. This allows the sample to be swept from the sample valve into column number one. Column number one separates inerts or other light components from the heavier components, but not from each other. The combined light components are allowed to pass into the second column where they are separated.

At a selected time during the analysis, column number two is switched out of the stream and the heavy components from column number one are routed to the detector via a restrictor. The light components, not yet eluted from column number two, remain in that column until the dual column valve is switched back to the dual column position. The resultant reverse flow through column number one causes those components still in the column to be eluted as a group, and recorded as one peak.

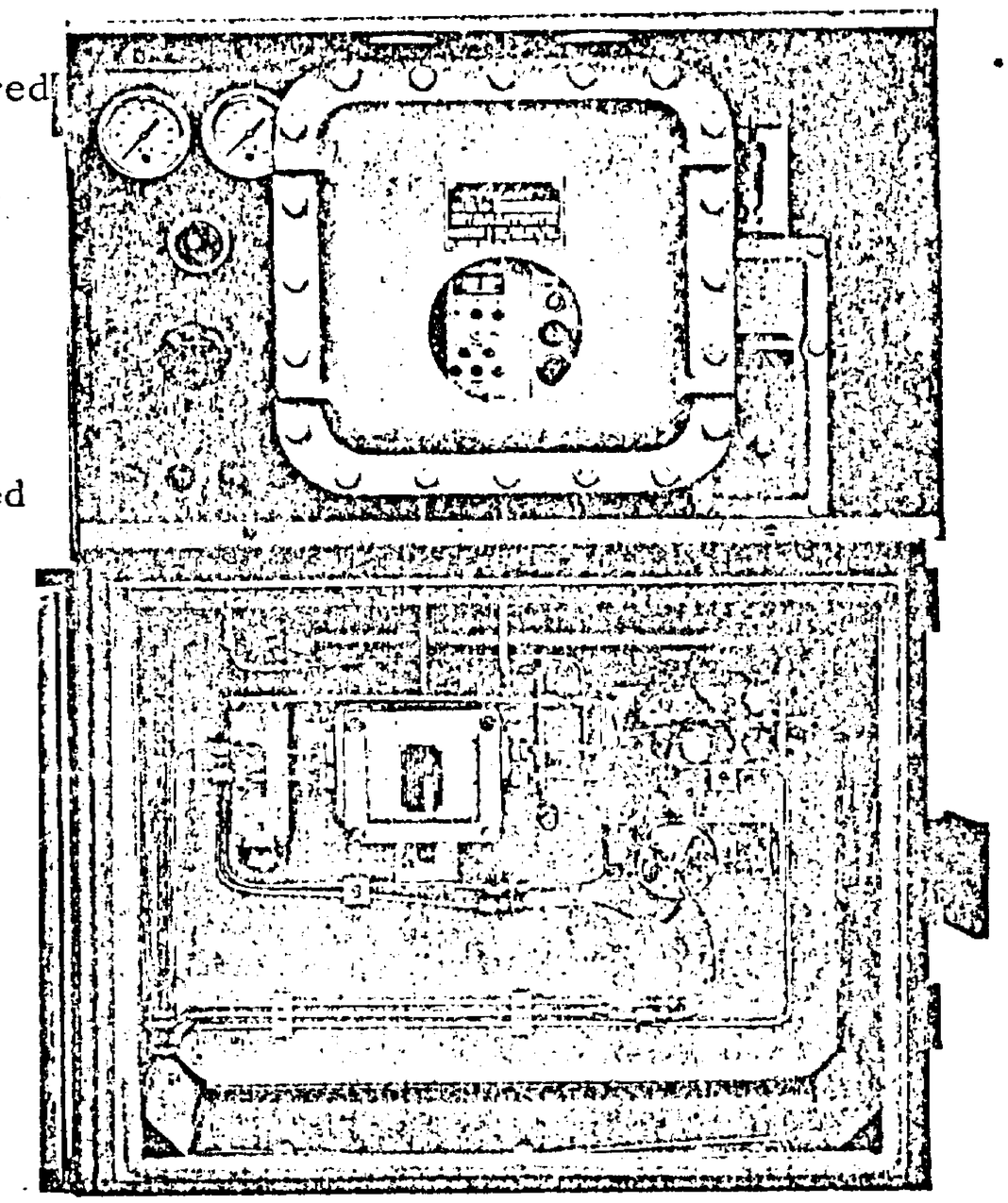
The specific parameters for the Honeywell chromatographic column are as follows:

analysis cycle time: 60 sec.
carrier gas: nitrogen
carrier pressure: 50 psig
column vent flow: 43 cc/min.
backflush vent flow: 60 cc/min.
heater air: 50 psig
oven temperature: 60°C
sample loop length: 48 in.
sample loop length I.D.: 0.047 in.
sample loop length O.D.: 1/16"
column material: SS
phase: 15% bis(2-ethoxyethyl) adipate
phase support: Chromosorb P

Parameters for the air and hydrogen are as follows:

hydrogen flow equals 55 cc/min. @ 50 psig
air flow equals 350 cc/min @ 220 psig

The Analyzer Section of the Model 1000 has been designed to permit the high-speed analyses required by the technological advances of the past few years.



The basis of this high-speed analytical system is the Micro Packed Column-High-Speed Micro Detector combination.

The resolution of the Micro Packed Column is enhanced by the High-Speed Micro Detector designed and manufactured by Honeywell with the following features: the cell volume is approximately 0.05 microliter; a semi-diffusion type of detector cell is utilized rendering it relatively insensitive to flow rate; the detector response to the presence of a component is suitable for analysis times of less than 1 second.

The Micro Packed Column, Micro Detector and associated sample and column-switching valves have been packaged in an analyzer designed to yield the high thermal stability and accessibility.

The temperature of the analyzer oven is controlled by an all solid state, proportional temperature controller. Several modifications to the widely used heated air type of temperature control system have resulted in an analyzer design that permits the full sensitivity of the Micro Detector to be utilized.

The use of each control of the analyzer is given in Table 1.

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## TABLE 1

## ANALYZER SECTION, OPERATING CONTROLS AND INDICATORS

| Control or Device | Purpose or Use |
|---|---|
| AIR Control | Controls air pressure to the valve actuating solenoid(s) and to the low mass heater. |
| AIR Gauge | Indicates air pressure (0-100 lbs.) set by the AIR control. |
| CARRIER Control | Controls carrier pressure to the column(s) (ultimately controlling the flow) and to the needle valves for reference, etc. |
| CARRIER Gauge | Indicates the carrier pressure (0-160 lbs.) set by the CARRIER control. |
| REF and AUX 1,2,3 Needle Valves | Used to precisely adjust carrier flow rates through the reference side of the detector and through three auxiliary valves. |
| Heater Air Shut-off Valve | Allows the heater air to be shut off, while air pressure is maintained on the air-actuated valves. |
| Remote Valve Switches and Indicators | Used to remotely actuate the Analyzer valves. Light emitting diodes are illuminated to indicate the corresponding air-control solenoid is energized. |
| Preamplifier Meter and BAL ADJ Control | Used to balances the preamplifier output. |
| Preamplifier Test Jacks | Meter/scope test points for monitoring the indicated preamplifier parameters. |
| Temperature Set Point Control | Used to set the oven temperature. Clockwise rotation increases the temperature, and counterclockwise decreases the temperature. |
| Temperature Control Indicator | Indicates the status of the oven temperature controller. Due to the proportional temperature control circuitry, and the overtemp switch on the heater barrel, the light will alternately glow and shut off, until the oven temperature begins to approach the ambient operating temperature. When the operating temperature has been reached, the indicator will remain on, but will be very dimly lighted. |

TABLE 1 (Cont.)

ANALYZER SECTION, OPERATING CONTROLS AND INDICATORS

| Control or Device | Purpose or Use |
| --- | --- |
| Heater Barrel Over-Temp Control | Located behind the brass plug in the front cover of the heater housing, this control permits adjustment of the temperature cut-off point of the overtemp switch. This temperature can be monitored by connecting a pyrometer to the I/C thermocouple wire coiled under the explosion-proof housing. This temperature is normally factory adjusted for about 300°C. |

## Sample Injection Procedure

In this multi-stream application, the sample system permits continuous purge from the stream switching system, to and through the analyzer. This insures that the sample being analyzed is from the proper stream.

Sample input is measured by a "gas" valve. The "gas" valve is an external-volume sample valve, in which the sample volume is a length of tubing external to the valve. This valve is used to inject gas samples, and is also the valve used for column switching.

The column configuration by which sample injection is accomplished is the dual column backflush configuration. Normally, a sample is injected with the dual column valve energized and with the backflush valve in the foreflush position. This allows the sample to be swept from the sample valve into column number one. Column number one separates inerts or other light components from the heavier components, but not from each other. The combined light components are allowed to pass into the second column where they are separated.

At a selected time during the analysis, column number two is switched out of the stream, and the heavy components from column number one are routed to the detector via the restrictor. The light components, not yet eluted from column number two, remain in that column until the dual column valve is switched back to the dual column position. The resultant reverse flow through column number one causes those components still in the column to be eluted as a group, and recorded as one peak. Note that the combined components bypass column number two via the column bypass restrictor.

The sample volume is 1346 µl. The injection valve specifications are as follows:

Sample valve:
- Material: SS
- Diaphgram: High-Temperature
- Part Number: 30740492-002

Backflush:
- Material: SS
- Diaphragm: High-Temperature
- Part Number: 30740492-002

## Sample Handling Equipment

There are 40 sampling points at the Aberdeen Plant. At each sampling point, sample is drawn into a 1/8" I.D. nylon sampling line through a M.S.A. high efficiency small volume paper filter. The model number of these filters is DZ-78006. These end of line filters are manufactured by:

Mine Safety Appliance Company
408 Penn Center Blvd.
Pittsburgh, PA

Samples are drawn through each of the sampling locations served by a single Honeywell unit, by a single vacuum pump. The vacuum pump is model number 289-EXP, with trademark "Dia-Vac", manufactured by:

Combination Control, Inc.
Kulpsville, PA 19443

Sample is drawn into the sampling line at a maximum rate of 1.5 cfm at 0 in. Hg vacuum. Sample inflow is continuous.

The Control Section of the Model 1000 consists of solid state, plug-in modules. Each module is self-contained to permit easy replacement for troubleshooting or maintenance. The modules require front access only for replacement. The contacts are gold-plated over nickel for resistance to corrosive atmospheres.

The timing system is a 240 KHz clock which generates a digital pulse each second.

The anlaysis is programmed as follows:

A digital pulse is chosen just prior to setting the exact time the occurrence of the function is desired (Coarse). An adjustable delay, triggered by the digital pulse, is then set to provide the exact (Fine) time of the function. In the case of setting a component time-span (gate), the digital pulse triggers an adjustable time-window. Gate duration adjustments are direct-setting.

Auxiliary test equipment is not required to make any of the adjustments of the Model 1000 Control Section. Test points, with front panel access, are provided on each module for maintenance trouble-shooting.

The basic programmer (Control Section) is composed of the following sub-systems:

The MONITOR MODULE contains a multiple point selector switch and readout meter to permit checking auto zero range, power supply voltages, detector preamp output, signal amplifier output and digital clock status. The memory output can also be checked with this switch, if this option is included in the basic control section. The Power switch is located on this module, as well as a Status switch (Normal/Bypass) and a Standard Sample switch for remote introduction if a calibration standard is desired. A recorder jack is included on the front panel to permit the use of a service recorder, if a dedicated recorder is not required for bargraph readout. An auto zero function is also included in this module.

THE SEQUENCER MODULE is a solid state, digital timing system with direct setting time adjustments for the sequenced funtions. The adjustments for the sample valve "Inject Time" are located in this module. The basic sequencer is a 0-100 second clock with a digital pulse generated each second.

THE AMPLIFIER MODULE contains an auto zero status switch, manual range (Spectrum) switch, amplifier zero potentiometer, and a built-in calibration. The calibrator generates synthetic signals which may be used to set, or check, the full-scale range of the measured components. This module gives the basic 0-10 volt output signal.

THE VALVE MODULE is required for multi-column applications. Direct-setting switches are adjusted to provide the exact time for the signal required for the valve-switch to occur. An additional auto-zero circuit and its timing adjustment is provided in this module.

A COMPONENT MODULE is required for each component to be measured. The basic control section can be supplied with one to six component modules. Each module contains the necessary adjustments for setting the full-scale range of the measured component and for setting the time-span (gate). An auto zero is an integral part of the module.

The standard Control Section provides bargraph output signals for each measured component. A trend output of peak height or peak area (integration) for each component is also available. The necessary interface requirements for computer-input of data can be provided. Current or voltage output is available as a standard feature.

The signal from the detector bridge is amplified to a level of approximately 0.1 volt before leaving the analyzer section. Thus no low level signals are switched within the Model 1000 system. Since the electronic auto zero circuit performs the zeroing function in less than fifty (50) milliseconds, it is normally actuated by each component "on gate".

The specific functions of each control option are given in Tables through 7.

## TABLE 2

## MONITOR MODULE, OPERATING CONTROLS AND INDICATORS

| Control or Indicator | Purpose or Use |
|---|---|
| ON/OFF Switch | Controls AC input power to the Control Section. |
| PWR (Power) Indicator | Indicates the power on/off status of the Control Section. |
| DET/OFF Switch | Controls DC power to the bridge detector circuit in the Analyzer. |
| DET (Detector) Indicator | Indicates the power on/off status of the bridge detector. |
| STD SAMP/OFF Switch | Used to actuate a solenoid in the sample system (if provided) for automatic standard sample introduction. In the STD SAMP position, a contact closure is provided at the Control Section rear panel. |
| STD SAMP Indicator | Lamp is illuminated when sample is flowing, and is off for normal operation. |
| STATUS NORM/BYPASS Switch | Provides a contact closure which can be used as a maintenance "out of service" switch, etc. Terminal connections are provided on the Control Section rear panel for connection to remote indicators, alarms, or a computer. |
| STATUS Indicator | Lamp is illuminated to indicate "bypass", and is off for normal operation. |
| Meter Display | Provides a visual indication of the Control Section operating conditions, as selected by the Meter Function Switch. |
| Meter Function Selector Switch | Selects the Control Section parameters to be presented on the Meter Display. |
| +20 and -20 Positions | Display the respective output levels from the Control Section DC power supply. Normal indication is approximately 50% of full-scale deflection, in the respective polarity direction. |
| SIG IN Position | Displays the signal amplifier input level received from the preamplifier in the Analyzer. (±0.1 volt range). |

TABLE 2 (Cont.)

| Control or Indicator | Purpose or Use |
|---|---|
| SIG OUT Position | Displays the output level of the signal amplifier. (±10 volt range). |
| AUTO ZERO Position | Displays the voltage required to bring the "baseline" back to zero. (±5 volt range). |
| CLOCK Position | Permits confirmation that the Control Section internal clock is functioning. Meter display will indicate 1/2-scale or better, and will drop to zero one second out of every 10 seconds. |
| C1 thru C6 Positions | Display the peak height voltages stored in the memory outputs for components 1 through 6. Can also be used for a rough setting of zero and span calibration of each memory. |
| RECORDER Connector | Provides AC power and chart advance levels to drive a portable "service" recorder for temporary spectra or gate readout. Back panel terminals are also available for permanent connections. |
| AUTO ZERO START Switches | A non-dedicated auto zero function which can be set to auto zero at any point during the analysis by dialing in the time (in seconds) on the thumbwheel switches. The fine adjustment allows delay of the start of Auto Zero from 0 to 2 seconds. |

## TABLE 3

## SEQUENCER MODULE, OPERATING CONTROLS AND INDICATORS

| Control or Indicator | Purpose or Use |
|---|---|
| SAMPLE VALVE Indicator | Lamp is illuminated when the valve is in the sample inject position. |
| MODE Selector Switch | Controls the operation of the Sequencer, and the readout to the recorder. |
| AUTO Position | Analysis events (sample inject, auto zero, component gating, etc.) occur automatically as programmed by Control Section front panel switches. The recorder is driven in the bargraph mode, and the amplifier output is enabled only during the selected "component gate" times. |
| GATE Position | Analysis events (sample inject, auto zero, component gating, etc.) occur automatically as programmed by Control Section front panel switches. The recorder chart is continuously driven, and the amplifier output is enabled only during the selected "component gate" times. This allows the programming gates to be visually checked. |
| SPEC (Spectrum) Position | Valve actuations occur automatically, as programmed by Control Section front panel switches. The recorder chart is driven continuously, and the amplifier output is continuously enabled. COMPONENT lights are gated to provide a visual indication of gate timing.<br><br>NOTE<br>The Amplifier module AUTO ZERO switch should be in the OFF position. The AUTO/MAN switch must be set to MAN to select the desired signal range. |
| MAN (Manual) Position | All functions must be operated manually. (Valve switches left in AUTO will cause the corresponding valves to go to the "on" condition). The recorder chart is continuously driven, and the amplifier output is continuously enabled.<br><br>NOTE<br>The Amplifier module AUTO/MAN switch must be set to MAN to select the desired signal range. |

TABLE 3 (Cont.)

| Control or Indicator | Purpose or Use |
|---|---|
| CYCLE Selector Switch | Permits selection of analysis time (length). |
| Time (lower) Position | Analysis time (in seconds) is determined by the setting of the TIME thumbwheel switches (0-99 seconds). |
| "100" Position | Analysis cycle time is a fixed 100 seconds, regardless of the TIME switch setting. The analysis will run in the time programmed, and will wait for the remainder of the 100 seconds before starting another analysis. |
| "600" Position | Analysis cycle time is a fixed 600 seconds, regardless of the TIME switch setting. The analysis will run in the time programmed, and will wait for the remainder of the 600 seconds before starting another analysis. |
| Sample Valve AUTO/MAN Switch | Permits selection of automatic or manual sample valve control. |
| AUTO Position | Sample valve is automatically controlled by the Sequencer module with "sampling length" selected by the VALVE DURATION thumbwheel switches. |
| Middle (off) Position | Sample valve is in the "bypass" position, and the sample is flowing through the sample volume ports. |
| MAN Position | Sample valve is in the "on" condition, and the sample is being injected into the column. |
| SEQ. (sequence) RESET Pushbutton | Allows the Sequencer to be manually reset to the start of an analysis.<br><br>NOTE<br>The SEQ. RESET pushbutton does not reset any auxiliary valves. Therefore, before pushing the SEQ. RESET button, wait for the VALVE lights to return to their initial "program start" conditions, or switch the sample valve off until a complete cycle runs on the sequencer. If any VALVE light is on, then one complete cycle must be run before a satisfactory readout can be obtained.<br><br>If the CYCLE switch is in the "600" position, SEQ. RESET advances the timer to 100 seconds, and an additional 500 seconds is required before the timer is reset. |

TABLE 3 (Cont.)

| Control or Indicator | Purpose or Use |
| --- | --- |
| Sample VALVE DURATION Thumbwheel Switches | Permits adjustment of the duration of the sample inject period. At the end of the set duration time (in seconds), the sample valve goes to the off (sample purge) position. |

## TABLE 4

## AMPLIFIER MODULE, OPERATING CONTROLS AND INDICATORS

| Control or Indicator | Purpose or Use |
|---|---|
| RANGE CALIBRATE Control | Permits adjustment of an internally-generated calibration voltage so that the full-scale range and peak memory output level for each measured component can be set. |
| AUTO/CAL Switch | In the AUTO position, which is the normal operational position of the switch, the input to the amplifier is the bridge preamp output from the analyzer. In the CAL position, the input to the amplifier is an internally-generated calibration voltage, the level of which is controlled by the RANGE CALIBRATE Potentiometer. |
| AUTO/ZERO/OFF Switch | Controls the operational mode of the Auto Zero circuitry, which automatically compensates for any drift in the bridge preamp "zero" (baseline) output level. Auto Zero is normally actuated for 50 milliseconds by each component "on-gate", and at other times as determined by the setting of the non-dedicated Auto Zero function(s). A moveable jumper on each Component Module allows Auto Zero to be inhibited at the corresponding component gate opening, if so desired. |
| AUTO ZERO Position | Auto Zero level is automatically updated at each Auto Zero time to compensate for preamp baseline drift. |
| Middle Position | Allows the last Auto Zero signal level to be held in the Auto Zero circuitry. This leaves the baseline at recorder zero when switching to Manual or Spectrum operations. |
| Off Position | The Auto Zero function is inhibited with Auto Zero "off". The AMPLIFIER ZERO control must be used to zero (balance) the output to the recorder. |
| AUTO/MAN Switch | In the AUTO position, the amplifier gain changes during each component gate, as determined by the setting of each component's RANGE potentiometer. In the MAN position, the amplifier gain is controlled exclusively by the setting of the MANUAL RANGE switch. |

TABLE 4 (Cont.)

| Control or Indicator | Purpose or Use |
|---|---|
| MANUAL RANGE Selector Switch | With the AUTO/MAN switch in the MAN position, this switch permits manual selection of the signal output range by attenuating or amplifying the bridge preamp output as follows: |

| Position | Factor |
|---|---|
| 1 | 10 |
| 2 | 5 |
| 5 | 2 |
| 10 | 1 |
| 20 | X2 |
| 100 | X10 |
| 200 | X20 |
| 500 | X50 |
| 1000 | X100 |

| | |
|---|---|
| AMPLIFIER ZERO Control | Permits manual adjustments of amplifier "zero" output, to balance the recorder. |
| GND. IN and OUT Test Jacks | Meter/scope test points for monitoring the amplifier input and output levels. |

## TABLE 5

## COMPONENT MODULE, OPERATING CONTROLS AND INDICATORS

| Control or Indicator | Purpose or Use |
|---|---|
| COMPONENT Indicator | Lighted during the time the associated component gate is open. |
| RANGE Control | Permits full-scale range (gain) adjustment for the associated component. The resultant gain setting is in effect only when the associated component gate is open, and then only if the Amplifier Module AUTO/MAN switch is in the AUTO position. |
| MEMORY ZERO AND SPAN Controls | Used in conjunction with the Amplifier Module calibration voltage to calibrate the memory output signal (if used). |
| AUTO/OFF/CAL Switch | Controls the operational status of the respective Component Module. |
| AUTO Position | This position enables the normal operational mode of the module, in which the gate circuitry, the bargraph output, and the memory output are operational. |
| OFF Position | In this position, the bargraph output and all gate functions are inoperative, and memory holds the last value and is allowed to update. |
| CAL Position | Used in conjunction with the AUTO/CAL switch on the Amplifier Module to calibrate the Component Module RANGE and MEMORY ZERO AND SPAN. |
| RESET Pushbutton | Used in conjunction with the memory calibration to reset the memory output to the baseline. |
| GATE Adjustments | Permit setting the starting time and duration of the associated component gate. |
| COARSE Thumbwheel Switches | Permit selection of gate "start" time in one-second increments from 0 to 99 seconds following sample inject. |

TABLE 5 (Cont.)

| Control or Indicator | Purpose or Use |
|---|---|
| FINE Control | Permits the gate "start" time to be delayed from 0 to 2 seconds beyond the setting of the COARSE thumbwheel switches. |
| DURATION Control | Permits vernier selection of gate duration from 0 to 10 seconds. |
| GND and OUT Jacks | Meter/scope test points for externally monitoring the memory output. |

## TABLE 6

## VALVE MODULE, OPERATING CONTROLS AND INDICATORS

| Control or Indicator | Purpose or Use |
|---|---|
| ON Indicator | Indicates power is applied to the actuating solenoid. |
| AUTO/OFF/MAN Switch | Controls the operational mode of the associated valve. |
| AUTO Position | In AUTO, the valve is actuated automatically at the times set on the ON-OFF/TIME thumbwheel switches. |
| OFF Position | The valve solenoid is de-energized. |
| MAN Position | The valve solenoid is energized. |
| AUTO ZERO Indicator | Indicates occurance of the respective Auto Zero function. |
| AUTO ZERO ON/TIME Thumbwheel Switches | Permits selection of an Auto Zero "start" time, in one-second increments, from 0-99 seconds following sample inject. |
| Valve ON/TIME Thumbwheel Switches | Permit selection of the ON (solenoid energized) starting time in one-second increments, from 0-99 seconds following sample inject. |
| VALVE Control | Permits the valve ON starting time to be delayed from 0 to 2 seconds beyond the setting of the valve ON/TIME thumbwheel switches. |
| Valve OFF/TIME Thumbwheel Switches | Permits selection of the OFF (solenoid de-energized) starting time, in one-second increments, from 0-99 seconds following sample inject. |
| VALVE OFF Control | Permits the valve OFF starting time to be delayed from 0 to 2 seconds beyond the setting of the valve OFF/TIME thumbwheel switches. |

TABLE 7

DUAL PREAMP MODULE, OPERATING CONTROLS AND INDICATORS

| Control or Indicator | Purpose or Use |
|---|---|
| Toggle Switch | The toggle switch selects one or the other of two detector bridge preamplifier circuits to be monitored on the balance meter. |
| Balance Meter | A 1-0-1 volt meter which is used in balancing the selected detector bridge/preamplifier circuit. |
| DET. BAL. Controls | Adjusts the balance of the respective detector bridge/preamplifier circuit. |
| Preamplifier Test Jacks | Meter/scope test points for monitoring the indicated preamplifier parameters. |
| Terminal Strips | Provide connections for respective detector leads. |

## C. PORTABLE HYDROCARBON DETECTORS

### 1. Introduction

The Aberdeen Plant has three portable hydrocarbon detectors. These devices are used to monitor vessels prior to entry, to monitor areas for the presence of vinyl chloride and to precisely locate leakage sources when leaks occur.

The devices which are in use are:

Century Portable Organic Vapor Analyzers
Model OVA-98

They are manufactured by:

Century System Corporation
P. O. Box 133
Arkansas City, Kansas 67005

The Century Model OVA-98 device uses hydrogen flame ionization detection to measure trace quantities of organic materials in air. It has a single logarithmic scale readout from 1 to 1000 ppm. This device is verified by the manufacturer to be accurate to within 10 ppm as is required by the standard. The flame ionization detector is an almost universal detector for organic compounds with the sensitivity to analyze for them in the parts per million range (v/V) in air in the presence of moisture, nitrogen oxides, carbon monixide and carbon dioxide.

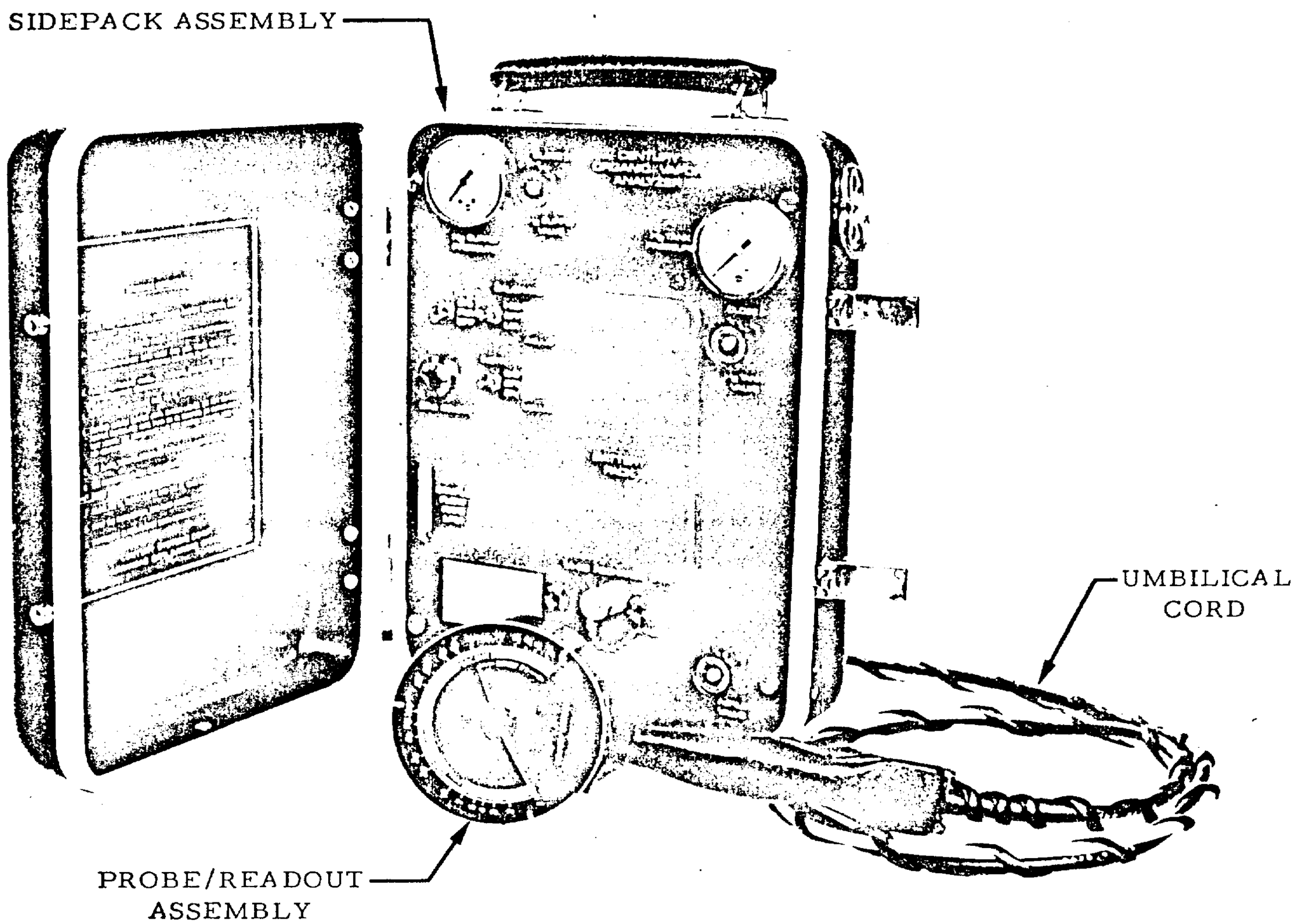
The instrument has broad application, since it has a continuous chemically resistant air sampling system, and can be readily calibrated to measure almost all organic vapors.

### 2. Description and Leading Particulars

#### General

The Century Portable Organic Vapor Analyzer (OVA), illustrated in Figure 1-1, is designed to detect and measure hazardous gases.

The instrument utilizes the principle of hydrogen flame ionization for detection and measurement of organic vapors. The instrument measures organic vapor concentration by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has previously been calibrated. During operation, a continuous sample is drawn into the probe and transmitted to the detector chamber by an internal pumping system. The




PORTABLE ORGANIC VAPOR ANALYZER

Figure 1-1

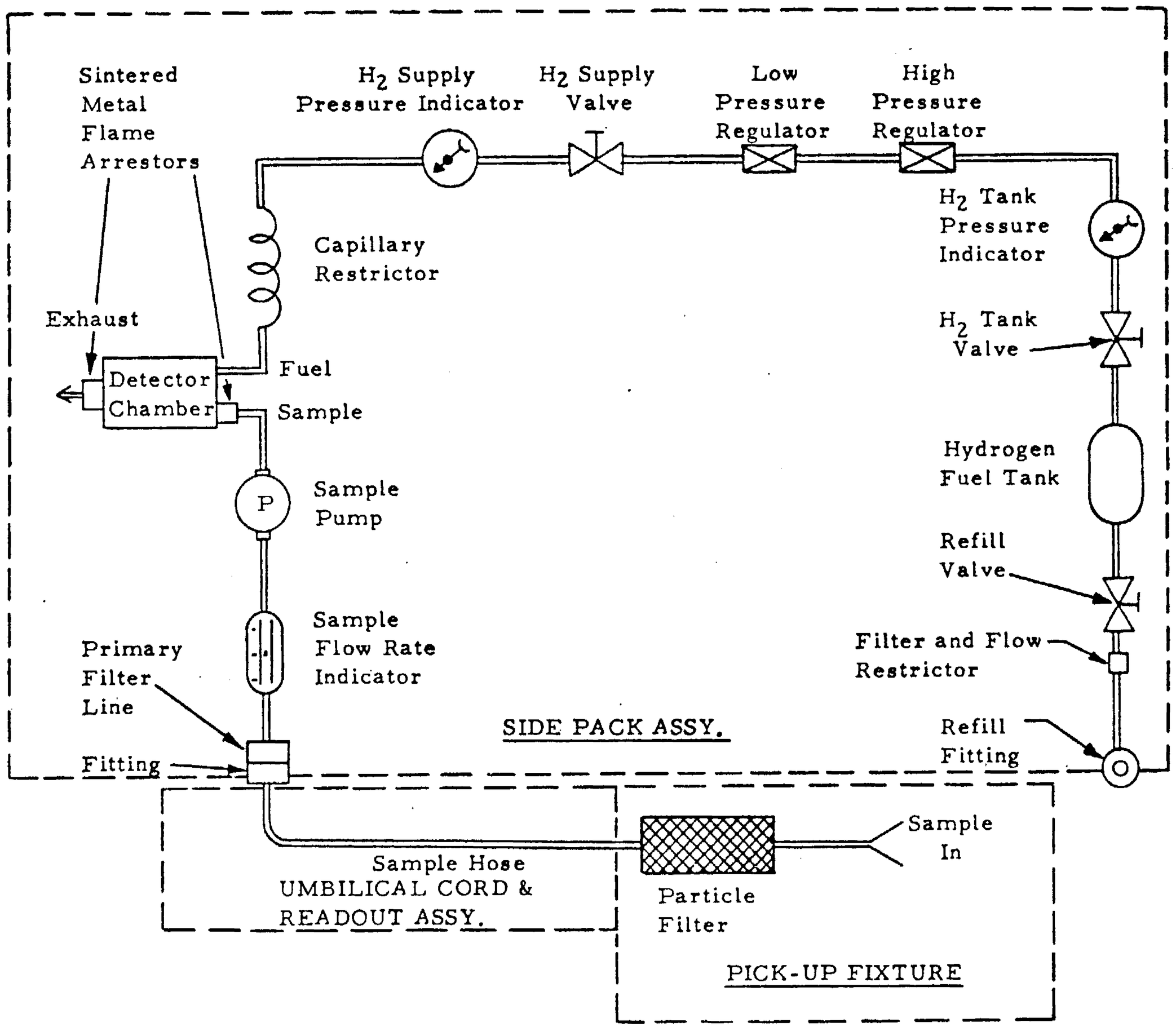



FIGURE A-1
Flow Diagram - Gas Handling System

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sample flow rate is metered and passes through particle filters before reaching the detector chamber. Inside the detector chamber, the sample is exposed to a hydrogen flame which ignites the combustible gases. When most organic vapors burn, they leave positively charged carbon containing ions which are collected by a negative collecting electrode in the chamber. An electric field exists between the conductors surrounding the flame and the collecting electrode which drives the ions to the collecting electrode. As the positive ions are collected, a current corresponding to the collection rate is generated on the input electrode. This current is measured with a logarithmic electrometer preamplifier which has an output signal proportional to the log of the input or ionization current. A signal conditioning amplifier is used to amplify the signal from the preamp and to condition it for subsequent meter or external monitor display. The meter display is an integral part of the Probe/Readout Assembly and can display a range of 1 to 1,000 ppm.

Typical Applications

(1) Measurement of most toxic organic vapors present in industry for compliance with Occupational Safety and Health Administration (OSHA) requirements.
(2) Survey of gas distribution and transmission lines and equipment for compliance with Office of Pipeline Safety (OPS) requirements.
(3) Various measurement and monitoring applications in the air pollution field.
(4) Leak detection in gas handling equipment.
(5) Detecting explosive-level gas conditions in indoor and outdoor locations.
(6 Measurement of methane in underground mines.

Other Typical Uses

(1) Controlling and monitoring atmospheres in manufacturing and packaging operations.
(2) Mudlogging, gas and mineral exploration.
(3) Lead detection related to volatile fuel handling equipment.

Major Features

The instrument consists of two major assemblies, the Probe/Readout Assembly and the Side Pack Assembly (see Figure 1-1). The output meter and alarm level adjustment are incorporated in the Probe/Readout Assembly which is operated with one hand. The Side Pack Assembly contains the remaining operating controls and indicators, the electronic circuitry, detector chamber, hydrogen fuel supply and electrical power supply. It is a quantitative type instrument with sensitivity to 1 ppm methane and readout capabilities from 0.0001% (1 ppm) to 0.1% cencentration by volume of methane in air.

Other major features are: 250° logarithmically scaled readout, internal electronic calibration, less than two second response time, and minimum eight hour service life for fuel supply and battery pack. Internal two point electronic calibration is provided for checking the instrument

and supply reference signals for setting up the gas select adjustment. A battery test feature allows charge condition to be read on the meter. Hydrogen flame-out is signified by an audible alarm plus a visual indication on the meter. The instrument contains a frequency modulated detection alarm which can be pre-set to sound at a desired concentration level. The frequency of the detection alarm varies as a function of detected level giving an audible indication of organic vapor concentration. The instrument is designed for one man, one hand operation and the entire unit weighs a total of less than 12 pounds, including fuel supply and battery. An earphone is provided for "only operator" monitoring.

During use, the Side Pack Assembly can be carried by the operator on either his left or right side or as a back pack. The Side Pack Assembly is housed in a high impact plastic case 8-5/8 inches wide, 11-5/8 inches long, and 4-1/4 inches deep and weighs only 10 pounds. The Probe/Readout Assembly can be detached from the Side Pack Assembly and broken down for transport and storage. See Figure 1-2 for the breakdown capability of the instrument.

## Adaptability Features and Accessories

### General

Maximum flexibility and operability features are included in the instrument design. As shown in Figure 1-2, a variety of pickup fixtures can be used. They can be installed by simply turning a knurled locking nut. Small diameter tubing can be used for remote sampling and electrically insulated flexible extensions can be used for difficult places to reach.

### Probe

The telescoping probe allows the length to be increased or decreased over an eight inch range to suit the individual user. A knurled locking nut is used to lock the probe at the desired length. The probe is attached to the Readout Assembly, using a knurled locking nut. For measurements in close areas, the probe is left completely off and only the compact Readout Assembly carried.

### Particle Filters

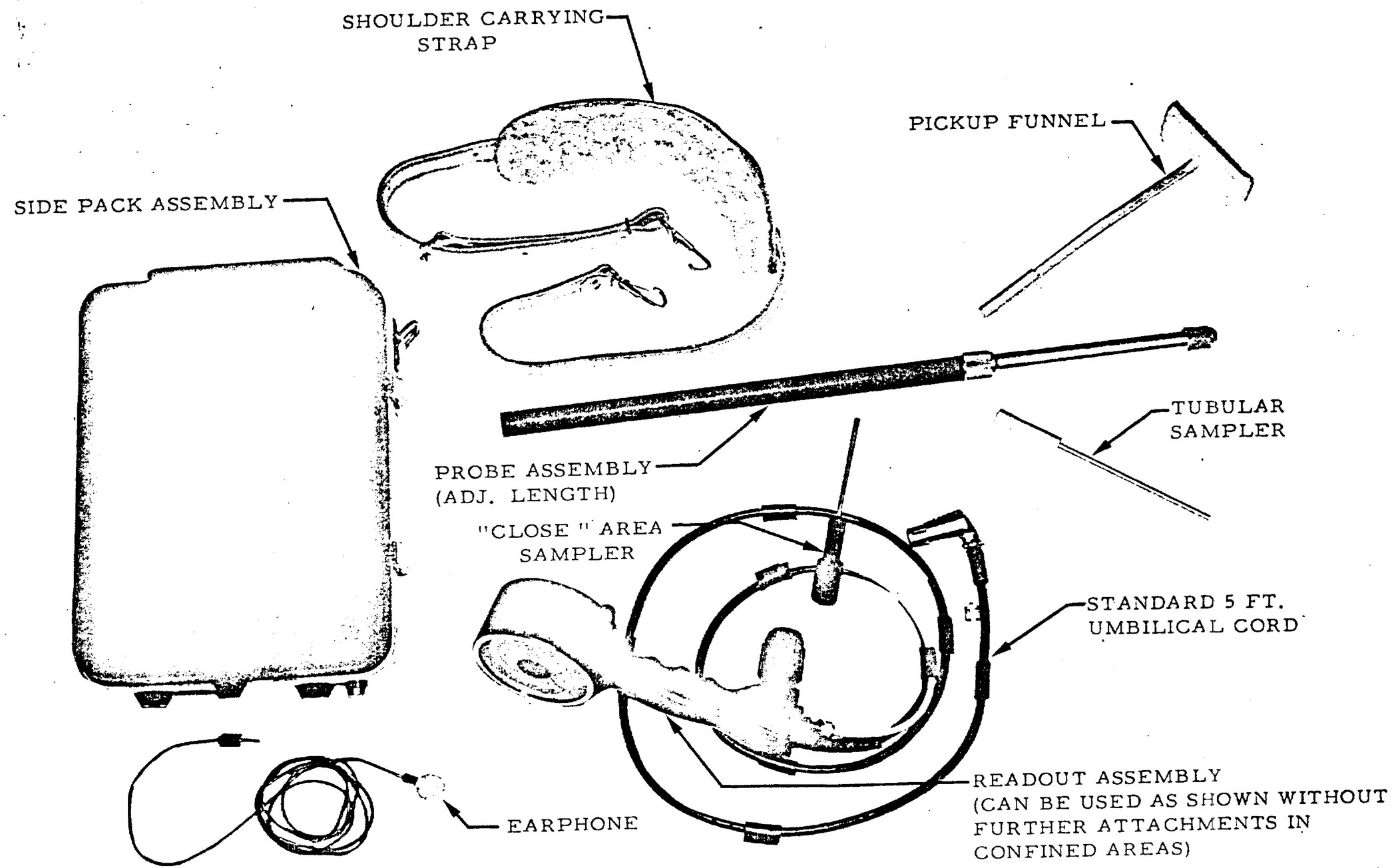
The primary filter is of porous stainless and located behind the sample inlet connector.

### Instrument Carrying Case

An instrument carrying case is provided to transport, ship, and store the disassembled Probe/Readout Assembly, the Side Pack Assembly, and other standard equipment.

## Specifications

| | |
|---|---|
| Sensitivity: | 1 ppm (methane) |
| Response time: | Less than 2 seconds |
| Readout: | 250° logarithmic scaled meter, various scales in the range of 1-1,000 ppm. External monitor connector. |
| Sample flow rate: | Nominally 2 liters per minute. |
| Fuel supply: | 75 cubic centimeter tank of pure hydrogen at maximum pressure of 2300 PSIG, fillable while in case. |
| Primary electrical power: | Rechargeable and replaceable battery pack, at 12 VDC. |
| Service life: | Hydrogen supply and battery power - 8 hours operating time minimum. |
| Size: | Side Pack Assembly - 8-5/8" wide X 11-5/8" long X 4-1/4" deep.<br>Probe/Readout Assembly - variable. |
| Weight: | Side Pack Assembly - less than 10 pounds.<br>Probe/Readout Assembly - less than 2 pounds. |
| Operator requirements: | One man, one hand operation. |
| Detection alarm: | Frequency modulated audible alarm. Can be pre-set to desired level. Frequency varies as a function of detection level. |
| Flame-out indication: | Audible alarm plus visual meter indication. |
| Battery test: | Battery charge condition indicated on readout meter or battery recharger. |
| Pickup fixtures: | Variety of types for various applications. |




INSTRUMENT DISASSEMBLED

FIGURE 1-2

| | |
|---|---|
| Probe: | Telescoping adjustment over 8 inches or probe can be completely removed from Readout Assembly. |
| Umbilical cord: | Five (5) feet long with connectors for electrical cable and sample hose. |
| Filtering: | In-line disposable and permanent particle filters. |
| Side pack case: | Molded high impact plastic case with carrying handle and shoulder strap. |
| Electrical protection: | Resistive current limiting to intrinsically safe level followed by power overload fuses, all components potted in battery pack assembly. |
| Standard accessories: | 1. Instrument carrying storage case.<br>2. Fuel filling hose assembly.<br>3. A.C. battery charger. |

## 3. Detailed Operating Procedures

### General

The procedures in this section are broken into five parts: (1) Starting, (2) Operating, (3) Shutdown, (4) Fuel Refilling, and (5) Battery Charging. After familiarization with the instrument, the summarized procedures described in Section 3 may be used for simplicity.

### Systems Controls, Indicators, and Connectors

Tables 2-1 and 2-2 describe the functions of the various controls, indicators, and connectors illustrated in Figure 2-1.

TABLE 2-1

SIDE PACK ASSEMBLY

| Controls/Indicators | Function |
|---|---|
| 1. INSTR/BATT TEST Switch | This 3 position toggle switch turns on all instrument electrical power except the pump and alarm power and also permits display of the battery charge condition on the readout meter. |
| 2. PUMP (ON-OFF) Switch | This toggle switch turns on power to the internal pump and audio alarms. |
| 3. IGNITER Switch | This momentary push button switch connects power to the igniter coil in the detector chamber and simultaneously disconnects power to the pump. |
| 4. CALIBRATE Switch | This 3 position toggle switch introduces the HIGH or LOW calibration signal currents. |
| 5. CALIBRATE Knob | This potentiometer adjusts the instrument electronic calibration. |
| 6. RECHARGER Connector | This BNC connector is used to connect the battery pack to the battery recharger assembly. |
| 7. $H_2$ TANK VALVE | This valve is used to supply or close off the fuel supply from the hydrogen tank. |
| 8. $H_2$ TANK PRESSURE Indicator | This high pressure gauge measures the pressure in the hydrogen fuel tank which is an indication of fuel supply. |

| | | |
|---|---|---|
| 9. | $H_2$ SUPPLY VALVE | This valve is used to supply or close-off the hydrogen fuel to the detector chamber. |
| 10. | $H_2$ TANK PRESSURE Indicator | This low pressure gauge is used to monitor the hydrogen pressure at the capillary restrictor. |
| 11. | SAMPLE FLOW RATE Indicator | This indicator is used to monitor the sample flow rate. |
| 12. | REFILL Connection | This 1/4" AN fitting is used to connect the hydrogen refill hose to the instrument. |
| 13. | REFILL VALVE | This valve is used to open one end of the instrument fuel tank for refilling with hydrogen. |

TABLE 2-2

PROBE/READOUT ASSEMBLY

| Controls/Indicators | Function |
| --- | --- |
| Meter | This 250° logarithmically scaled meter displays the output signal level in ppm or percent. |
| ALARM LEVEL ADJ | This potentiometer is used to set the vapor detection level at which the audible alarm is actuated. |

Starting Procedure

Initial Preparation for Use

Initial Assembly (Reference Fig. 1-2)

a. Normal Survey Configuration

1. Connect the adjustable length probe to the Readout Assembly with the captive locking nut. Ensure that the probe is seated firmly in the Readout Assembly.
2. Select the desired pickup fixture and check that a particle filter is installed.
3. Connect the pickup fixture to the probe using the knurled locking nut.
4. Connect the umbilical cord and sample hose to the Side Pack Assembly.

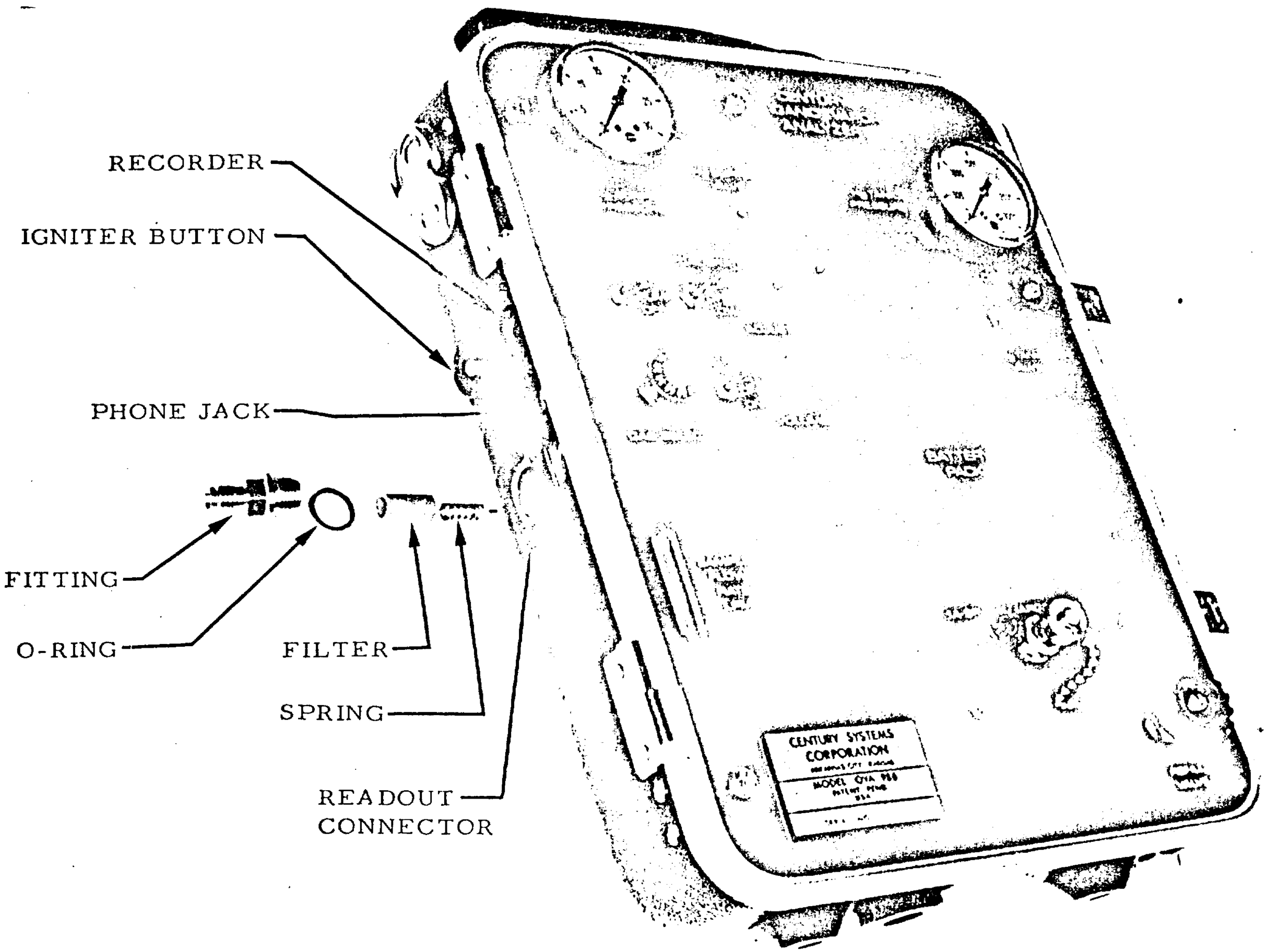
b. "Close Area" Survey Configuration

1. Check to ensure that a particle filter is installed in the close area sampler.
2. Connect the close area sampler directly to the Readout Assembly.
3. Connect the umbilical cord and sample hose to the Side Pack Assembly.

Servicing

a. Fueling

Pure, dry hydrogen can normally be purchased locally. The maximum instrument supply bottle pressure is 2300 PSIG. A high pressure hydrogen filling hose assembly is provided with the instrument. This assembly includes the proper fittings for the instrument and supply bottle, and a three-way fill/bleed valve. Initial fueling and subsequent refilling using the Century high pressure filling hose should be accomplished in accordance with the detailed instructions described later in this manual.




INSTRUMENT CONTROLS AND INDICATORS
Figure 2-1

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b. Battery Check

Move INSTR/BATT TEST switch to the BATT TEST position and insure battery is charged by reading the indication on the readout meter.

c. Calibration

Standard factory calibration is performed using methane in air.

## Safety Precautions

Certain safety precautions must be followed in using the instrument. Hydrogen gas, when mixed with air, is highly flammable. Operating and refueling instructions should be strictly followed to ensure safe, reliable operation.

## Turn On Procedure

The GAS SELECT control should be pre-set to the desired dial indication prior to turn-on. The procedure for determining this setting is described later.

a. Move the INSTR Switch to ON and allow one minute for warm-up.
b. To set the audible alarm to a predetermined level, first turn the pump switch to ON, then adjust the meter pointer to the desired level, using the CALIBRATE knob. Turn the ALARM LEVEL ADJ on the back of the Readout Assembly until the audible alarm just comes on. The instrument is then pre-set to activate the alarm when the level exceeds that of the setting.
c. Move the CALIBRATE Switch to HIGH and check that the meter reads full scale. If not, adjust meter reading to full scale with the CALIBRATE knob.
d. Move CALIBRATE Switch to LOW and verify that the meter reads 10 ppm for the OVA-98.
e. Move the PUMP switch to ON and observe the SAMPLE FLOW RATE indicator. Indication should be approximately 2 liters per minute. Note the audible flame out alarm will not be on until the $H_2$ flame is ignited (step h below).
f. Open $H_2$ TANK VALVE 1/2 turn and observe the reading on the $H_2$ TANK PRESSURE Indicator. Approximately 150 psi of pressure is needed for each hour of operation.
g. Open $H_2$ SUPPLY VALVE 1/2 turn ad observe the reading on the $H_2$ SUPPLY PRESSURE indicator.
h. Press IGNITER switch. There will be a slight "pop" as the hydrogen ignites and the meter pointer will move upscale and return to a position upscale of 1 ppm. Immediately after ignition, release the IGNITER button. After ignition, the audible flame out alarm will go off.
i. Adjust speaker volume with VOLUME knob. If earphone is used, plug in and readjust the volume.

CAUTION

Do not leave $H_2$ SUPPLY VALVE open when the pump is not running, as this will allow a large concentration of hydrogen to accumulate in the detector chamber.

i. After chamber ignition, allow approximately one minute for the chamber to reach operating temperature. After warm-up, the meter will read the organic vapor level present.
j. If the alarm level is to be set above the normal background detection level, turn the ALARM LEVEL ADJ until it actuates slightly above background.

THE INSTRUMENT IS NOW READY FOR USE.

Operating Procedures

a. Using one hand operation, survey the areas of interest while observing the meter and/or listening for the organic vapor audible alarm indication. For ease of operation, carry the Side Pack Assembly positioned on the side opposite the hand which holds the Probe/Readout Assembly. For broad surveys outdoors, the pickup fixture should be positioned several feet above ground level. When making quantitative reading or pinpointing, the pickup fixture should be positioned at the point of interest.
b. When organic vapors are detected, the meter pointer will move upscale and the audible alarm will sound when the pre-set point is exceeded. The frequency of the audible alarm will increase as the detection level increases.
c. If the FLAME OUT alarm is actuated, ensure that the pump is running, then press the IGNITER button. Under normal conditions, flame out results from sampling a gas mixture that is above the lower explosive level which causes the $H_2$ flame to extinguish. If this is the case, re-ignition is all that is required to get back in operation.

Another possible cause for flame out would be restriction of the sample flow line which wuld not allow sufficient air into the chamber to support combustion of the $H_2$ flame. The normal cause for such restriction would be a clogged particle filter or other restriction in the line.

It should be noted that the chamber exhaust port is on the bottom of the case and blocking this port with the hand will cause fluctuations and/or flame out.

Shut-Down Procedure

The following procedure should be followed for shut-down of the instrument:

1. Close $H_2$ SUPPLY VALVE.
2. Close $H_2$ TANK VALVE.
3. Move INSTR switch to OFF.
4. Wait 5 seconds and move PUMP switch to OFF.

## Fuel Refilling

a. The instrument should be completely shut down as described previously during hydrogen tank refilling operations. The refilling should be done in a ventilated area. There should be no potential igniters or flame in the area being used.

b. If you are making the first filling of the instrument or if the filling hose has been allowed to fill with air, the filling hose should be purged with $N_2$ or $H_2$ prior to filling the instrument tank. This purging is not required for subsequent fillings.

c. The filling hose assembly should be left attached to the hydrogen supply tank. Ensure that the FILL/BLEED valve on the instrument end of the hose is in the OFF position. Connect the hose to the REFILL connection on the Side Pack Assembly.

d. Open the hydrogen supply bottle valve slightly. Open the REFILL VALVE and the $H_2$ TANK VALVE on the instrument panel and place the FILL/BLEED valve on the filling hose assembly in the FILL position. The pressure in the instrument tank will now be indicated on the $H_2$ TANK PRESSURE gauge.

e. After the instrument fuel tank is filled, shut off the REFILL VALVE on the panel, the FILL/BLEED valve on the filling hose assembly, and the hydrogen supply bottle valve.

f. The hydrogen trapped in the hose should now be bled off to atmospheric pressure. CAUTION should be used in this operation as described in step g below, since the hose will contain a significant amount of hydrogen at high pressure.

g. The hose is bled by turning the FILL/BLEED valve on the filling hose assembly to the BLEED position. After the hose is bled down to atmospheric pressure, the FILL/BLEED valve should be turned to the FILL position to allow the hydrogen trapped in the connection fittings to go into the hose assembly. Then, again, turn the FILL/BLEED valve to the BLEED position and exhaust the trapped hydrogen. Then turn the FILL/BLEED valve to OFF to keep the hydrogen at one atmosphere in the hose so that at the time of the next filling, there will be no air trapped in the filling line.

h. Close the $H_2$ TANK VALVE.

i. With the $H_2$ TANK VALVE and the $H_2$ SUPPLY VALVE closed, a small amount of $H_2$ at high pressure will be present in the regulators and plumbing. As a leak check, observe the $H_2$ TANK PRESSURE indicator while the remainder of the system is shut down and ensure that the pressure indication does not go down rapidly, indicating a significant leak. If it does decrease rapidly (greater than 350 PSIG/hr.), there is a significant leak in the $H_2$ supply system.

## Battery Recharging

### AC Battery Charger

a. Plug charger BNC connector into mating connector on battery cover and insert AC plug into 115 VAC wall outlet.

b. Move the battery charger switch to the ON position. The light above the switch button should illuminate.

c. Battery charge condition is indicated by the meter on front panel of charger; meter will deflect to the right when charging. When fully charged, the pointer will be in line with "charged" marker above the scale.

d. Approximately one hour of charging time is required for each hour of operation. However, an overnight charge is recommended, since the charger can be left ON indefinitely without damaging the batteries. When finished, move the battery charger switch to OFF and disconnect from the side pack assembly.

## 4. Summarized Operating Procedures

### General

The procedures presented in this section are intended for use by personnel generally familiar with the operation of the instrument.

It is assumed that, prior to start-up, the positions of all switches and valves are in shut-down configuration as described below.

### Start-Up

1. Move pump switch to on and check battery condition with the battery test switch.
2. Move instr switch to on and allow five (5) minutes for warm-up.
3. Check calibration with high and low calib switch. End check by going to high position and then to off.
4. Place instrument panel in vertical position and check sample flow rate indication.
5. Open the $H_2$ tank valve, and the $H_2$ supply valve.
6. Depress igniter button until burner lights. Do not depress igniter button for more than six (6) seconds. (If burner does not ignite, let instrument run for several minutes and re-try ignition.)
7. Set alarm threshold knob on readout to desired level.
8. The instrument is now ready for use.

### Shut-Down

1. Close the $H_2$ supply valve and the $H_2$ tank valve.
2. Move the instr switch, and pump switch to off.
3. Instrument is now in shut-down configuration.

## 5. Safety Considerations

### General

All flame ionization hydrocarbon detectors are potentially hazardous since they use Hydrogen ($H_2$) or $H_2$ mixtures as their fuel. Mixtures of $H_2$ and air are flammable over a wide range concentrations whether an inert gas such as Nitrogen ($N_2$) is present or not. Therefore, the recommended precautions and procedures should be followed for maximum safety. Safety considerations were a major consideration in the design of the Organic Vapor Analyzer (OVA). For example, the entire $H_2$ system is "hard" plumbed containing no flexible tubing and all connectors are of the permanent type as opposed to quick disconnect.

To protect against external ignition of flammable gas mixtures, the flame detection chamber has porous metal flame arrestors on both the sample input and the exhaust ports. The standard battery pack has internal current limiting to an intrinsically safe level and also includes fuses for overload protection.

Fuel Supply and Tank

The OVA fuel tank has a volume of 75 to 85 cc which, when filled to the maximum rated pressure of 2300 PSI, holds approximately 5/8 cubic foot of gas. The fuel used in the OVA is pure $H_2$ which can be readily purchased in a highly pure form at nominal cost. The $H_2$ tanks used in the instrument are made from stainless steel, proof-tested to 6,000 PSI and 100% production tested to 4600 PSI.

$H_2$ Flow Restrictors

Hydrogen gas gains heat when expanding and, therefore, should not be rapidly released from a high pressure tank to a low pressure environment. A flow restrictor is incorporated in the $H_2$ refill fitting and $H_2$ is restricted on the output side of the tank by the low flow rate control system. In addition, a special flow restrictor is incorporated in the fill/bleed valve of the hydrogen filling hose assembly. These precautions to limit the flow rate of the $H_2$ remove the possibility of self-ignition of the $H_2$ due to self-heat either through expansion or ignition from frictional heating.

Detector Chamber

The OVA has a small (0.33 $in^3$) flame ionization chamber cavity with sintered metal flame arrestors on both the input and output ports. The chamber is ruggedly constructed out of teflon such that even if highly explosive mixtures of $H_2$ and air are inadvertently created in the chamber and ignited, the chamber would not rupture. One condition that could create this possibility would exist if the $H_2$ fuel was turned on to the chamber and the sample input line restricted allowing a high 20% to 50% mixture of $H_2$ and air in the chamber at the time of ignition.

$H_2$ Filling And Emptying Operations

Precautions should be takne during $H_2$ filling or $H_2$ tank emptying operations to insure that there are no sources of ignition in the immediate area. Since the instrument tank at 2300 PSI holds only 5/8 $ft^3$ of $H_2$, the total quantity if released to the atmosphere would be quickly diluted to a non-flammable level. There is, however, the possibility of generating flammable mixtures in the immediate vicinity of the instrument during the filling or emptying operations if normal care is not exercised.

Venting

The OVA case is vented to eliminate the possibility of trapping an explosive mixture of $H_2$ and air inside the case.

## Short Circuit Protection

The battery pack has two (2) power circuits, one for the pump motor and igniter and the other for the electronic circuits. Both circuits have resistive current limiting to restrict the short circuit current to an intrinsically safe level. In addition to the current limiting, there is a fuse in each line to protect against overload conditions.

A

# LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

## D. CALIBRATION AND MAINTENANCE PROCEDURES - CONTINUOUS MONITORING SYSTEM

### 1. Calibration:

#### a. General

The Honeywell continuous monitors are each calibrated and spanned once per week. This is more often than is necessary to retain accuracy based on our extensive experience with the units and based upon our conversations with the equipment manufacturers. If the EPA desires more frequent spanning and calibration, which would serve no useful purpose, we ask for data to support the need for the frequency the EPA desires, and the specific frequency to be followed.

#### b. Calibration Procedure

1. Pre-calibration equipment checks (information as noted is recorded on "Daily Checklist" at the end of this section).
   a. Visually check strip chart recorder for proper operation.
   b. Visually check the control panels for the following settings:
      1. Monitor panel "on"
      2. Sequence panel in "auto" setting
      3. Amplifier panel in "auto" setting
      4. Dual valve panel in "auto" setting
      5. Dual component panel in "auto" setting
      6. Stream panel showing the proper sequence of stream sampling.
   c. Record the following data (all recorded on "Daily Checklist").
      1. Air cylinder pressure, high
      2. Air cylinder pressure, low
      3. Air usage per day (today's pressure reading subtracted from yesterday's' an abnormally high reading indicates possible system leaks which would need correction prior to calibration).
      4. Nitrogen cylinder pressure, high
      5. Nitrogen cylinder pressure, low
      6. Nitrogen usage per day
      7. Hydrogen cylinder pressure, high
      8. Hydrogen cylinder pressure, low
      9. Hydrogen usage per day
   d. Insure that pump is operating normally (record on "Daily Checklist").
   e. Check to see if flame is on (record on "Daily Checklist")
   f. Check the oven temperature to insure that it is correct. (Record on "Daily Checklist").
   g. Make sure that gates 1 through 10 are operating correctly (record on "Daily Checklist").
   h. Check the oven parameters: temperature, air pressure, air flow.

2. Calibration (record data for each of the four units on "Honeywell Continuous Monitor Calibration Report" at end of this section).

   a. Shut off regular sample flow.
   b. Open flow line of standard gas until flow meter indicates proper flow rate (5 cc/min.).
   c. Change the sequencer panel setting from "auto" to "gate".
   d. After the peaks on the strip chart line out for the standard gas reading, do the following:

      1. change the sequencer panel setting to "spectrum".
      2. change the amplifier panel setting from "auto" to "auto zero" to insure correct timing between peaks.
      3. when peak timing is seen to be stable, do the following on the sequencer panel: set the "auto" and "auto zero" switches to "calib"; also do the following to the dual component panel: change the setting to "calib".
      4. adjust the FID setting and the range setting.
      5. reset the sequencer panel to "auto" and "auto zero".
      6. reset the dual component panel to "auto".
      7. if the resulting peak registers 10 ppm for the 10 ppm standard gas, the calibration is finished;
      8. if the resulting peak does not register 10 ppm, change the sequencer switches from "auto" to "calib" and from "auto zero" to calib; also reset the dual component panel on "calib".
      9. repeat steps (4) through (7) above.

3. Post-Calibration Procedure

   a. Check the panel settings to insure they are as described below:

      1. sequence panel in "auto" setting.
      2. amplifier panel set on "auto".
      3. dual component panel set on "auto".

   b. Make the following notations on the strip chart as an additional record that calibration has been accomplished:

      1. date
      2. time
      3. calibration span (must be 10 ppm)
      4. calibrator's initials

   c. Shut off standard gas flow line.

   d. Open normal sample flow line.

# HONEYWELL CONTINUOUS MONITOR
# CALIBRATION REPORT

Date_____

| Gas Chromatograph Location | Range PPM | Span Gas Concentration (ppm) | Reading With Span Gas Prior to Calibration (ppm) | Reading With Span Gas After Calibration (ppm) | Calibration Checked by | Comments |
|---|---|---|---|---|---|---|
| | 1._____<br>2._____ | | | | | |
| | 1._____<br>2._____ | | | | | |
| | 1._____<br>2._____ | | | | | |
| | 1._____<br>2._____ | | | | | |

| Cylinder Pressure | |
|---|---|
| Nitrogen | 1. |
| | 2. |
| Hydrogen | 1. |
| | 2. |
| Air | 1. |
| | 2. |
| STD | 1. |

## CALIBRATION

1. Close sample valve and open standard gas valve.
2. Run STANDARD Gas until reading stablizes-4 to 5 analysis.
3. If STANDARD is reading incorrectly record and adjust as follows.
4. Set the Amplifier Module **Auto zero/off** switch to the centered position.
5. Set sequencer Module **MODE** switch to **MAN.**
6. Set **Auto/off/cal** switch on component module to **CAL.**
7. Set amplifier module **Auto/Cal** switch to **CAL.**
8. Adjust amplifier **Range Calibrate** control to produce the same recorder reading as the standard produced on the last analysis.
9. Adjust the **Range** control screws on the component module to make the recorder out put read the correct valve for the standard.
10. Return all switches to their normal auto position and run the standard gas. Record the STD reading.

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A

# LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

## D. CALIBRATION AND MAINTENANCE PROCEDURES - CONTINUOUS MONITORING SYSTEM

### 2. Maintenance

a. Preventive Maintenance Schedule and Procedure

Preventive maintenance includes the following procedure:

1. Check the air flow through the sample lines and the vacuum pump operation.
2. Check the gas bottles for adequate pressure (includes bottles of air, $H_2$, $N_2$); make sure backup supply cylinders are always present.
3. Check the pressure in the VCM standard cylinder. Standard is 10 ppm VCM.
4. Check the combustion flame for proper appearance.
5. Make sure oven temperature is correct.
6. Check the air pressure to valves.
7. Examine the recorder to insure that:
   a. each sample point is represented on the chart;
   b. cycle times are correct.
8. Check the sample switching valves operation.
9. Check the sampling station lights to insure correct electronic operation of the system.
10. Take hourly readings from the strip charts to spot any problem developing during the day. These readings are recorded, for each of the Honeywell units, on the "Continuous Monitoring Log Sheets" at the end of this section.

The preventative maintenance procedure is followed every week day. The attached preventative maintenance checklist is completed at the time of the check.

b. Corrective Maintenance Procedure

When a malfunction occurs, the following troublshooting procedure is first followed:

1. Check the flame ionization cell for the voltage reading (should be -100 V DC); also check cleanliness of flame tip, and see if igniter is open.
2. Check preamplifier.
3. Check amplifier input and output.
4. Check recorder input and output.
5. Examine power supply.
6. Check sequencer to see if sample streams are being sampled in proper order.
7. Check stream selector to see if sample inlet solenoid valves are operating properly.
8. Check stream selector cards and dual component cards with the test module card, to see if threshold voltage of the IC chip cells is correct.

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DAILY CHECK LIST HONEYWELL LOCATION _____

| | | MON. | TUES. | WED. | THURS. | FRI. | SAT. | SUN. |
|---|---|---|---|---|---|---|---|---|
| AIR PRESSURE | HIGH A | | | | | | | |
| RECORD # | HIGH B | | | | | | | |
| | LOW A | | | | | | | |
| | LOW B | | | | | | | |
| NITROGEN PRESSURE | HIGH A | | | | | | | |
| RECORD # | HIGH B | | | | | | | |
| | LOW A | | | | | | | |
| | LOW B | | | | | | | |
| HYDROZED PRESSURE | HIGH A | | | | | | | |
| RECORD # | HIGH B | | | | | | | |
| | LOW A | | | | | | | |
| | LOW B | | | | | | | |
| STANDARD GAS # | HIGH | | | | | | | |
| MP | A RUNNING | | | | | | | |
| | B RUNNING | | | | | | | |
| FLAME ON OVEN TEMPERATURE °C | | | | | | | | |
| CHECK GATE AND ADJ. AS NEEDED | | | | | | | | |
| check sample flow on | #1 | | | | | | | |
| | #2 | | | | | | | |
| | #3 | | | | | | | |
| | #4 | | | | | | | |
| | #5 | | | | | | | |
| | #6 | | | | | | | |
| | #7 | | | | | | | |
| | #8 | | | | | | | |
| | #9 | | | | | | | |
| | #10 | | | | | | | |

CHECK ALL SAMPLE POINT FILTERS ONCE PER WEEK.

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b. Corrective Maintenance Procedure (Cont.)

If the above procedure fails to pinpoint the cause of the malfunction, a more detailed troubleshooting procedure must be followed. This procedure is now discussed in detail, as is the repair procedure.

The Model 1000 PGC is specifically designed so that significant electrical and electronic levels can be readily monitored at front-panel test points, in the Control Section and in the Analyzer Section. Preamplifier test points, and the preamplifier "BALANCE" adjustment, are accessible by removing the threaded access plate in the front of the Analyzer's explosion-proof electronics housing. If required, the entire front of the housing can be removed to expose the Analyzer terminal strips for measurement of Analyzer input and output levels. The terminal strips and the printed circuit card rack can be removed by turning 1/4 turn fasteners.

An additional maintenance feature is the meter and function-selector switch on the front panel of the Monitor Module. This feature is especially valuable in monitoring the operation of the Chromatograph, and in troubleshooting the equipment.

Inasmuch as possible, the troubleshooting procedures are intended to fully utilize the modular design concept of the Honeywell Model 1000, and the front-panel test points provided in both the Control Section and the Analyzer Section. The primary objective of these procedures is to localize the problem, so that where possible, module substitution can be used to quickly return the equipment to proper operation.

Preliminary Checks

Before attempting to troubleshoot the equipment, make certain that the trouble is not caused by improper control settings or by some external condition. Confirm that all operating parameters are as specified. If a discrepancy is noted, refer to the appropriate troubleshooting chart in this section to further isolate the problem and to implement repairs.

Spectrum Interpretation

Operation of the equipment in the Spectrum mode is an effective means of troubleshooting the unit. Run several analyses in the spectrum mode to establish reproducibility, and interpret the results in accordance with Table 3.

Oven Heating System Troubleshooting

Refer to Table 9 for possible heater malfunctions and probable causes.

## Analyzer Leak Check

Leaks in the Analyzer plumbing are a common cause of many operational problems. A leak can cause insufficient sensitivity, poor reproducibility, excessive valve-switching transients, and overall system instability. If the equipment exhibits any of these malfunctions, the Analyzer should be leak checked as follows. If internal valve leakage is suspected, refer to the valve checkout procedures.

1. Apply carrier pressure to the Analyzer.
2. Plug all carrier gas vent lines.
3. Close valve at carrier gas supply and check that pressure drop on the carrier supply gauge is less than 0.5 pounds per hour. If pressure drop exceeds this rate, localize the leak by successively plugging the exit from each valve or column.

## Preamplifier Troubleshooting

Check that the preamplifier is operational by observing the preamp meter and varying the setting of the BAL (balance) adjustment potentiometer from side to side. The meter should move in a direction opposite the rotation of the BAL adjustment, and it should be possible to center the meter with this control.

If the meter indicates full-scale in either direction, adjustment can be simplified by placing a meter across the"+ BAL -" test points so that the effect of turning the BAL adjustment can be observed while setting the preamp 1-0-1 volt meter back within full scale. If the bridge will not balance, short out both detectors at the terminal strip on the preamp front panel, and again attempt to center the meter with the BAL adjustment. If the meter can be centered, a defective detector element is indicated.

If the meter cannot be centered, check from the ground test point to the + and - test points for +15 volts and -15 volts, respectively. The regulated ±15 volts is produced within the preamplifier from the ±20 volts supplied by the Control Section. If the ±15 volts is not present, check that the ±20 volts is present at the terminal strip in the upper portion of the explosion-proof housing.

## Detector Bridge Checkout

Proper operation of the detector bridge can be confirmed by monitoring the bridge current at the R-C-S test points on the preamplifier front panel, or at the R-C-M test points on the Dual Preamplifier. Use a 20,000 ohms per volt meter, or better, and measure from the common (c) test point to the R or M test point, and then the S test point. Each voltage reading, multiplied by three, provides the detector current. This value can be compared with the nominal detector current as stated on the Instrument Operational Parameters sheet. Some variation from the specified value may exist due to temperature variance, however, the two sides of the bridge should be equal.

Detector Bridge Checkout (Cont.)

As a further check, the resistance of each thermistor can be measured by turning the power off at the Control Section, and disconnecting the detector leads from the terminal stirp on the front of the preamp. Refer to the Instrument Operational Parameters sheet for the nominal resistance value at 25°C. Again, some variation from this value is acceptable due to temperature variance, however, the two thermistors should read the same.

Valve Checkout Procedures

1. Standard Valve (External Sample Loop)

   a. Connect four-way vlave to control ports (outer plates), and set air pressure to 32 psig.
   b. Connect supply gas line to port #1. Use of helium is recommended.
   c. Connect bubble tubes to ports #2 and #3.
   d. Plug port #4.
   e. Submerge bubble tubes in a beaker of water (down about 1/2").
   f. Set supply gas pressure to 100 psig.
   g. Port #2 should flow freely with the four-way valve in one position, and should not flow more than one bubble every 30 seconds with the valve in the other position.
   h. Port 3 should not pass more than one bubble every 30 seconds in either control position, however, momentary flow is permissable during the switching transient.
   i. Repeat steps 7 and 8 with the supply gas pressure set at 2 psig.
   j. Connect supply gas line to port #8.
   k. Connect bubble tubes to ports #6 and #7.
   l. Plug port #5.
   m. Submerge bubble tubes in a beaker of water.
   n. Set the supply gas pressure to 100 psig.
   o. Port #7 should flow freely with the four-way valve in one position, and should not flow more than one bubble every 30 seconds with the valve in the other position.
   p. Port #6 should not pass more than one bubble every 30 seconds in either control position, however, momentary flow is permissable during the switching transient.
   q. Repeat steps 15 and 16 with the supply gas pressure set at 2 psig.
   r. Check for external leakage by plugging all ports except one and submerging the valve in iso-proply alcohol with 100 lbs. of helium pressure.
   s. If the valve fails to meet the above requirements, replace the valve, or recondition the valve.

2. Internal Sample Loop Valve

a. Connect four-way valve to control ports (outer plates), and set air pressure to 32 psig.
b. Connect supply gas line to port #1.
c. Connect bubble tubes to ports #2 and #3.
d. Plug port #6.
e. Submerge bubble tubes in a beaker of water (down about 1/2").
f. Set supply gas pressure to 100 psig.
g. Port #2 should flow freely with the four-way valve in one position, and should not flow more than one bubble every 30 seconds with the valve in the other position.
h. Port #3 should not pass more than one bubble every 30 seconds in either control position, however, momentary flow is permissable during the switching transient.
i. Repeat steps 7 and 8 with the supply gas pressure set at 2 psig.
j. Connect supply gas line to port #8.
k. Connect bubble tubes to ports #6 and #7.
l. Plug port #3.
m. Submerge bubble tubes in a beaker of water.
n. Set the supply gas pressure to 100 psig.
o. Port #17 should flow freely with the four-way valve in one position, and should not flow more than one bubble every 30 seconds with the valve in the other position.
p. Port #6 should not pass more than one bubble every 30 seconds in either control position, however, momentary flow is permissable during the switching transient.
q. Repeat steps 15 and 16 with the supply gas pressure set at 2 psig.
r. Check for external leakage by plugging all ports except one, and submerging the valve in isopropyl alcohol with 100 lbs. of helium pressure.
s. If the valve fails to meet the above requirements, repalce the valve, or recondition the valve.

## Repair and Replacement Procedures

### Module Replacement

As previously mentioned, module substitution can be effectively used to troubleshoot the equipment, and to quickly return the equipment to proper operation. However, in substituting one module for another, the following points must be considered.

The first three left-hand module positions in the Control Section must always contain the Monitor Module, the Sequencer Module, and the Amplifier Module, in that order. All other modules can be intermixed in the remaining module positions without restriction.

WARNING

Do not install or remove plug-in modules while power is applied to the Control Section. Damage to the module and the Control Section will result.

In replacing a Monitor Module, a Component Module, an Integrator Module, or a Valve Module, the green AUTO ZERO jumper must be moved to either the functional position or the "disabled" position, depending on the requirements of the application. Refer to the Instrument Operational Parameters sheet furnished with the equipment.

In replacing a Component Module, a Dual Component Module, an Integrator Moduel, or a Ratio Module, the blue GATE jumper (if GATE is used) must be set to coincide with the Component number for which the module is to be used. In Component Modules, the orange MEMORY jumper (if MEMORY output is used) must also be set to coincide with with the appropriate Component number. In replacing a Valve Module or a Dual Valve Module, the red VALVE jumper must be set to coincide with the corresponding valve number. Note that the VALVE #1 terminal on the Valve Module and Dual Valve Module printed circuit boards corresponds to the Valve #2 connections on the back of the Analyzer Section. In the Analyzer, Valve #1 is the Sample valve.

In replacing the Sequencer Module, it may be necessary to adjust the CHART ADVANCE potentiometer on the Sequencer printed circuit board to achieve the desired bargraph spacing. In addition, some adjustment of the VALVE DELAY potentiometer may be required to "fine turn" the sample inject duration to coincide with the setting of the previously used module.

In replacing a Stream Selector Module which uses analog stream identification, it may be necessary to adjust trimpot R50 on the analog identification printed circuit card to achieve the desired width of the identification bar.

Detector Replacement

1. Turn detector power and Control Section power off by means of the appropriate switches on the Monitor Module. Shut-off all gas flow through the Analyzer.
2. Remove four screws, and remove the cover from the detector housing.
3. Disconnect four detector leads from the terminal strip inside the housing.
4. Remove two screws and bend the terminal strip up and out of way.
5. Remove the four tubing nuts which connect the detector cell to the feed-thru adapters inside the housing.
6. From outside the housing, disconnect the four tubing leads.
7. Loosen the lock-nut on each tubing adapter, and back out the four adapters as required to obtain clearance for removal of the cell.
8. Remove the detector cell and mount securely in a vise.
9. Remove the two detector hold-down nuts and remove the two detectors. Replace with two detectors obtained from Honeywell Inc. Part Number for 8K Thermistor - 11600228001; for 100K Thermistor - 1160021003.
10. Re-install the detector hold-down nuts and use a box-end wrench to tighten the nuts securely.

Detector Replacement (Cont.)

11. Place the detector cell inside the detector housing, and retighten the four tubing adapters in the housing ends.
12. Re-connect the four tubing leads inside the housing, and tighten the four tubing nuts.
13. Place the terminal strip in position and secure with two screws.
14. Connect the four detector leads to the terminal strip.
15. Install the detector housing cover and secure with four screws.

Valve Overhaul

1. Remove the 3/8-inch bolt through the center of the valve and set aside the bolt, the spring washer, and the bottom plate.
2. Disassemble the valve, being careful not to drop the parts or misplace the two 1/8-inch dowel pins.
3. Remove and discard the rubber diaphragm and the Teflon diaphragm and paper backing.
4. Examine the center place for evidence of scratches or chemical etching. If defects are noted, replace with P/N 30740489 (internal volume) or P/N 30740483 (external loop) obtained from Honeywell, Inc.
5. Apply one drop of #550 silicone oil to each piston and reinstall in the respective cylinder. Check each piston for proper fit.
6. Re-assemble the valve by first inserting the two 1/8-inch dowel pins into the center plate. These pins will align the remaining parts during reassembly.
7. Install replacement Teflon diaphragms (Honeywell P/N 30740488-2) on each side of the center plate. The smooth side of the diaphragm must be against the center plate.
8. Install the backing paper, the cage, and the pistons and cylinders. Check that the blank cylinders are positioned over the blank areas on the center plate.
9. Install the replacement rubber diaphragms (Honeywell P/N 30740488-1).
10. Install the head plates, making sure that the four holes in the lapped side of each plate are toward the center plate.
11. Install the spring washer and 3/8-inch hex head bolt, and tighten to 10ft.-lbs. of torque.
12. Check the operation of the valve in accordance with the appropriate procedure. In the event that port-to-port leakage occurs following installation of new diaphragms, increase air pressure to approximately 100 psig to "wear in" the Teflon. After the valve has been "worn in" at 100 psig, reduce air pressure to 32 psig and repeat the valve checkout procedure.

Standard Sample Calibration

In order to perform a meaningful calibration, all equipment parameters must be as specified in the Instrument Operational Parameters sheet. In addition, allow at least 30 minutes for the oven temperature and the Control Section electronics to stabilize.

1. Check the preamp balance and adjust as required.
2. Set all front panel controls as specified in the Instrument Operational Parameters sheet and run several bargraph analyses of the sample gas.

3. Observe each component peak and check for improper component levels. To calibrate a specific component, proceed as follows.
4. Set the Amplifier Module AUTO ZERO/OFF Switch to the centered position. This will hold the baseline at the same position during the calibration.
5. Set the Sequencer Module MODE switch to MAN to inhibit the timer.
6. Set all AUTO/OFF/CAL switches to OFF, except for the component of interest. Set this switch to the CAL position.
7. Set the Amplifier Module AUTO/CAL switch to the CAL position.
8. Adjust the Amplifier Module RANGE CALIBRATE control to produce the same recorder displacement as the component produced during the previous analyses.
9. Adjust the RANGE control on the Component Module of interest to achieve the correct percentage of full-scale deflection on the recorder.
10. Repeat steps 6 through 9 for each remaining component which requires calibration.

Memory Calibration

1. Set all front panel controls as specified in the Instrument Operational Parameters sheet. If desired, calibration time can be substantially shortened by setting the Sequencer Module TIME switches to about 10 seconds, and setting the gate time for the component of interest to about 7 seconds.
2. Set the Sequencer Module sample valve AUTO/MAN switch to the centered (off) position, and the MODE switch to any position except MAN.
3. Set all Component Module AUTO/OFF/CAL switches to OFF, except for the component of interest. Set this switch to the CAL position.
4. Set the Amplifier Module AUTO/MAN switch to AUTO, the AUTO/ZERO/OFF switch to OFF, and the AUTO/CAL switch to CAL.
5. Monitor the amplifier output level by placing a meter across the Amplifier Module GND and OUT test points.
6. Adjust the Amplifier Module RANGE control to produce the desired full-scale output level from the amplifier. Allow the Sequencer to run through several cycles.
7. Measure the output at the GND and OUT test points of the Component Module of interest, and adjust the corresponding MEMORY SPAN control to bring the memory output to the level of the amplifier output, or to the trend recorder full-scale.
8. Place the Amplifier Module AUTO ZERO/OFF switch in the AUTO ZERO position and run several analyses.
9. Again measure the output level at the GND and OUT test points of the Component Module of interest, and adjust the corresponding MEMORY ZERO control to produce a 1 volt (or trend recorder zero) output.
10. Re-set the Amplifier Module AUTO ZERO/OFF switch to OFF, and repeat steps 7, 8, and 9 until the proper zero and full-scale memory outputs are produced.

## Chart Advance Adjustment

Bargraph spacing between successive gates and between successive analyses can be adjusted by placing the Sequencer Module on a board extender and adjusting the CHART ADVANCE potentiometer on the printed circuit board. Because analysis spacing is a function of gate spacing, adjustment of CHART ADVANCE effects both functions.

WARNING

Do not install or remove plug-in modules while power is applied to the Control Section. Damage to the module and the Control Section will result.

## Sample Valve Duration Adjustment

Sample valve inject duration can be adjusted up to one second beyond the thumbwheel setting by placing the Sequencer Module on a board extender and adjusting the VALVE DELAY potentiometer on the printed circuit board.

WARNING

Do not install or remove plug-in modules while power is applied to the Control Section. Damage to the module and the Control Section will result.

## Heater Pressure Switch

The heater air pressure switch is factory set to automatically shut off electrical power to the oven heater in the event that the applied air pressure drops below 15 psig. No further adjustment is required. If defective, order replacement P/N 212-010-0003 from Honeywell, Inc.

## Oven Temperature Adjustment

The optimum oven temperature, as stated in the Instrument Operational Parameters sheet, is factory set, and normally should not require re-adjustment. If adjustment is required, remove the threaded access plate on the front of the Analyzer electronics housing, and adjust the TEMP SET control on the front of the temperature controller. Clockwise rotation increases oven temperature, and counterclockwise rotation decreases oven temperature.

NOTE

If the oven operating temperature is to be changed from that specified on the instrument.

## Adjustment of Oven Over-Temperature Switch

The oven over-temp switch does not require adjustment, except when the Analyzer is re-configured by installation of new column types which require a change in the oven operating temperature. If adjustment is required, proceed as follows:

1. Remove the threaded access plate on the front of the Analyzer electronics housing so that the indicator on the front of the temperature controller can be seen.
2. Remove four screws on the front of the oven over-temperature switch and remove the cover plate.
3. Set the switch adjustment flush with the front of the setscrew color, then turn the adjustment 3 1/2 turns clockwise.

CAUTION

Do not turn the adjustment fully clockwise.

4. Close the oven door and apply air pressure and electrical power to the Analyzer Section. Adjust the TEMP SET control on the temperature controller as required to stabilize the oven at 10°C above the specified operating temperature for the columns to be used.
5. Open the oven door and rotate the switch adjustment counter-clockwise until the dimly-lit indicator on the controller goes out.
6. Re-adjust the TEMP SET control to stabilize the oven at the proper operating temperature.
7. Re-install the cover over the switch housing, and re-install the threaded access plate.

## Adjustment of Heater Barrel Over-Temperature Switch

The heater barrel over-temperature switch does not require adjustment, except following replacement of the heater barrel. To adjust, proceed as follows:

1. Connect a pyrometer to the thermocouple leads which are coiled and stored below the explosion-proof electronics housing in the upper portion of the Analyzer Section.
2. Remove the threaded access plate on the front of the housing so that the indicator on the front of the temperature controller can be seen.
3. Remove the brass plug in the front of the heater housing, and turn the adjustment fully clockwise.
4. Apply power to the Analyzer Section and observe the pyrometer. When the barrel temperature reaches 300-350°C, slowly turn the adjustment counterclockwise until the light on the temperature controller goes out.
5. Disconnect the pyrometer; coil and stow the leads; and install the brass plug and the threaded access plate.

## Auto Zero Track and Amplifier Offset Adjustments

The Auto Zero Track and Amplifier Offset adjustments are factory set, and field adjustment is not recommended. If the amplifier fails to meet the performance requirements, the Amplifier Module should be replaced and returned to Honeywell, Inc. for servicing. If field adjustment is to be attempted, the following instructions must be fully understood and precisely implemented.

NOTE

Place the Amplifier Module on a board extender and allow at least one hour for the Control Section electronics to thermally stabilize.

1. Disconnect the preamplifier signal leads at the rear of the Control Section and short the amplifier input.
2. Set the Sequencer Module sample valve AUTO/MAN switch to the centered (off) position, and the MODE switch to SPEC. Set the TIME selector switches to 02 seconds and the DURATION switches to 01 seconds.
3. Set the Valve Module AUTO/OFF/MAN switches to OFF.
4. Set the Monitor Module Auto Zero COARSE time selector switches to 01 seconds. This will cause the auto zero function to be repetitively fired during the adjustments.
5. Set the Amplifier Module AUTO/MAN switch to the MAN position and set the MANUAL RANGE selector to the "1000" position.
6. Set the Amplifier Module AUTO/CAL switch to AUTO and the AUTO ZERO/OFF switch to OFF.
7. Center the Amplifier Module AMPLIFIER ZERO control to produce zero volts at the wiper arm of the potentiometer.
8. Place a meter across the Amplifier Module GND and OUT test points, and adjust trimpot R42 on the printed circuit board to produce zero volts out.
9. Set the Amplifier Module AUTO/CAL switch to the CAL position, and adjust the RANGE CALIBRATE control to produce one or two volts (positive or negative) at the amplifier output.
10. Place the Amplifier Module AUTO ZERO/OFF switch in the AUTO ZERO position and allow the Sequencer to cycle three or four times.
11. Measure the voltage level at the amplifier output and adjust trimpot R18 on the printed circuit board to produce zero volts.
12. Turn the Amplifier Module AMPLIFIER ZERO control fully to one end, and allow the sequencer to cycle three or four times.
13. Measure the amplifier output level and note any variance from zero volts.
14. Adjust trimpot R18 to remove one-half of the error, and adjust trimpot R28 to remove the remaining error.

15. Turn the Amplifier Module AMPLIFIER ZERO control fully in the opposite direction.
16. Measure the amplifier output level and adjust R18 to remove one-half the error, and then adjust R28 to remove the remaining error.
17. Repeat steps 13, 14, and 15 until the Auto Zero circuitry tracks as close to zero as possible. Any error present must be the same at both extremes of the AMPLIFIER ZERO control.
18. Adjust trimpot R42 on the Amplifier Module printed circuit board to reduce any offset of the amplifier output to zero.
19. Perform the Auto Zero Tracking and Amplifier Offset Checks and "fine tune" R18 to compensate for any negative baseline shift of the component with the highest gain setting.
20. Remove the short at the amplifier input and re-connect the preamplifier leads.

Stream Selector Analog Identification Adjustments

1. Set the analysis times as specified in the Instrument Operational Parameters sheet. If desired, the times may be set proportionally shorter to speedup the adjustment procedure. Set all Component and Valve modules to OFF.
2. Place the Stream Selector Module on an extender board, apply power to the Control Section, and allow 30 minutes for warmup.
3. Set the Sequencer Module sample valve AUTO/MAN switch to the centered position, and the MODE switch to SPEC.
4. Set all "stream-select" switches to the ON position.
5. Depress the Stream Selector RESET switch, and then the Sequencer Module SEQ. RESET switch.
6. Center the zero adjustment (R73) and the span adjustment (R78). Observe the recorder or use a meter at TP2, and adjust R78 to produce a 1-volt difference between each successive output as the Stream Selector cycles.
7. Adjust R73 to produce a 5-volt output when Stream 5 is selected. The resultant output for each of the other stream selections should be nominally: Stream 1 = 1 volt, Stream 2 = 2 volts, etc. Alternately adjust R73 and R78 to produce a readily identifiable output for each stream selected. Precise adjustment is not required.
8. Adjust R50 on the analog identification printed circuit board to vary the width of the identifying bar on the recorder.

Integrator Module Adjustments

1. Place the Integrator Module on an extender board and apply power to the Control Section. Allow 30 minutes for warmup.
2. Set the Sequencer TIME switches to produce a 15-second analysis, and set the sample valve AUTO/MAN switch to the centered (off) position. Set MODE to any position except MAN.
3. Set the Integrator COARSE switches to produce an integrator gate which is ON at 05 seconds and is OFF at 10 seconds.
4. Short the Integrator input at pins 36 and 37 on the integrator printed circuit board. Adjust offset potentiometer R19 to produce 0 volts out of TP2.

5. Adjust R38 on the integrator printed circuit board so that the voltage at pin 2 of Q4 is equal to the voltage at pin 6 of Q4. On some models, R38 is a fixed resistor, and must be selected to produce the desired voltage at pin 2.
6. Monitor the front-panel GND and OUT test jacks, and adjust the front-panel ZERO control to produce 1-volt out after the integrator gate is closed.
7. Remove the short at the Integrator input.
8. Adjust the SPAN control, as required to produce an optimum output waveshape for the peak(s) being integrated.

Ratio Module Adjustments

The five trimpots associated with the ratio circuitry of A1 and IC5 (R42, R44, R45, R48, R49) should not be adjusted in the field. These adjustments effect the operation of the ratio elements of the circuit, and specialized equipment is required for calibration and adjustment. Instead, adjust the input memories and the output memory as follows:

1. Place the Ratio Module on an extender board and apply power to the Control Section. Allow 30 minutes for warmup.
2. Set the Sequencer TIME switches to 60 seconds and set the sample valve AUTO/MAN switch to the centered (off) position.
3. Set one component gate of interest to be ON for 10 seconds duration, starting at 05 seconds into the analysis. Set the other component gate of interest to be ON for 10 seconds duration, starting at 25 seconds into the analysis.
4. Set the Ratio Module COARSE switch to 40 seconds.
5. Set all AUTO/OFF/CAL switches to OFF, except for the two components of interest and the Ratio Module. Set these switches to AUTO.
6. Set the Amplifier Module AUTO ZERO/OFF switch to AUTO ZERO, and the AUTO/CAL switch to CAL.
7. Adjust the Amplifier Module RANGE CALIBRATE control to produce 5 volts out of the Amplifier Module GND and OUT test jacks during the gate associated with relays K1 and K2 in the Ratio Module.
8. Adjust zero control R22 on the Ratio Module printed circuit board to produce 1 volt at TP6 during the Auto Zero which occurs coincident with the gate opening. Adjust span control R31 to produce 5 volts at TP6 after the Auto Zero is completed.
9. Adjust the RANGE control on the Component Module associated with relays K3 and K4 in the Ratio Module, to produce 5 volts out of the Amplifier Module GND and OUT test jacks during the associated component gate.
10. Adjust zero control R26 on the Ratio Module printed circuit board to produce 1 volt at TP5 during the Auto Zero which occurs coincident with the gate opening. Adjust span control R37 to produce 5 volts at TP5 after the Auto Zero is completed.
11. Allow the Sequencer to complete several cycles. Adjust the Ratio Module front-panel ZERO control to produce a 1-volt output at TP9.

12. Adjust the RANGE control on the Component Module associated with relays K3 and K4 in the Ratio Module, to produce 0 volts out of the Amplifier Module GND and OUT test jacks during the associated component gate.
13. Allow the Sequencer to complete several cycles. Adjust the Ratio Module front-panel SPAN control to produce a 5-volt output at TP9.
14. Re-calibrate the Component Module associated with relays K3 and K4 in the Ratio Module.

## Re-Application Data

The preamplifier gain can be increased or decreased by changing the values of resistors R15 and R17 in the Preamplifier Module. The preamp gain is normally a function of the intended application and is thus preset at the factory. In the event of reapplication in the field, the following factors should be considered.

Resistors R15 and R17 are a precisely matched pair of high-quality wirewound resistors. If the preamp gain is to be changed, refer to Table 8 and order the appropriate matched pair from Honeywell, Inc. The gain of the preamp should be selected so that the largest anticipated peak will not drive the amplifier to saturation. Maximum peak output should be 5 to 6 volts.

In installing the replacement resistors, exercise extreme care in soldering the leads in place. Do not apply prolonged excessive heat which could change the resistance of the components.

## Component Module or Integrator Module Gain Change

The gain range of a Component Module or Integrator Module can be increased or decreased by changing the value of resistor R65 on the printed circuit card. Refer to Table 9 and select a resistor value which will produce a slightly less than full-scale output and will allow final full-scale adjustment by means of the Component Module or Integrator Module RANGE Control.

## Installation of New Column Types

In the event that field re-application involves installation of columns which differ from those previously used, special attention must be given to establishing the proper oven temperature.

## TABLE 8

## SPECTRUM ANALYSIS TROUBLESHOOTING CHART

| Indication | Possible Cause or Solution |
|---|---|
| Baseline drift in one direction | 1. Analyzer oven not stabilized at proper temperature.<br>2. Incorrect column or reference flow.<br>3. Check for column leak, or uneven column bleeding in two-column system.<br>4. Check the sample for materials which may be entering the column as a liquid.<br>5. Check detector bridge current.<br>6. Replace supply gas cylinder(s).<br>7. Replace supply gas drier(s). |
| Wavy or sine-wave baseline | 1. Analyzer oven temperature cycling.<br>2. Check the recorder.<br>3. Check stability of column flow.<br>4. Check carrier pressure and leak check carrier flow system.<br>5. Check sample gas for leakage into carrier gas. |
| Noisy or erratic baseline | 1. Defective Preamplifier Module.<br>2. Replace Amplifier Module.<br>3. Excessive power supply ripple. Monitor power supply output with an oscilloscope at the rear of the Control Section.<br>4. Check for loose leads, bad ground connections or dirty switch contacts.<br>5. Check for carrier gas leak.<br>6. Replace or recondition contaminated columns. |
| Improper elution times | 1. Check that the Analyzer oven has stabilized at the proper temperature.<br>2. Check the column flow rates.<br>3. Replace or recondition the columns. |
| Incorrect component readout | 1. Check that the Analyzer oven has stabilized at the proper temperature.<br>2. Calibrate the Control Section.<br>3. Check the column flow-rates.<br>4. Check for proper valve switch timing.<br>5. Check for foreign components in the sample. |
| Baseline shift at Auto Zero times | 1. Auto Zero circuitry defective or improperly adjusted. |

TABLE 8 (Cont.)

| Indication | Possible Cause or Solution |
|---|---|
| No peaks | 1. Check that the Monitor Module DET (detector) power switch is on.<br>2. Check for proper flow rates and air pressure settings.<br>3. Check valve switch timing. See Instrument Operations Parameters sheet.<br>4. Check for defective sample inject valve.<br>5. Check preamp and detector bridge.<br>6. Check for defective column-switching valve. |
| Poor Sensitivity | 1. Check for improper MANUAL RANGE setting.<br>2. Check that the Analyzer oven has stabilized at the proper temperature.<br>3. Check for insufficient sample size or partially blocked sample volume chamber.<br>4. Check for extreme preamplifier imbalance. |
| Steady baseline drift in one direction, then in the other direction. | 1. Check for cycling oven temperature.<br>2. Check for contaminated carrier or drier. |
| "Stairstep" baseline | 1. Check recorder for proper operation. Check ground connections. |
| Inverted peaks | 1. Check for reversed recorder leads at the rear of the Control Section. |
| Incorrect trend output | 1. Memory circuitry defective or improperly adjusted. |
| Auto Zero not functioning | 1. Check that Amplifier Module AUTO ZERO/OFF switch is set to AUTO ZERO position.<br>2. Check that the corresponding Auto Zero jumper (green) is set to the functional position. |
| Column-switching valve not functioning | 1. Check for proper air pressure. Adjust as required.<br>2. Check that the corresponding valve switch on the Solenoid Driver Card is in the AUTO position.<br>3. Check that the Valve Module VALVE jumper (red) is set to the proper position. |
| Memory (trend output inoperative) | 1. Check that the Component Module MEMORY jumper (orange) is set to the proper position. |

TABLE 8 (Cont.)

| Indication | Possible Cause or Solution |
|---|---|
| Incorrect Ratio Output | 1. Ratio memory circuits defective or improperly adjusted. |
| Incorrect Integrator Output | 1. Integrator module defective or integrator memory circuits improperly adjusted. |
| Incorrect Analog Stream Identification | 1. Stream Selector analog identification circuit defective or imporperly adjusted. |
| Stream Selector Inoperative | 1. Stream 1 ON-OFF switch is not set to the ON position. |

TABLE 9

OVEN HEATING SYSTEM TROUBLESHOOTING CHART

| Indication | Possible Cause or Solution |
|---|---|
| No heating | 1. Check AC power to Analyzer Section at terminal strip inside explosion-proof electronics housing.<br>2. Check fuse on front of temperature controller module.<br>3. Check that sufficient air pressure (34 psig) is applied, and that the heater air shut-off valve is open.<br>4. Check for 115 VAC across the heating element.<br>5. Check for AC power to and through the contacts of the oven over-temperature switch, the low-pressure shut-off switch the heater barrel over-temp switch. |
| Oven stabilizes at incorrect temperature | 1. Temperature Controller Module defective or improperly set.<br>2. Oven over-temp switch defective or set below the specified operating temperature.<br>3. Check for leaks around oven door seals. |
| Oven temperature will not stabilize | 1. Check operation of Temperature Controller Module.<br>2. Check for leaks around oven door.<br>3. Check for air flow obstructions in the oven.<br>4. Heater barrel over-temp switch or oven over-temp switch defective. |

# HONEYWELL VALVE OVERHAUL

Procedure: Disassembly

1. Place the valve into a vise allowing only the mounting fixture to remain in the jaws of the vise.

2. Loosen the 3/8 inch bolt by turning in a counter clockwise direction.

3. Remove entire valve from vise and prepare for disassembly in a clean area.

4. Remove 3/8" bolt, belleville washers and force washer from valve head plate and set aside.

5. Carefully slide remaining portion of valve from mounting fixture.

6. Place the valve on clean tissue paper with port number 8 toward you and at the lower right hand corner.

7. Remove head plate from top portion of valve and inspect surface for scratches.

8. Leave both dowel pins in place until disassembly leaves only the center plate.

9. Remove the actuating diaphragm and discard.

10. Remove cylinder plate and inspect cylinder walls for wear and galling.

11. Remove pistons, cylinders and cylinder blank from valve and check each piston and cylinder for ease of movement. This is done by gently tapping the bottom of the piston with the finger and observing the free movement of the piston within the cylinder. If the piston does not move freely, check to determine if piston or cylinder is the cause, and replace as necessary.

12. Remove sealing diaphragm and discard.

13. Taking remaining portion of valve, turn it over and repeat above operation.

A

# HONEYWELL VALVE OVERHAUL

Procedure: Assembly

1. Place a clean, lapped and de-burred center plate upon a clean tissue.

2. Having carefully inspected the above plate for scratches, insert two dowel pins on either side of the center plate.

3. Turn the center plate such that port 8 will be at the lower right hand corner facing you.

4. Take one sealing diaphragm and inspect both sides for scratches, cuts, etc.

5. Place over dowel pins and onto center plate such that the dull side faces the center plate and slide down onto the center plate.

6. Slide a clean cylinder plate over dowel pins onto the sealing diaphragm. Cylinder plate must be free of scratches on inside walls that house piston and cylinder assembly.

7. Pistons and cylinder assemblies, and cylinder blanks must be thoroughly cleaned with freon, and cylinder and cylinder and piston land areas inspected for scratches, etc. Each outside wall of cylinders must be inspected for evidence of binding in the cylinder plate.

8. Each piston and cylinder assembly must move freely without any binding.

9. Place the cylinder blank and piston and cylinder assembly into their respective positions and be sure that the vent hole faces the vent area in the cylinder plate.

10. If the valve is to be used in a <u>dual column mode</u>, place a small viton o-ring 1/32" thick over the piston which controls flow to port #2. Check assembly drawing. Do not insert plug into port #2 until valve test is complete.

11. Place clean actuating diaphragm over dowel pins and onto top of cylinder plate housing piston-cylinder assemblies.

12. Place top head plate over dowel pins making sure exit holes are down. The actuating air connection port is on the side with ports #6 and #7 for 8 port valves, and on the same side as ports #3 and #6 for 6 port valves. Plug air ports not used with 1/8" s.s. ball bearing and seal with screw socket.

13. Turn the valve over and repeat above procedure exactly except replace step 10 with step 14.

14. If the valve is to be used in the <u>dual column mode</u>, place a small viton o-ring 1/32" thick over the piston controlling flow to port #7. Check assembly drawing. Do not insert plug into port #7 until valve test is complete.

15. Having completed the above, turn the partially assembled valve right side up and place upon the mounting fixture.

Procedure: Assembly (Cont.)

16. Slide the belleville washer stack onto the bolt. Check assembly drawing to be sure the belleville washers have been stacked properly.

17. Slide the force washer onto the bolt below the belleville washer. Stack and insert through the center of the valve and thread hand tight into the mounting fixture.

18. Grasp mounting fixture only in a holding device and with a torque wrench and 9/16" socket, tighten to 110 inch pounds.

19. The valve should be re-torqued after 24 hours and stored in a protective enclosure when not in use.

A

## VALVE TEST PROCEDURE

- Check torque to be sure it is 110 inch/pounds.
- Check that ports in manifold plates which are not being used are plugged. The actuating air line from each manifold must be connected to a four way actuating valve - or to two two-ways.
- Set actuating pressure to 50 PSIG.
- Actuate the valve 20 times, allowing 5 seconds between actuations.

### Flow Rate Test

- Set supply gas (carrier) pressure to 1.0 PSIG and connect to ports as below. A flow rate of at least 300 ml/min should be measured out of the appropriate port. Should proper flows not be obtained, disassemble valve and inspect center section for restricted passage.

(A) Standard 8 Port Valve

| Supply Gas | Flow Meter | Manifold Pressurized |
|---|---|---|
| #1 | #2 | Bottom |
| #1 | #4 | Top |
| #3 | #4 | Top |
| #5 | #6 | Top |
| #5 | #8 | Bottom |
| #7 | #8 | Top |

(B) Internal Loop Sampling Valve

| Supply Gas | Flow Meter | Manifold Pressurized |
|---|---|---|
| #1 | #2 | Bottom |
| #1 | #6 | Top |
| #3 | #8 | Bottom |
| #7 | #8 | |

(C) Dual Column Valve Applications

| Supply Gas | Flow Meter | Manifold Pressurized |
|---|---|---|
| #5 | #6 | Top |
| #5 | #8 | Bottom |
| #1 | #4 | Top |
| #3 | #4 | Bottom |

(D) Backflush Valve Applications

| Supply Gas | Flow Meter | Manifold Pressurized |
|---|---|---|
| #1 | #2 | Bottom |
| #1 | #4 | Top |
| #3 | #4 | Bottom |
| #5 | #6 | Top |
| #5 | #8 | Bottom |

## PRESSURE TEST

A

-Set supply gas pressure at 110 PSIG. For carrier pressures in excess of 110 PSIG, consult Table 1 for the proper air actuation pressure.

-Connect supply gas, plugs, and bubble tube to appropriate ports as described below. When properly connected, no flow must be observed through the bubble tube.

-If gas flow is observed, disassemble the valve and inspect for foreign matter in the sealing area. Also, inspect the center section, cylinder lands, piston lands for surface flaws

(A) Standard 8 Port Valve

| Supply Gas | Bubble Tube | Plugged Ports | Manifold Pressurized |
|---|---|---|---|
| #1 | #2 | #3, #4 | Top |
| #1 | #2 | #4 | Top |
| #1 | #4 | #2, #3 | Bottom |
| #8 | #6 | #5, #7 | Bottom |
| #8 | #7 | #5 | Bottom |
| #8 | #5 | #6, #7 | Top |

- Connect jumper tube between ports #4 and #5 for external sampling application. Plug port #8.
- Connect 110 PSIG supply gas to port #3.
- Connect bubble tubes to ports #6 and #2.
- Apply actuation pressure to top manifold and note momentary bubble of gas out of port #6.
- Apply actuation pressure to bottom manifold. No bubble must be observed at port #6 or #2.

(B) Internal Loop Sampling Valve 6 Port

| Supply Gas | Bubble Tube | Plugged Ports | Manifold Pressurized |
|---|---|---|---|
| #1 | #2 | #3, #6, #7, #8 | Top |
| #1 | #3 | #2, #6, #7, #8 | Bottom |
| #3 | #1 | #6, #7, #8 | Top |
| #3 | #6 | #7, #8 | Bottom |
| #7 | #6 | #8, #1 | Top |
| #7 | #8 | #3 | Bottom |

- Connect 110 PSIG supply gas to port #3.
- Connect bubble tubes to port #6 and #2. Plug port #8.
- Apply acutation pressure to top manifold and note momentary bubble out of port #6.
- Apply actuation pressure to bottom manifold. No bubble must be observed at port #6 or #2.

(C) Dual Column Valve Application

| Supply Gas | Bubble Tube | Plugged Ports | Manifold Pressurized |
|---|---|---|---|
| #1 | #2 | #3, #4 | Bottom |
| #1 | #4 | #3 | Bottom |
| #1 | #3 | #4 | Top |
| #8 | #7 | #5, #6 | Top |
| #8 | #5 | #6 | Top |
| #8 | #6 | #5 | Bottom |

- Ports #2 and #7 should now be plugged.

(D) Backflush Valve Application

| Supply Gas | Bubble Tube | Plugged Ports | Manifold Pressurized |
|---|---|---|---|
| #1 | #2 | #3, #4 | Top |
| #1 | #3 | #4 | Top |
| #1 | #4 | #2, #3 | Bottom |
| #8 | #7 | #5, #6 | Bottom |
| #8 | #6 | #5 | Bottom |
| #8 | #6 | #5, #7 | Top |

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- Port #7 should now be plugged.

c. Electronic Zero Periodic Verification Procedure

The following procedure is followed at the same time it is calibrated.

1. Set the Sequencer Module sample valve AUTO/MAN switch to the centered position, and the MODE switch to SPEC.

2. Set the Amplifier Module AUTO/MAN switch to MAN, and the MANUAL RANGE selector to "1000". Place the AUTO ZERO/OFF switch to OFF.

3. Place the Amplifier Module AUTO/CAL switch in the CAL position, and adjust the RANGE CALIBRATE control to produce one or two volts at the amplifier output.

4. Place the Amplifier Moduel AUTO/MAN switch to AUTO, and the AUTO ZERO/OFF switch to AUTO ZERO.

5. Observe the baseline and check for any excessive baseline shift during the gate openings. If excessive baseline shift is noted, the Amplifier Module should be replaced and returned to Honeywell for service.

## E. CALIBRATION AND MAINTENANCE PROCEDURES - PORTABLE HYDROCARBON DETECTORS

### CALIBRATION

#### General

The OVA is capable of responding to nearly all organic compounds. For precise analyses it will be necessary to calibrate the instrument with the specific compound of interest. This is especially true for materials containing elements other than carbon and hydrogen.

Century OVA instruments contain a two point internal electronic calibration system, wherein reference signals are generated by introducing small currents at the input to the electrometer preamplifier. These reference signals are introduced by a CALIBRATE switch on the instrument panel.

The Model OVA-98 was designed for use in applications requiring the instrument response to be readily and rapidly calibrated to a variety of organic compounds. To accomplish this, the OVA-98 incorporates a GAS SELECT control on the instrument panel which is used to set the internal calibration reference signals to a predetermined point corresponding to a particular organic vapor compound.

Electronic adjustments, other than the operational adjustments on the instrument panel, are provided to calibrate and align the electronic circuits. There are three (3) such adjustments all located on the electronics board. One adjustment potentiometer, R-38, is used to set the power supply voltage and is a one-time factory adjustment. The remaining two adjustments, R-4 and R-16 are used for (1) setting the electronic amplifier gain and, (2) setting the amplifier bias respectively. The bias adjustment, R-16, is a one-time factory adjustment. Access to the adjustments is accomplished by removing the instrument from its case. Figure 5-1 indicates the location of the adjustments.

#### Electronic Adjustments

#### Gain Adjustment

a. Turn the INSTR switch to ON. Leave all other controls and valves OFF.
b. Place the CALIBRATE switch in the HIGH position and adjust for full scale deflection using the CALIBRATE knob on the instrument panel.
c. Then place the CALIBRATE switch in the LOW position and the meter should read 10 ppm. If the meter reads higher, place CALIBRATE switch in HIGH position and turn potentiometer R-4 clockwise, which will increase the reading. If the meter reads lower than 10 ppm it should be in the LOW calibrate position, place CALIBRATE switch in HIGH position and turn R-4 counterclockwise, which will decrease the meter reading.

d. After making an adjustment, reset CALIBRATE knob for full scale reading and repeat steps b and c until the meter reads full scale in the HIGH calibrate position and 10 ppm in the LOW calibrate position. After making this adjustment, the gain of the entire electronics system is calibrated.

Bias Adjustment (Methane Calibration)

a. Place the instrument in normal operation and apply a known sample of methane in air at the input.
b. Adjust the meter reading to correspond with the level of the known sample using the CALIBRATE knob on the instrument panel. Then turn the $H_2$ fuel system off so that only the electronics are on.
c. Place the CALIBRATE switch in the LOW position and turn potentiometer R-16 until the meter reads 10 ppm.
d. After this adjustment, the electronic bias is calibrated to actual response to methane.
e. The GAS SELECT control should be set to 500 prior to this adjustment.

Calibration to Other Organic Vapors

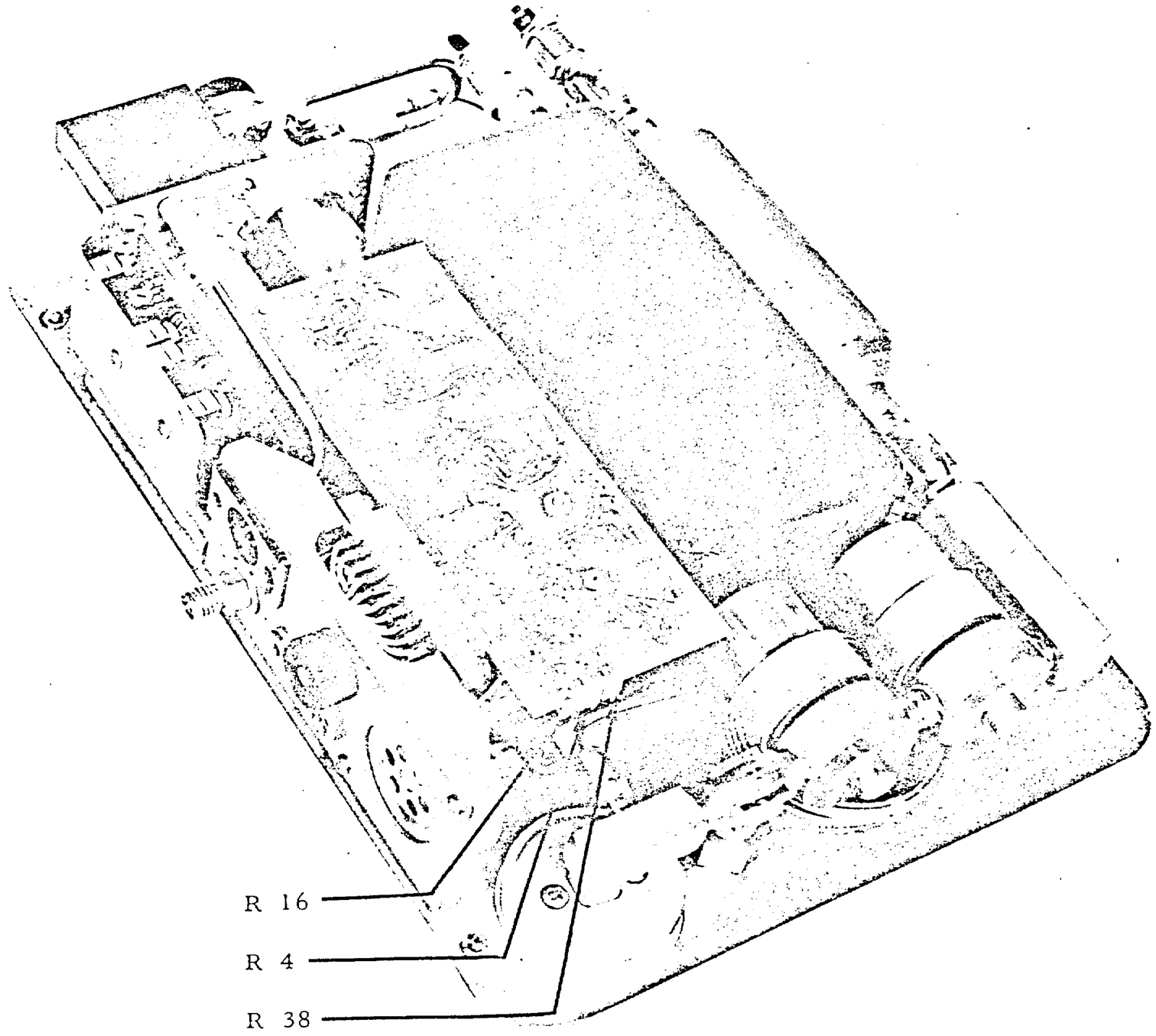
Setting Gas Select Control

Primary calibration of the instrument is accomplished using a known mixture of 10 ppm of vinyl chloride gas. Prior to calibration, the two point electronic calibration is used to ensure the gain of the system is aligned. After the instrument is in operation, a sample of the mixture is drawn into the instrument. The CALIBRATE knob on the panel is then used to shift the readout meter indication such that it corresponds to the concentration of the calibration gas mixture.

The flame in the instrument is then shut off to eliminate any background signal and the CALIBRATE switch placed in either the HIGH or LOW position. The GAS SELECT control which is a ten turn "digidial" readout is then used to align the meter indication to the point corresponding to the reference signal. The instrument is then calibrated for the vapor mixture being used. After this adjustment, the setting on the "digidial" is read and recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds and when desiring to read a particular compound the GAS SELECT control is turned to the predetermined setting for the compound and the normal electronics calibration check is used to adjust the instrument response.

Using Empirical Date

Once the relative response data is obtained, it may be used to estimate concentrations of vapors. With the instrument calibrated to methane, obtain the vapor level reading and multiply by the percent relative response. This method is useful when few readings of several vapors are to be taken and using the GAS SELECT would only be time consuming.




LOCATION OF ELECTRONIC ADJUSTMENTS
Figure 5-1

## Theory

Theoretical background and empirical data related to the Century Organic Vapor Analyzer is presented below.

Halogenated compounds show a lower relative response as compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus, $CHCl_3$ gives a much higher response than does $CCl_4$. As in the other cases, when the carbon to halogen ratio is 5:1 or greater, the response will be similar to that observed for simply hydrocarbons.

The approximate relative response at 100 ppm levels relative to methane for vinyl chloride is:

Vinyl chloride ($C_2H_3Cl$) 35

The OVA has negligible response to carbon monoxide and carbon dioxide which evidently, due to their structure, do not produce appreciable ions in the detector flame. Thus, other organic materials may be analyzed in the presence of CO and $CO_2$.

# MAINTENANCE

## General

This section describes the routine maintenance schedule recommended and provides procedures for trouble shooting malfunctions or failures in the instrument. (See Figure 6-1 for location of components).

## Routine Maintenance

### Filters

#### Primary Filter

This filter is located behind the sample inlet connector and is removed for cleaning by using a thin wall socket to unscrew the sample inlet. The filter cup and loading spring will then come out as shown in Figure 2-1. The porous stainless cup can then be cleaned by blowing out or washing in a solvent. If a solvent is used, care should be taken to insure that all solvent is removed by blowing out or heating the filter. Reassemble in reverse order insuring that the "O" ring seal on the inlet fitting is intact.

#### Particle Filters

A particle filter is located in each pickup fixture. One of these filters must be in the sample line whenever the instrument is in use.

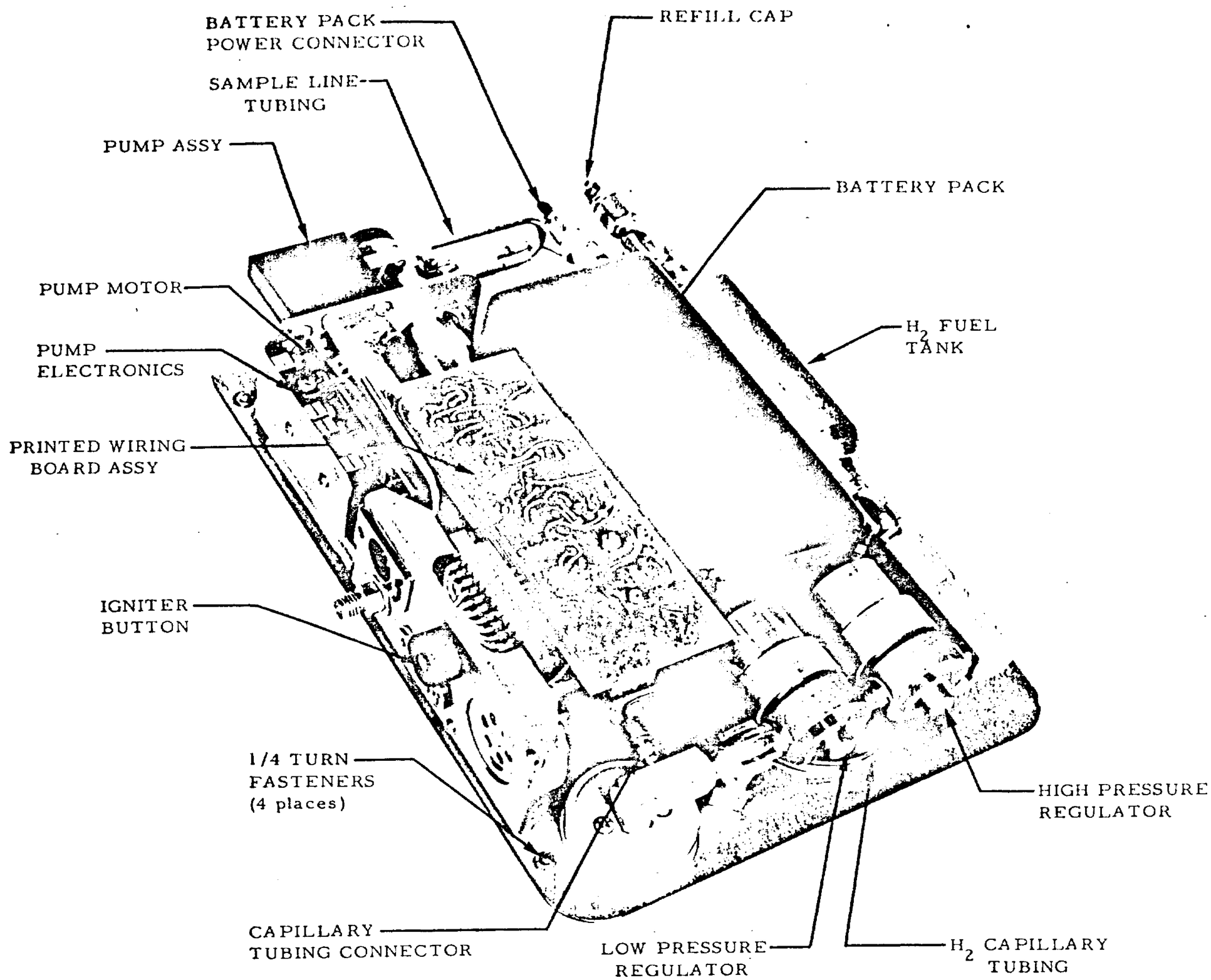
The OVA-98 uses a porous metal filter which can be placed or cleaned using the procedure described above for the primary filter.

#### Sample Mixer

Another porous metal particle filter is incorporated at the input to the detector chamber. This filter is used as the sample mixer and inlet flame arrestor in the chamber. This filter should not become contaminated under normal conditions but can be cleaned or replaced if necessary. Access to this filter is gained by disassembling the flame chamber. See Figure 6-2 and troubleshooting table 6-1.

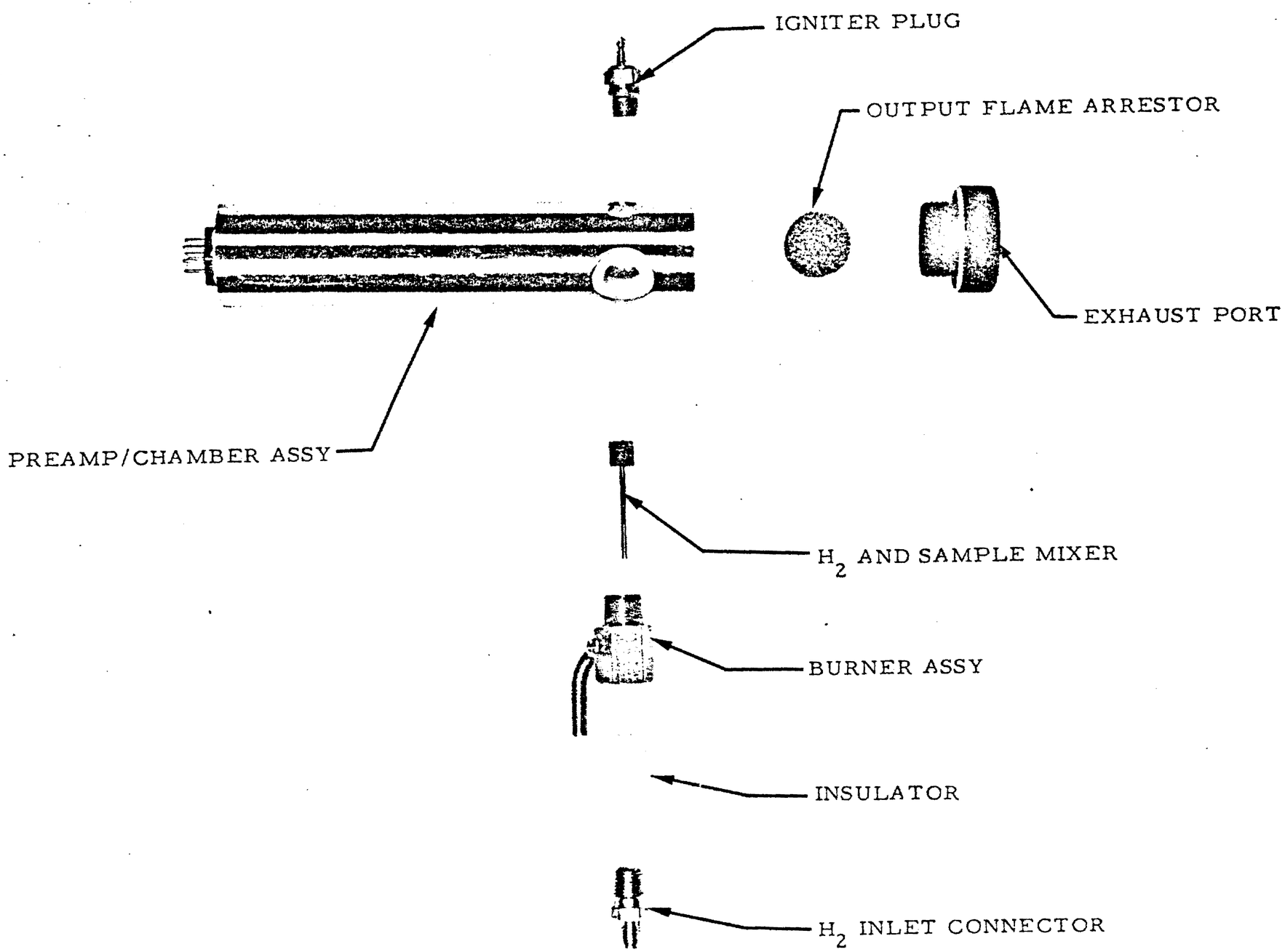
#### Exhaust Flame Arrestor

A porous metal flame arrestor is located on the output side of the detector chamber which also acts as a particle filter on the chamber output and restricts foreign matter from entering the chamber. This filter may be cleaned, if required, by removing the chamber exhaust port. (See Figure 6-2).




MAJOR COMPONENT/ASSEMBLY LOCATION
REAR VIEW OF INSTRUMENT PANEL

FIGURE 6-1




EXPLODED VIEW -- DETECTOR CHAMBER ASSY
Figure 6-2

## Flow Restrictor

A porous metal flow restrictor is incorporated in the $H_2$ filling connector and serves as a particle filter in the $H_2$ filling line. This filter should not require cleaning; however, if it becomes faulty, the fitting should be replaced.

## Pickup Fixtures

The pickup fixtures should be periodically cleaned with an air hose and/or detergent water to eliminate foreign particle matter. If a solvent is used, the fixture should be subsequently cleaned with detergent and baked out at 120°F. to eliminate any residual hydrocarbons from the solvent.

## Factory Maintenance

To ensure continuous trouble-free operation, Century recommends a periodic factory maintenance, overhaul, and recalibration. The recommended schedule is every six (6) to nine (9) months. This maintenance program would include replacement of plastic seals and parts as required, pump overhaul, motor check, new batteries, sample line cleaning, $H_2$ leak check, recalibration, replacement of plastic hose as required, and detail examination of the unit for any other required maintenance and repair.

## Seal Maintenance

Periodically the valve stem seals may have to be tightened or replaced because of $H_2$ leakage. Leakage can be determined by using Lead-Tec, Snoop, or a soap solution around the valve stems.

## $H_2$ Tank and Refill Valves

After some time, the teflon washers under the valve packing nut can "cold flow" (move with pressure) and allow hydrogen to leak. This can usually be stopped by tightening the compression nut.

## Drain Hydrogen Tank First:

1. Remove panel assembly from the case. (Remove the exhaust port and refill cap on the refill fitting).
2. Remove the valve knob screw and knob.
3. Loosen the panel nuts with a 3/4" wrench.
4. The valve compression nut is located just under the panel. Tighten the compression nut -- usually not more than 1/4 turn.

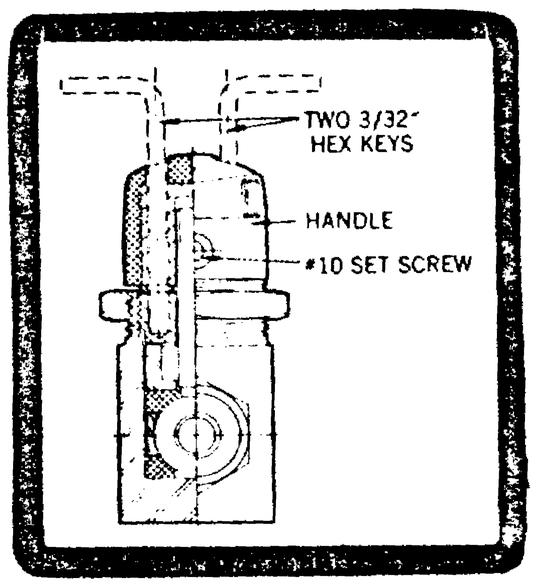
This compression is against soft material and only a small amount of force is necessary to sufficiently compress the teflon washers. If after tightening leakage still occurs, it would be advisable to replace the teflon washers, as follows:

1. Remove panel assembly from the case. (Remove the exhaust port and refill cap on the refill fitting).
2. Loosen capillary tube from the manifold at low pressure gauge.
3. Remove all three knob screws and knobs.
4. Remove the three panel nuts and washers.
5. Carefully remove the tank assembly from the panel.
6. Remove the compression nut on the valve, that is not sealing properly. Remove the stem by unscrewing it from the valve body. Observe the sandwich of metal and teflon washers and note their order.
7. Visually check the Kel-F seat on the stem for cracks or foreign material. Wipe clean, if necessary, with a lint free cloth (no solvents or oils) and replace if damaged.
8. Remove the washers and replace the teflon washers (the factory procedure is a light wipe of hydrocarbon free silicone grease).
9. Replace the stem assembly in the valve body and tighten lightly. Push the washers down into the compression area in the same order as noted upon removal. Replace the compression nut and tighten snuggly.

Close the low pressure valve and fill the tank assembly. Check valves for leaks. Tighten again, if necessary, and reassemble the unit.

## Refiller Valve Packing Adjustment

Adjustment for the valve on the refiller can be made by loosening the set screw with a 3/32" hex key, so that the handle turns freely on the stem. Insert two 3/32" hex keys through the holes provided in the handle and turn until they engage the holes in the packing adjuster. Then tighten the packing by turning the handle.




## Fuse Replacement

There are two (2) overload fuses incorporated in the battery pack assembly, one is a 3AG-1 AMP slo-blo in the power line to the pump and igniter and the other a 3AG-1/4 AMP in the power line to the electronics. Both fuses follow the current limiting resistors which provide primary short circuit protection. However, in the event of an excessive overload, the fuses will open and prevent overheating of the current limiting resistors. It should be pointed out that the 1 AMP slo-blo fuse will blow in approximately 12 seconds if the igniter switch is kept depressed. Normal ignition should take place in not more than 6 seconds. Therefore, do not depress igniter button for more than 6 seconds. If ignition does not occur, wait 1 to 2 minutes and try again. If a 1 AMP slo-blo fuse is required and cannot be readily obtained, replace temporarily with a 3 AMP-3AG standard fuse.

## Troubleshooting

Table 6-1 presents a summary of recommended field troubleshooting procedures. If necessary, the instrument panel is removed from the case by unlocking the four (4) 1/4 turn fasteners on the panel face and also removing the refill cap and exhaust port. The battery pack is removed by taking out the four (4) screws on the panel and disconnecting the power connector at the battery pack.

## Recommended Spares

The following is a list of the recommended basic spares for normal field maintenance. A more complete listing of spares can be provided upon request.

RECOMMENDED SPARES FOR OVA-98

| Item | Description | Part No. | Quantity |
|---|---|---|---|
| 1. | Igniter | 510027-1 | 2 |
| 2. | Battery Pack | 510070-1 | 1 |
| 3. | Sample Line Assy. | 510316-1 | 1 |
| 4. | Pump Diaphragm | 510063-1 | 1 |
| 5. | $H_2$ & Sample Mixer | 510146-1 | 1 |
| 6. | Input Particle Filters (small) | 510116-1 | 3 |
| 7. | Slow Blow Fuse | 3AG-1A-SB | 5 |
| 8. | Fuse | 3AG-1/4A | 5 |
| 9. | Input Line Filter (cup) | 510318-1 | 1 |

TABLE 6-1

| TROUBLE | TROUBLE SHOOTING PROCEDURE | REMEDY |
|---|---|---|
| 6-1 Low sample flow rate on flow indicator | a) Check primary filter in sidepack and particle filters in the pickup assembly. | Replace or clean filter if clogged. |
| | b) Determine assembly containing restriction by process of elimination, i.e., remove probe, remove readout assembly, remove primary filter, etc. | Investigate the assembly containing this restriction to determine cause of blockage. Clean or replace as required. |
| | c) If the restriction is in the side pack assembly, further isolate by disconnecting the sample flow tubing at various points, i.e., pump output, chamber input, etc.<br>Note: The inherent restrictions due to length of sample line, flame arrestors, etc., must be taken into account when trouble shooting. | If the restriction is found to be in the detector chamber, remove and clean or replace porous metal flame arrestors. If pump is found to be faulty, remove and clean or replace unit. |
| 6-2 $H_2$ flame won't light | a) Check sample flow rate (see 6-1 above). | If sample flow rate is low, follow procedure of 6-1 above. |
| | b) Check igniter by removing the chamber exhaust port and observing the glow when the IGNITE button is depressed. | If igniter does not light up, replace the plug. |
| | c) Check for rated $H_2$ Supply Pressure. | If low, adjust to proper level by turning the allen wrench adjustment on the regulator cap. |
| | d) Check $H_2$ flow rate by observing the PSI decrease in pressure on the $H_2$ Tank Pressure gauge. The flow rate should be about 150 PSI decrease in pressure per hour.<br>Note: Sufficient time (1 to 2 min.) should be allowed for the $H_2$ to flow through the capillary to the detector chamber at initial turn-on. | The normal cause for $H_2$ flow restriction would be a blocked or partially blocked capillary tube. If flow rate is marginally low, attempt to compensate by increasing the $H_2$ Supply Pressure by one-half or one PSI. If flow rate cannot be compensated for, replace capillary tubing. |

TABLE 6-1 (Continued)

| TROUBLE | TROUBLE SHOOTING PROCEDURE | REMEDY |
|---|---|---|
| 6-5 Slow response time, i.e., time to obtain response after gas is applied to input. | a) Check to ensure that Probe is firmly seated on the rubber seal in the Readout Assembly | Reseat by holding the probe firmly against the rubber seat and then lock in position with the knurled locking nut. |
| | b) Check sample flow rate per procedure 6-1 above. | See 6-1 above. |
| | c) Investigate whether sample input system is leaking by closing off input at the probe and observing the flow rate and sound of the pump. Another method is to blow smoke around the various connections and observe the instrument response. | Through the process of elimination find the source of the leak and repair. |
| 6-6 Slow recover time, i.e., too long a time for the reading to get back to ambient after exposure to a high level organic vapor. | a) This problem is normally caused by contamination in the sample input line which absorbs the organic vapor and then has to be pumped for a long period to get the system clean of vapors again. Charcoal in the lines would be the worst type of contamination. Isolate through the process of elimination where the contamination is (see 6-1 (b)). | Clean or replace contaminated sample line or assembly as required. |
| | b) Check flame chamber for contamination. | Clean as required. |
| 6-7 Ambient background reading in clean environment is too high. | a) An ambient background reading can be caused by hydrocarbons in the $H_2$ fuel or fuel supply system. Place finger over sample probe tube restricting sample flow and if meter indication does not go down significantly the contamination is probably in the $H_2$ fuel. | Use a higher grade of hydrocarbon-free hydrogen.<br>Check for contaminated fittings on filling hose assembly. |

TABLE 6-1 (Continued)

| TROUBLE | TROUBLE SHOOTING PROCEDURE | REMEDY |
|---|---|---|
| 6-2 (Continued) | e) Check to see if $H_2$ supply system is frozen up by taking unit into a warm area. | If there is moisture in the $H_2$ supply system and the unit must be operated in sub-freezing temperatures, purge the $H_2$ system with dry $N_2$ and ensure the $H_2$ gas used is dry. |
| | f) Remove exhaust port and check for contamination | If the chamber is dirty, clean with ethyl alcohol and dry by running pump for approximately 15 minutes. If $H_2$ fuel jet is misaligned, ensure the porous metal flame arrestor is properly seated. |
| 6-3 $H_2$ flame lights but will not stay lighted. | a) Follow procedures 6-2 (a), (c), (d), and (f) above. | |
| 6-4 Flame out alarm will not go on when $H_2$ flame is out. | a) Check instrument calibration setting and GAS SELECT control setting. | Place to proper setting. |
| | b) Remove exhaust port and check for leakage path in chamber (probably moisture or dirt in chamber). | Clean contamination and/or moisture from the chamber using a swab and alcohol, dry chamber by running pump for approximately 15 minutes. |
| | c) If procedure (a) does not resolve the problem the probably cause is a malfunction in the preamp assembly. | Return preamp/chamber assembly to the factory for repair. |

TABLE 6-1 (Continued)

| TROUBLE | TROUBLE SHOOTING PROCEDURE | REMEDY |
|---|---|---|
| 6-7 (Continued) | b) An ambient background reading can be caused by a residue of sample, building up on the face of the sample inlet filter. If the test in 6-7 (a) above produces a large drop in reading, this is usually the cause. | Remove the exhaust port (it is not necessary to remove instrument from case) use small wire brush from the tool kit or a knife blade and lightly scrub surface of sample inlet filter. |
| | c) An ambient background reading can also be caused by hydrocarbon contamination in the sample input system. The most likely cause would be a contaminent absorbed or condensed in the sample line. | Clean and/or replace the sample input lines. Normally the lines will clear up with sufficient running. |
| | d) It should be pointed out that running the instrument tends to keep down the buildup of background vapors. Therefore, run the unit whenever possible and store it with the carrying case open in clean air. | |
| 6-8 Pump will not run. | a) Check 1 AMP slow blow fuse on battery pack cover. | Replace fuse. If fuse continues to blow when igniter switch is closed, check igniter for short circuit. If igniter is not the problem, there is a short in the wiring or pump motor. |
| 6-9 No power to electronics but pump runs. | a) Check 1/4 AMP fuse on battery pack cover. | Replace fuse. If fuse continues to blow, there is a short in the electronics assembly. |
| 6-10 No power to pump or electronics. | a) Place battery on charger and see if power is then available. | If power is available, battery pack is dead or open. |

## CALIBRATION SCHEDULE

The vinyl chloride emission regulation does not specify a required calibration schedule for the portable hydrocarbon detector. As the portable hydrocarbon detector is used to precisely locate the leak source, its precise calibration is not necessary.

Nevertheless, our plant intends to follow a rigid schedule to insure accurate calibration of the devices being maintained. Each portable hydrocarbon detector will be checked against a known calibration gas cylinder, traceable to the National Bureau of Standards, on a weekly basis. If the portable hydrocarbon detector is not found to be accurate it will be calibrated using the procedure previously described.

In the normal course of events, any mis-calibration of the portable hydrocarbon detector will first be noted in the field. In the event of any such mis-calibration, the portable hydrocarbon detector will be immediately taken to the plant laboratory for calibration adjustment.

## MAINTENANCE SCHEDULE

The vinyl chloride emission regulation does not specify a required maintenance schedule for the portable hydrocarbon detector. As this device readily exhibits by inaccurate readings any specific malfunctions, a preventative maintenance program would not seem warranted.

Nevertheless, our plant intends to follow a rigid schedule of periodic maintenance inspection. Each portable hydrocarbon detector will be checked by the instrument maintenance department at least once per month. Required maintenance, if any, will be completed at that time. The applicable procedures will be as previously described.

In the normal course of events, any malfunction will first be noted in the field, rather than through any scheduled preventative maintenance inspection program. In the event of any such malfunction, the portable hydrocarbon detector will be immediately taken to the instrument shop for any required adjustment.

## DATA RECORDING AND HANDLING SYSTEM

The portable hydrocarbon detector will be used once per week to insure no small leaks exist. The general areas covered by chromatographs 1 and 2 (See Section F) will be searched. If any small leaks are found, they will initiate the sequence of recording, handling and correction events as described in Section G.

## LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

### F. LOCATION OF CONTINUOUS MONITORING POINTS

As indicated, the Plant has four Honeywell Model 1000 Process Gas Chromatographs. Each instrument monitors 10 locations for the presence of vinyl chloride. Thus a total of forty points are monitored.

The continuous vinyl chloride monitoring system serves three primary purposes.

1. Protection of employees from exposure to vinyl chloride.

2. Identification of process conditions which precipitate vinyl chloride emissions.

3. Monitoring of plant for equipment malfunctions or leaks.

All forty points, to a greater of lesser degree, serve these functions.

Changing process conditions or newly identified needs may suggest moving the monitoring points. The system used is adaptable to such changes. The plant reserves the right to modify the location of the forty points. The locations will be changes and the location records revised only as desired to optimize the needs of the three defined functions.

The precise location of the forty points are indicated on the attached Table 1. The location is also indicated on the attached Plant Plot Layout drawing.

TABLE 1
LOCATION OF CONTINUOUS MONITORING POINTS
ABERDEEN PVC PLANT

HONEYWELL CHROMATOGRAPH NO. 1 ( MODULE NO. 1 AREA)

| Point | Location |
|---|---|
| 1-A | East Side Of Control Room |
| 1-B | VCM Charge Receiver |
| 1-C | Bottom Of Cooler Scrubber |
| 1-D | Above Recovery Compressors |
| 1-E | Above Dump Sweco |
| 1-F | Bottom Of D-300 Reactor |
| 1-G | Top Of D-300 Reactor |
| 1-H | Bottom Of D-500 Reactor |
| 1-I | Top Of D-600 Reactor |
| 1-J | Plant Breathing Air System |

HONEYWELL CHROMATOGRAPH NO. 2 ( RAILCAR UNLOADING AREA)

| Point | Location |
|---|---|
| 2-A | Bottom Of D-600 Reactor |
| 2-B | West Of North RVCM Receiver |
| 2-C | South Unloading Spot |
| 2-D | Fresh Air Inlet |
| 2-E | Middle Unloading Spot |
| 2-F | North Unloading Spot |
| 2-G | Corken Unloading Compressor Area |
| 2-H | Water Stripping Tank |
| 2-I | North RVCM Receiver |
| 2-J | Electrical Switch Gear Room |

HONEYWELL CHROMATOGRAPH NO. 3 ( DRYER AREA)

| Point | Location |
|---|---|
| 3-A | Between Dryer No. 5 and No. 6 Transfer |
| 3-B | Inside Dryer Control Room |
| 3-C | Between Dryer No. 7 and No. 8 Transfer |
| 3-D | Dryer No. 6 Discharge |
| 3-E | Blend Tank Slurry Inlet |
| 3-F | Dryer No. 8 Inlet |
| 3-G | West Of Dryer No. 4 and No. 5 Inlet |
| 3-H | Between Centrifuge No. 7 and No. 8 |
| 3-I | Between Centrifuge No. 4 and No. 5 |
| 3-J | At V-10 Bagging Machine |

HONEYWELL CHROMATOGRAPH NO. 4 (WAREHOUSE AREA)

| Point | Location |
|---|---|
| 4-A | Between No. 1 and No. 2 Baggers |
| 4-B | Quality Control Laboratory |
| 4-C | 1st Floor Of South Warehouse |
| 4-D | 2nd Floor Of West Warehouse |
| 4-E | Development Laboratory |
| 4-F | 2nd Floor South Warehouse |
| 4-G | Dry Blend Control Room |
| 4-H | Warehouse Basement |
| 4-I | Center Of East Warehouse |
| 4-J | At Entrance From Warehouse To Offices |

## LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

### G. ACTION PLAN FOR LEAK ELIMINATION

The presence of a leak, as detected by the Honeywell Process Chromatographs or by the portable hydrocarbon detector, will activate a reporting, leak search, leak identification, and leak elimination program.

If a vinyl chloride process leak occurs, it will be detected and defined as indicated in Section H. The existence of the leak will generate the following sequence of events.

1. The Operator will record the items (1), (2), (3), (4) and (5) on the attached Leak Detection Reporting Form, Table 1.

2. The Lead Operator in the area will contact the Shift Supervisor and give him the information that a leak exists.

3. The Operator or Shift Supervisor will then use the portable hydrocarbon detector to go to the area to pinpoint the location of the leak. This person is to wear appropriate personnel protective equipment consistent with plant safety rules.

4. When the leak is pinpointed, immediate action will be taken, if possible, to eliminate the source of the emission. In any case, item (6) is to be completed on the Leak Detection Reporting Form.

5. If the leak is eliminated, the Shift Supervisor is to verify this at item (7). The Operations Supervisor should verify this in item (9). The Operator and Shift Supervisor should initial the report under (10). The report is then to be properly filed.

6. If the Operator cannot eliminate the leak source, the Shift Supervisor is to inspect the problem and fill out item (7). If the Shift Supervisor correctes the leak, the Operations Supervisor is to verify under item (9) and the report is to be filed.

7. If the Shift Supervisor cannot correct the leak, he is still to complete item (7). He is then to generate an Emergency (E) Maintenance Work Order to correct the leak source.

8. When the maintenance work is completed, the Shift Supervisor is to verify under item (8).

9. The Operations Supervisor is to verify this in item (9). The report is to be initialed in item (10) and then appropriately filed.

10. Leak Reporting Forms are to be available at each Honeywell Chromatograph location. The reports when completed will be kept by the Process Engineering Technician. These files will be kept for a minimum of two years.

TABLE 1

LEAK DETECTION REPORTING FORM

ABERDEEN PVC PLANT

1. HONEYWELL CHROMATOGRAPH NO. OR PORTABLE DETECTOR NO. _____

2. DATE _____

3. TIME _____

4. MONITORING POINT WITH HIGH READINGS _____ _____ _____ _____ _____ _____

5. READINGS, PPM _____ _____ _____ _____ _____ _____

6. OPERATOR ACTION
RESULT _____

7. SHIFT SUPERVISOR ACTION
RESULT _____

8. MAINTENANCE ACTION
RESULT _____

9. VERIFIED BY _____

10. OPERATOR _____ SHIFT SUPERVISOR _____

## LEAK DETECTION AND ELIMINATION PROGRAM

## ABERDEEN PVC PLANT

### H. DEFINITION OF A LEAK

The process employed in Aberdeen for the manufacture of PVC uses a very restricted amount of vessels in vinyl chloride service. The productivity per reactor is in excess of 40 MM lbs. per year.

As a result of the above, the tendency for and location of vinyl chloride process leaks is confined.

The plant defines a leak as:

A condition which results in the emission of persistent amounts of vinyl chloride.

Because of the limited amount of vessels in vinyl chloride service and the number of and location of continuous monitoring points, the evidence that a leak exists will usually be a persistently high reading on the continuous monitor.

The tendency of the various process monitoring points to indicate leaks is dependent upon their location. As various areas have certain background levels as a result of current process operations, the action level of Leak Detection Reporting will vary. Eventually, as all process changes are completed, background levels will all decrease. The action level for Leak Detection Reporting will periodically be revised to reflect the adjusted background levels.

The Leak Detection and Leak Elimination Action Plan will be activated by three successive readings in excess of the action level. Three successive readings are evidence of persistent quantities of vinyl chloride and evidence of a leak.

The value at each monitoring point will be observed by the operator on the existing recorders and will be transcribed onto a data sheet once per hour. This will be used by management to insure leaks are being properly detected and corrected by plant personnel. The once per hour reading will be recorded on forms similar to the one attached. It is emphasized that this function is not part of the Leak Detection Program. This function will, however, be used to insure the Leak Detection Program is being properly followed.

The attached table indicates the action levels for the Leak Detection Program. Also shown are typical background levels at each location. The plant will revise the actionlevels downward as is appropriate as background levels decrease.

# CONTINUOUS MONITORING LOG SHEET

Location_____

Date_____

NAME

| TIME | | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream No. | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 6 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 8 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 10 | | | | | | | | | | | | | | | | | | | | | | | | |
| Flame On | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plant Air On | | | | | | | | | | | | | | | | | | | | | | | | | |

LARGE REACTOR AREA

STREAM LOCATIONS

1. East Side Of Control Room
2. VCM Charge Receiver
3. Bottom of Cooler Scrubber
4. Above Recovery Compressors
5. Above Dump Sweco
6. Bottom of D-300 Reactor
7. Top of D-300 Reactor
8. Bottom of D-500 Reactor
9. Top of D-600 Reactor

VAB.0001110270

TABLE 2

ACTION LEVELS FOR LEAK DETECTION REPORTING AND ELIMINATION PROGRAM

ABERDEEN PVC PLANT

| Point No. | Location | Background Level | Action Level |
|---|---|---|---|
| 1-A | East Side of Control Room | < 1.0 | 5.0 |
| 1-B | VCM Charge Receiver | < 1.0 | 5.0 |
| 1-C | Bottom of Cooler Scrubber | < 1.0 | 5.0 |
| 1-D | Above Recovery Compressors | < 1.0 | 5.0 |
| 1-E | Above Dump Sweco | < 1.0 | 5.0 |
| 1-F | Bottom of D-300 Reactor | < 1.0 | 5.0 |
| 1-G | Top of D-300 Reactor | < 1.0 | 5.0 |
| 1-H | Bottom of D-500 Reactor | < 1.0 | 5.0 |
| 1-I | Top of D-600 Reactor | < 1.0 | 5.0 |
| 1-J | Plant Breathing Air System | < 1.0 | 5.0 |
| 2-A | Bottom of D-600 Reactor | < 1.0 | 10.0 |
| 2-B | West of North RVCM Receiver | < 1.0 | 10.0 |
| 2-C | South Unloading Spot | <10.0 | 10.0 |
| 2-D | Plant Fresh Air System | < 1.0 | 10.0 |
| 2-E | Middle Unloading Spot | <10.0 | 10.0 |
| 2-F | North Unloading Spot | <10.0 | 10.0 |
| 2-G | Corken Unloading Compressor Area | <10.0 | 10.0 |
| 2-H | Water Stripping Tank | < 5.0 | 10.0 |
| 2-I | North RVCM Receiver | < 1.0 | 10.0 |
| 2-J | Electrical Switch Gear Room | < 1.0 | 10.0 |
| 3-A | Between Dryer No. 5 and No. 6 Transfer | < 0.5 | 5.0 |
| 3-B | Inside Dryer Control Room | < 0.5 | 5.0 |
| 3-C | Between Dryer No. 7 and No. 8 Transfer | < 0.5 | 5.0 |
| 3-D | Dryer No. 6 Discharge | < 0.5 | 5.0 |
| 3-E | Blend Tank Slurry Inlet | < 0.5 | 5.0 |

TABLE 2 (Cont.)

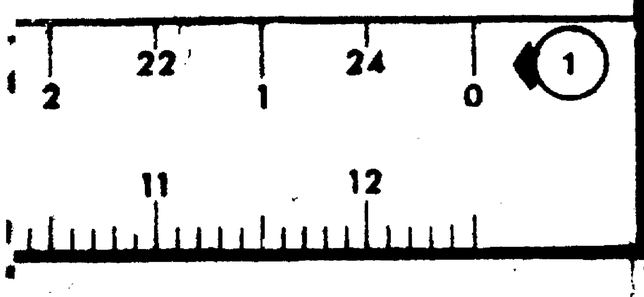
| Point No. | Location | Background Level | Action Level |
|---|---|---|---|
| 3-F | Dryer No. 8 Inlet | <0.5 | 5.0 |
| 3-G | West of Dryer No. 4 and No. 5 Inlet | <0.5 | 5.0 |
| 3-H | Between Centrifuge No. 7 and No. 8 | <0.5 | 5.0 |
| 3-I | Between Centrifuge No. 4 and No. 5 | <0.5 | 5.0 |
| 3-J | At V-10 Bagging Machine | <0.5 | 5.0 |
| 4-A | Between No. 1 and No. 2 Baggers | <0.5 | 5.0 |
| 4-B | Quality Control Laboratory | <0.5 | 5.0 |
| 4-C | 1st Floor of South Warehouse | <0.5 | 5.0 |
| 4-D | 2nd Floor of West Warehouse | <0.5 | 5.0 |
| 4-E | Development Laboratory | <0.5 | 5.0 |
| 4-F | 2nd Floor of South Warehouse | <0.5 | 5.0 |
| 4-G | Dry Blend Control Room | <0.5 | 5.0 |
| 4-H | Warehouse Basement | <0.5 | 5.0 |
| 4-I | Center of East Warehouse | <0.5 | 5.0 |
| 4-J | At Entrance from Warehouse to Offices | <0.5 | 5.0 |

| ISU | DATE | DESCRIPTION | BY | CKD | APD |
|---|---|---|---|---|---|
| 1 | 12-7-76 | REVISED LEGEND | CAC | | |
| 0 | 12-1-76 | ORIGINAL | CAC | | |

CONOCO CHEMICALS
ABERDEEN, MISS.

FIGURE I
PLOT PLAN
EPA MONITORING POINT LOCATIONS
USE BORDER SCALE: 1"=100'

APPD:
DATE:

No.

DWR.