MOOERS LANDFILL
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

FINAL

WORK PLAN - APPENDIX A
SAMPLING AND ANALYSIS PLAN

NOVEMBER 1990

PREPARED FOR

CLINTON COUNTY HIGHWAY DEPARTMENT

LANDFILL DIVISION

Clinton County, New York

PREPARED BY

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290 Elwood Davis Road
Box 3107
Syracuse, New York 13220

PROJECT NO. 244.19

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1.0 INTRODUCTION

This document presents the Sampling and Analysis Plan (SAP) for the Remedial Investigation/Feasibility Study (RI/FS) to be undertaken by Barton & Loguidice, P.C. on behalf of the Clinton County Highway Department, Landfill Division, for Mooers Landfill.

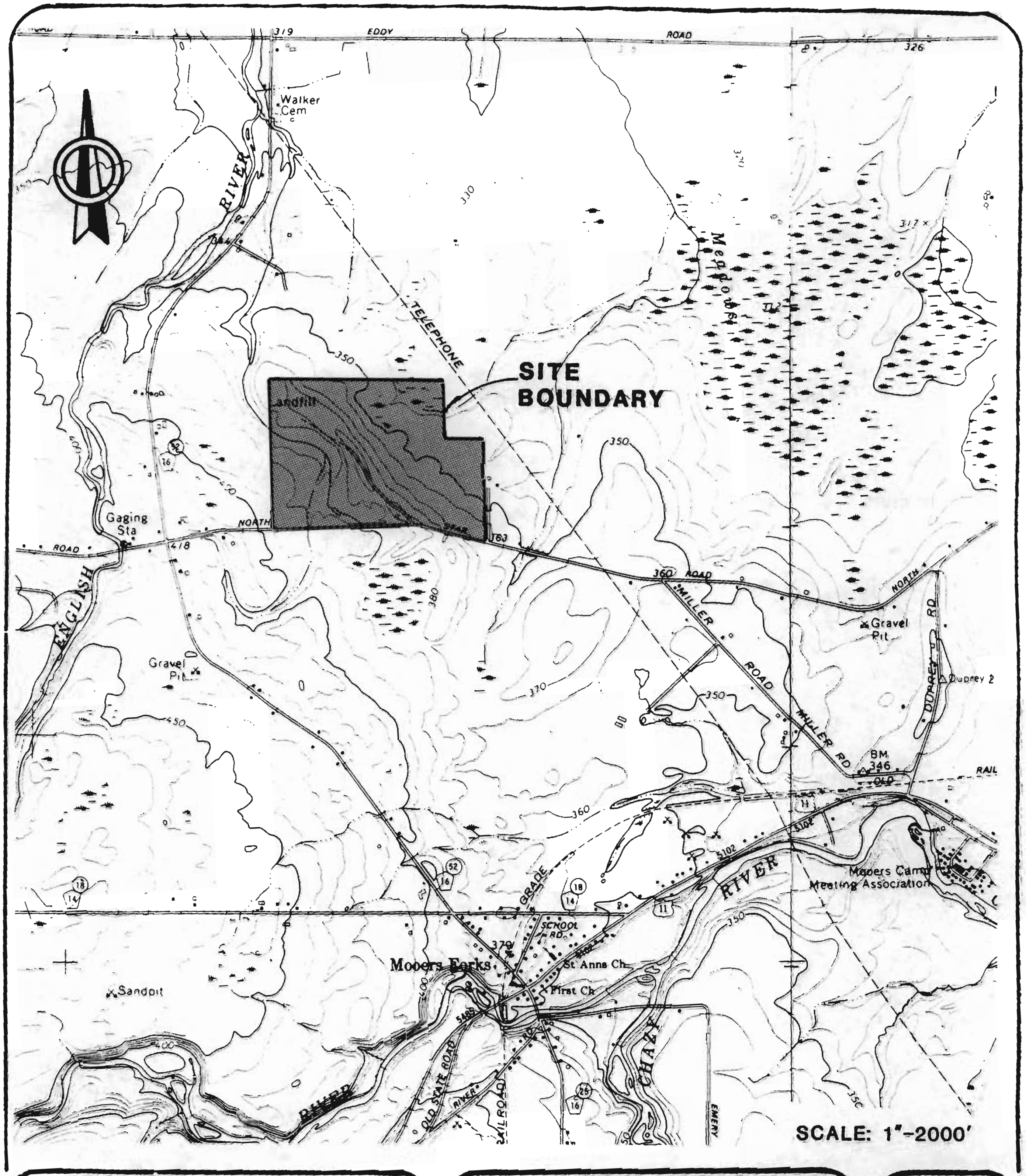
The SAP defines the procedures to be followed during all field investigation activities.

The SAP contains five sections including this Introduction, Section 1.0. Section 2.0 outlines the sampling objectives of the RI/FS. Section 3.0 provides a description of the field investigation and sampling program, including sample designation, sample handling, and analysis procedures. Section 4.0 details the field investigation procedures. Section 5.0 outlines the field sampling and sample analysis quality assurance/quality control procedures.

1.1 Site History

The Mooers Landfill site covers an area of approximately 11 acres of a 145-acre tract of land owned by Clinton County, located on North Star Road in the Town of Mooers in northern Clinton County (Figure 1-1).

The landfill is currently operational, accepting approximately 10,000 tons of municipal waste per year from residents of northern Clinton County. Hazardous wastes were reportedly landfilled at the site between 1979 and 1985. Subsequently, the NYSDEC has classified Mooers Landfill as an inactive hazardous waste site, and has



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MOOERS SANITARY LANDFILL

SITE LOCATION MAP

TOWN OF MOOERS CLINTON CO

Figure

1-1

Project No.

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listed the site in the Registry of Inactive Hazardous Waste Disposal Sites in New York (No. 510005).

Leachate seeps have been observed on the landfill site. Drainage from the landfill site flows either west into an unnamed tributary of the English River or east into a wetland complex named Beaver Meadows. None of the surface waters are known to be used directly as potable water supplies.

There are no municipal wells within the vicinity of the Mooers site. Private groundwater wells have been identified along North Star Road, south of the landfill; Blackman Corners Road to the west; and unidentified roads north and east of the site.

2.0 SAMPLING OBJECTIVES

2.1 Chemical Characterization

Table 3-1 of the work plan summarizes the results of the preliminary groundwater, surface water, and leachate sampling performed in 1989 by the NYSDEC. From this list, a number of chemicals of concern can be identified. Factors important in the selection of these chemicals are their relative toxicities, concentrations relative to background levels, and the likelihood of migration from the site. Based on these criteria, the following chemicals of concern have been tentatively identified:

- 1,1,1-Trichloroethane
- 1,1-Dichloroethane
- Chloroethane
- Acetone
- Methyl ethyl ketone
- Methyl isobutyl ketone
- Toluene
- Phenol
- 4-Methylphenol (p-cresol)
- Benzoic acid

2.2 Data Quality Objectives

Data quality objectives (DQO) are based on the concept that different data uses may require different levels of data quality. Data quality can be defined as the degree of uncertainty in the data with respect to precision, accuracy, and completeness. The five levels of data quality are:

1. Screening (Level 1) - This provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at

the site, preliminary comparison to ARARs, initial site characterization to locate areas for subsequent and more accurate analyses, and for engineering screening of alternatives (bench-scale tests). These types of data include those generated on-site through the use of HNU, pH, conductivity, and other field monitoring equipment.

2. Field Analyses (Level 2) - This provides rapid results and better quality than in Level 1. Analyses include mobile lab generated data.

3. Engineering (Level 3) - This provides an intermediate level of data quality and is used for site characterization. Engineering analyses may include mobile lab generated data and some analytical lab methods (e.g., laboratory data with quick turnaround used for screening but without full quality control documentation).

4. Confirmational (Level 4) - This provides the highest level of data quality and is used for purposes of risk assessment, engineering design, and cost analyses. These analyses require full Contract Laboratory Program (CLP) analytical and data validation procedures in accordance with USEPA or NYSDEC-recognized protocols.

5. Non-Standard (Level 5) - This refers to analyses by non-standard protocols, for example, when exacting detection limits, or analysis of an unusual chemical compound is required. These analyses often require method development or

adaption. The level of quality control is usually similar to Level 4 data.

Barton & Loguidice will contract with a CLP laboratory to generate either Level 4 or Level 5 analytical data for all leachate, groundwater, surface water, and sediment samples collected at the Mooers Landfill site. In addition, Level 1 data will be generated which includes field OVA or HNU readings gathered during well drilling, sampling, and other routine field activities. Field measurements of sample parameters such as pH, Eh, temperature, or specific conductivity are also examples of Level 1 data to be collected. These types of data may be used to demonstrate the adequacy of well development/purging procedures or, in the case of HNU or OVA readings, to help protect the health and safety of workers, or provide data for the design of groundwater monitoring wells.

DQO Level 3 would be utilized in any treatability studies (if required), not during the field investigation.

3.0 FIELD INVESTIGATION

3.1 Field Investigation and Sampling Program

The objective of this task is to conduct the necessary remedial investigations to characterize the site and its actual or potential hazard to public health and environment, and to identify both contaminant sources and receptors. The field investigation is designed to provide data of adequate technical content to support the development and evaluation of remedial alternatives during the Feasibility Study. The objectives of the field investigation are to:

- Characterize groundwater flow conditions and delineate the groundwater contamination in the overburden as related to the landfill.
- Gather data to evaluate the probability of contamination in the deep groundwater system.
- Characterize surface water and sediment contamination.
- Gather data to support a public health risk assessment and environmental impact assessment.
- Gather data to adequately evaluate potential remedial action technologies/alternatives.

The field investigation will consist of the following subtasks:

1. Subcontracting
2. Mobilization and Demobilization
3. Site Survey and Base Map
4. Geophysical Survey

5. Drilling/installation of groundwater monitoring wells.
6. Staff Gauge Placement and Stream Flow Measurements
7. Groundwater Sampling
8. Leachate, Surface Water and Sediment Sampling
9. Ecological Survey

A geophysical field investigation is proposed at Mooers Landfill to characterize leachate migration pathways from the landfill using an electromagnetic conductivity survey. Data obtained from the geophysical survey will aid the location of the monitoring wells.

Sampling will include groundwater from the newly-installed monitoring wells, and surface water and sediment locations from two streams in the vicinity of the site to determine the extent of surface water and stream bed contamination. Discrete leachate samples will also be obtained from active leachate seeps on the landfill. In addition, soil samples will be collected from split-spoons obtained during the installation of the groundwater monitoring wells. Table 3-1 provides a summary of the proposed analytical parameters for the sampling program including all required QA/QC samples to be collected in the field.

An ecological investigation will be conducted, including a macroinvertebrate survey, to gather information on the existing wildlife found in the area, vegetative composition, hydrographic features, and the potential existence of critical and significant habitats. A determination of the impact of the site on the surrounding ecosystem will also be made.

TABLE 3-1
MOOERS SANITARY LANDFILL
SUMMARY OF PROPOSED ANALYTICAL PARAMETERS

	MATRIX	NUMBER OF LOCATIONS	NUMBER OF SAMPLES	TCL (1) VOC	TCL (2) BNA	TOTAL PETROL. HYDROCARB.	TCL (3) PEST/PCB	CLP TCL (4) METALS	CLP (5) CYANIDE	pH (FIELD)	SPEC COND (FIELD)	TEMP (FIELD)	DO (FIELD)	TOTAL AMMONIA	HARDNESS	TOC	TDS	TSS	TOTAL SOLIDS	SPECIFIC GRAVITY
GROUNDWATER MONITORING WELLS																				
MONITORING WELLS	WATER	19	38	38	38		38	38	38	38	38	38					38	38		
MATRIX SPIKE	WATER		2	2	2		2	2												
MATRIX SPIKE DUPLICATE	WATER		2	2	2		2	2												
DUPLICATE SAMPLE	WATER		2	2	2		2	2	2								2	2		
TOTAL GROUNDWATER SAMPLES (7)		19	44	44	44		44	44	40	38	38	38					40	40		
SURFACE WATER																				
SURFACE WATER	WATER	18	18	18	18		18	18	18	18	18	18	18	18	18		18	18		
MATRIX SPIKE	WATER		2	2	2		2	2												
MATRIX SPIKE DUPLICATE	WATER		2	2	2		2	2												
DUPLICATE SAMPLE	WATER		2	2	2		2	2	2					2	2		2	2		
TOTAL SURFACE WATER SAMPLES (7)		18	24	24	24		24	24	20	18	18	18	18	20	20		20	20		
SEDIMENTS																				
SEDIMENTS	SOIL	6	6	6	6		6	6	6							6			6	6
MATRIX SPIKE	SOIL		1	1	1		1	1												
MATRIX SPIKE DUPLICATE	SOIL		1	1	1		1	1												
DUPLICATE SAMPLE	SOIL		1	1	1		1	1	1							1			1	1
TOTAL SEDIMENT SAMPLES		6	9	9	9		9	9	7							7			7	7
WASTE/SUBSUFACE SOILS																				
SOIL	SOIL	10	10	10	10		5	5												
MATRIX SPIKE	SOIL		1	1	1		1	1												
MATRIX SPIKE DUPLICATE	SOIL		1	1	1		1	1												
TOTAL SOIL SAMPLES (6)		10	12	12	12		7	7												
BLANK SAMPLES																				
GROUNDWATER FIELD BLANKS	WATER		0	0	0		0	0	0											
GROUNDWATER TRIP BLANKS	WATER		2	2																
SW/SED FIELD BLANKS	WATER		2	2	2		1	1	1											
SW/SED TRIP BLANKS	WATER		1	1																
SOIL/WASTE FIELD BLANKS	WATER		3	3	3		3	3												
SOIL/WASTE TRIP BLANKS	WATER		0	0																
TOTAL BLANK SAMPLES			8	8	5		4	4	1											
TOTAL SAMPLES		53	97	97	94		88	88	68	56	56	56	18	20	20	7	60	60	7	7

(1) SUPERFUNDED CLP METHODS, NYSDEC ASP 9/89 VOA
(2) SUPERFUNDED CLP METHODS, NYSDEC ASP 9/89 BNA
(3) SUPERFUNDED CLP METHODS, NYSDEC ASP 9/89 PEST/PCB
(5) EPA SW-846 METHOD 9010/9012
(6) NUMBER INCLUDES TEST BORINGS AND IS ESTIMATED; ACTUAL NUMBER WILL DEPEND UPON FINDINGS IN THE FIELD
(7) NUMBER INDICATES TWO COMPLETE ROUNDS OF SAMPLES

3.2 Sample Designation

Each sample will be designated by an alpha-numeric code which will identify the site, matrix sampled, and contain a location-specific number.

The site code will be ML for Mooers Landfill. Location types (matrix sampled) will be identified by a two letter code, for example: SD (Sediment), MW (Monitoring Well), etc. Each matrix sampling location will be identified by a two digit number. Sample numbers at each location for each sample matrix type will begin with 01 and increase sequentially.

The following is a general guide for sample identification:

First Segment	Second Segment	Third Segment
AA	AA	NN
Site	Location Type	Specific Location

Character Type

A = Alpha
N = Numeric

Site

ML = Mooers Landfill

Location Type

BI = Biota Sample
MW = Monitoring Well Water
SB = Soil Boring
SD = Sediment
SW = Surface Water
TB = Trip Blank
FB = Field Blank

MS = Matrix Spike
MSD = Matrix Spike Duplicate

A cumulative sampling master log will be maintained as the field program progresses. The samples taken will be referenced to each sampling location in the master log and on a site map. These data will be maintained in the site logbook and on PC disk.

3.3 Sample Handling

3.3.1 Sample Container Requirements and Holding Times

Table 3-2 specifies the number of samples and duplicates, type of sample matrix, sample container requirements, sample preservation required, holding times, and laboratory and field analyses to be performed on each sample type.

3.3.2 Sample Packaging and Shipping

Samples will be packaged and shipped according to the procedures outlined in Section 5.1. Samples will be shipped for next-day delivery to the contract laboratory within 24 hours of collection.

3.3.3 QA/QC Samples

The proposed analytical program includes QA/QC samples. Matrix spike and duplicate matrix spike samples will be analyzed at a frequency of 1 set in 20 per individual sample matrix. Duplicate samples will be collected to demonstrate the reproducibility of sampling technique and laboratory analysis.

Table 3-2
MOORES LANDFILL
FIELD SAMPLING AND ANALYTICAL PROGRAM

Matrix	Number of Samples and Duplicates	Sample Container (ICHEM 300 or equivalent)	Sample Preservation	Holding Time[1]	CLP Laboratory Analysis	Field Analysis
Sediments	8	(2) 40 mℓ glass vials	Cool to 4°C	7 days	TCL VOC **Superfund CLP Methods From NYSDEC ASP 9/89**	--
	8	(1) 8 oz wide mouth glass jar	Cool to 4°C	6 months Hg (26 days)	TCL Metals **Superfund CLP Methods From NYSDEC ASP 9/89**	-
	8	(1) 8 oz wide mouth glass jar	Cool to 4°C	5 days extract; 40 days analyze	TCL BNAs **Superfund CLP Methods From NYSDEC ASP 9/89**	--
	8	(1) 8 oz wide mouth glass jar	Cool to 4°C	5 days extract; 40 days analyze	TCL Pest/PCB **Superfund CLP Methods From NYSDEC ASP 9/89**	--
	6	(1) 8 oz wide mouth glass jar	Cool to 4°C	12 days	Cyanide-EPA SW-846 Methods 9010/9012	--
	6	(1) 8 oz wide mouth glass jar	Cool to 4°C	12 days	TOC EPA SW-846 Method 9060	--
	6	(1) 8 oz wide mouth glass jar	Cool to 4°C	7 days	Total Solids EPA 160.3	--
	6	(1) 8 oz wide mouth glass jar	Cool to 4°C		Specific Gravity	--
Soil and Waste	12	(2) 40 mℓ glass vials	Cool to 4°C	7 days	TCL VOC **Superfund CLP Methods From NYSDEC ASP 9/89**	--

Notes:

1. All CLP holding times are from verified time of sample receipt.
2. Metals samples will only be filtered with NYSDEC approval.

Table 3-2
MOORES LANDFILL
FIELD SAMPLING AND ANALYTICAL PROGRAM

Matrix	Number of Samples and Duplicates	Sample Container (ICHEM 300 or equivalent)	Sample Preservation	Holding Time[1]	CLP Laboratory Analysis	Field Analysis
	7	(1) 8 oz wide mouth glass jar	Cool to 4°C	6 months Hg (26 days)	TCL Metals Superfund CLP Methods From NYSDEC ASP 9/89	-
	12	(1) 8 oz. wide mouth glass jar	Cool to 4°C	5 days extract; 40 days analyze	TCL BNAs Superfund CLP Methods From NYSDEC ASP 9/89	--
	7	(1) 8 oz. wide mouth glass jar	Cool to 4°C	5 days extract, 40 days analyze	TCL Pest/PCB Superfund CLP Methods From NYSDEC ASP 9/89	--
Groundwater and Surface Water	32	(2) 40 mℓ glass vials	Cool to 4°C	7 days	TCL VOC Superfund CLP Methods From NYSDEC ASP 9/89	--
	32	(1) One-liter polyethylene bottle	HNO_3 to pH<2 Cool to 4°C	6 months Hg (26 days)	TCL Metals (total) Superfund CLP Methods From NYSDEC ASP 9/89	--
	32	(2) One-liter amber bottles	Cool to 4°C	5 days extract; 40 days analyze	TCL BNA's Superfund CLP Methods From NYSDEC ASP 9/89	--
	32	(2) One-liter amber bottles	Cool to 4°C	5 days extract; 40 days analyze	TCL Pest/PCB Superfund CLP Methods From NYSDEC ASP 9/89	--
	28	(1) One-liter polyethylene bottle	NaOH to pH>12; 0.6g ascorbic acid Cool to 4°C	12 days	Cyanide-EPA SW- Superfund CLP Methods From NYSDEC ASP 9/89	--

Notes:

1. All CLP holding times are from verified time of sample receipt.
2. Metals samples will only be filtered with NYSDEC approval.

Table 3-2
MOORES LANDFILL
FIELD SAMPLING AND ANALYTICAL PROGRAM

Matrix	Number of Samples and Duplicates	Sample Container (ICHEM 300 or equivalent)	Sample Preservation	Holding Time[1]	CLP Laboratory Analysis	Field Analysis
	26	-	--	--	-	pH, Temp, Specific cond. Dissolved Oxygen
	28	(1) One-liter bottle or polyethylene bottle	Cool to 4°C	7days	TSS EPA 160.2	--
	28	(1) One-liter polyethylene bottle	Cool to 4°C	7days	TDS EPA 160.3	--
	7	(1) One-liter bottle or polyethylene bottle	H_2SO_4 to $pH < 2$; Cool to 4° C	28 days	Ammonia EPA 350.2	--
	7	(1) One-liter bottle or polyethylene bottle	H_2SO_4 to $pH < 2$; Cool to 4° C	6 months	Hardness (as (C_aCO_3) EPA 130.1	--
Field Blanks	5	(2) 40 mℓ glass vials	Cool to 4°C	7 days	TCL VOC Superfund CLP Methods From NYSDEC ASP 9/89	--
	5	(1) One-liter polyethylene bottle	HNO_3 to $pH < 2$; Cool to 4°C	6 months, Hg (26 days)	TCL Metals (Total) Superfund CLP Methods From NYSDEC ASP 9/89	--
	5	(2) One-liter amber bottles	Cool to 4°C	5 days extract; 40 days analyze	TCL BNAs Superfund CLP Methods From NYSDEC ASP 9/89	--

Notes:

1. All CLP holding times are from verified time of sample receipt.
2. Metals samples will only be filtered with NYSDEC approval.

Table 3-2
MOORES LANDFILL
FIELD SAMPLING AND ANALYTICAL PROGRAM

Matrix	Number of Samples and Duplicates	Sample Container (ICHEM 300 or equivalent)	Sample Preservation	Holding Time[1]	CLP Laboratory Analysis	Field Analysis
	5	(2) One-liter amber bottle	Cool to 4°C	5 days extract; 40 days analyze	TCL Pest/PCB Superfund CLP Methods From NYSDEC ASP 9/89	--
	2	(1) One-liter polyethylene bottle	NaOH to pH > 12; 0.6 g ascorbic acid Cool to 4°C	12 days	Cyanide EPA SW-846 Methods 9010/9012	-
Trip Blanks	9	(2) 40 mℓ glass vials	Cool to 4°C	7 days	TCL VOC Superfund CLP Methods From NYSDEC ASP 9/89	--

Notes:

1. All CLP holding times are from verified time of sample receipt.
2. Metals samples will only be filtered with NYSDEC approval.

Duplicate samples will be taken at a frequency of 1 set in 20 per sample matrix. Field blanks will be taken for each sampling matrix and sampling procedure during each sampling period. Field blanks will be analyzed for the same parameters as the original samples. A trip blank will accompany each daily sample group requiring analyses for TCL volatiles, and will be analyzed for TCL volatiles only.

4.0 FIELD INVESTIGATION PROCEDURES

4.1 Preparation for Field Entry

Prior to the initiation of field activities the following tasks will be performed:

1. Kick-off meeting with all involved personnel to review the scope of work to be performed, and the Sampling and Analysis Plan.
2. Review of the Health and Safety Plan by all on-site personnel.
3. Operational checkout and pre-calibration of all equipment to be taken into the field.
4. Location, flagging and labeling of all proposed borings and sampling locations.
5. Arrange access for drill rig at proposed drilling locations.
6. Mobilization of equipment and personnel to site.

4.2 Decontamination Procedures

4.2.1 Decontamination of Sampling Equipment

All reusable sampling equipment (bailers, trowels, bowls, etc.) will be pre-cleaned prior to field entry. The following cleaning procedures will be used:

1. Alconox detergent and potable water scrub.

2. Potable water rinse.

3. Ten percent nitric acid rinse (when sampling for heavy metals). Carbon steel split-spoons will be rinsed with a one percent nitric acid solution (when sampling for heavy metals).

4. Deionized water rinse or potable water rinse.

5. Methanol or hexane rinse.

6. Deionized water rinse.

7. Air dry.

Following this decontamination procedure, equipment will be wrapped in aluminum foil or stored in sealed polyethylene bags for on-site use. Whenever possible, pre-cleaned equipment will be used; however, if the need arises, equipment will be cleaned in the field according to the general procedures described above.

Preparation for Sampling On Site

Prior to any field activity, the required Health and Safety procedures will be followed. Background and downwind HNU (HNU Systems Photoionization Analyzer Model P1-101) and/or OVA (Foxboro Organic Vapor Analyzer Model OVA-128) readings will be recorded for site-specific work zones. In the event of adverse weather conditions, outside sampling events will be postponed so that the integrity of the samples is maintained. A general overview of the site will be made to foresee possible hazards or delays. If applicable, the site manager will be informed of the field team's intention.

4.2.2 Decontamination of Drilling Equipment and Reusable Tools

All drilling and excavation equipment and reusable tools will undergo complete decontamination procedures. The purpose of these procedures is to ensure that all equipment utilized at the site is contaminant free. Through these procedures, problems resulting from the introduction of contamination into a test boring or monitoring well, or cross-contamination between borings and wells, can be eliminated.

Decontamination Pad and Staging Area

To facilitate steam-cleaning of the drill rig and associated hardware, a decontamination pad will be constructed. The decontamination pad will consist of a layer of gravel or crushed stone. The pad will be constructed within the operational portion of the landfill. Drainage from the decontamination pad will be impounded and prevented from running off site. Decontamination fluids will be collected and disposed of as necessary to assure that contaminated fluids are not introduced to areas beyond the existing waste limits.

A staging area outside the area of contamination will be designated for the storage of well construction materials and newly-cleaned equipment and tools. All decontaminated materials will be placed on clean surfaces of trucks or trailers, or stored on saw horses or plastic sheeting in the staging area.

Equipment Condition

1. All drilling and excavation equipment entering the site will be inspected for integrity of hydraulic and oil fluid handling systems and general overall cleanliness. Leaking hoses, tanks, hydraulic lines, etc., shall be replaced or repaired prior to entering the site.

2. All well casing screening and other construction materials must be in new condition. Used materials shall not be permitted in well construction.

3. All observations regarding the condition of equipment and materials entering or leaving the site will be recorded daily in a field book by the site operations manager or supervising geologist.

Equipment Cleaning and Handling

Initial Cleaning

1. Following initial inspection, all drilling and excavation equipment and associated tools will be taken to the decontamination pad and steam-cleaned upon arrival at the site. Typical tools and equipment to be cleaned include:

   - Drilling rods, bits
   - Augers (clips, pins, and associated hardware)
   - Samplers (i.e., split-spoon, Denison, etc.)
   - Casing materials (both temporary and permanent)
   - Wrenches
   - Hammers
   - Other hand tools and tool boxes
   - Mud tub/pan
   - Hoses, tanks
   - Cable clamps and other holding devices in direct contact with drilling rods
   - Drill rig and undercarriage, wheelwells, chassis, and any other items that may come in contact with work area

2. During the cleaning operation, equipment shall be handled only with clean gloves. A new set of gloves will be utilized between successive cleanings for each new location.

3. Cleaned materials shall be protected from contamination during transport to the staging area by such means as the Supervising Geologist or Site Operations Manager deems necessary.

4. The Site Operations Manager will document equipment decontamination.

On-site Cleaning Between Borings/Test Pits

1. Following each well installation, all drilling equipment (listed above under "initial cleaning") shall be steam-cleaned between borings.

4.3 Geophysical and Soil Gas Survey Equipment and Procedures

Geophysical Survey

Both downhole and terrain geophysical surveys are proposed at Mooers Landfill pending a site evaluation to determine the suitability of electromagnetic conductivity, electrical resistivity and downhole, gamma logging methodologies. The scope of each of the proposed surveys is described in the Work Plan Section Numbers 4.2.2, 4.2.7, 5.2.1 and 5.2.6.

All geophysical survey work will be subcontracted, and the selected subcontractor will provide for approval quality assurance and quality control procedures for the specific geophysical methodology to be utilized in meeting the geophysical program objectives and scope of work.

At the planning stage it is anticipated that one of the instruments and methods below will be appropriate for the given site conditions. The geophysical subcontractor will select and implement the most suitable method.

EM-31-DL

For conducting a shallow penetrating EM survey, a Geonics EM-31-DL is used. This device is a one man portable unit that has a depth of exploration of approximately 12 to 15 feet (the approximate reach of a backhoe). The instrument simultaneously records the quadrature and in-phase magnetic components of the electromagnetic fields generated by the device's transmitter. The quadrature component measures terrain conductivity in units of milliSiemens/meter. A terrain conductivity map of the study site will outline areas of inorganically contaminated soils and groundwater. Contaminated areas will exhibit anomalously high terrain conductivity values compared to natural or background conditions.

The EM-31-DL device also records the in-phase magnetic component of the EM fields, and this measurement is considered the metal detection mode. The in-phase magnetic component helps identify buried metal pipes, utilities and buried metallic containers and debris. Buried metals will exhibit anomalously low and/or high values when compared to natural or background conditions. Data collection will be referenced to a topographic survey grid. Terrain conductivity and in-phase data are simultaneously recorded and stored on portable digital logging equipment. The data logger transmits information to a lap top computer where data are stored on floppy disks. This method is commonly used to map near surface contaminated soils, buried metals and contaminant plumes.

EM-34-3

For performing a multi-depth terrain conductivity survey, a Geonics EM-34-3 is used. This EM device is a two-man instrument that has variable intercoil spacings of 33, 66 and 132 feet (10, 20 and 40 meters). This allows the operators to collect data to depths of approximately 25, 50 and 100 feet (7.5, 15 and 30 meters) in the horizontal dipole mode and to depths of approximately 50, 100 and 200 feet (15, 30 and 60 meters) in the vertical dipole mode. By collecting data in both dipole modes and/or by varying the intercoil spacing (sounding), data can be generated of the subsurface stratigraphy. The success of this method is dependent upon sufficient contrasts in the electrical properties of the stratified subsurface material. By collecting data at constant intercoil spacings (profiling), information regarding lateral changes in stratigraphy and the presence of contaminated soils and groundwater. This method is commonly used to map subsurface stratigraphy, contaminated soils and contaminant plumes.

EM-16R

The Geonics EM-16R VLF (Very Low Frequency) resistivity meter is used to measure the apparent resistivity of subsurface material and the phase angle between the electrical field component and the reference magnetic field. The apparent resistivity is measured in units of ohm-meters and the phase angle is measured in units of degrees (used as an indicator of subsurface homogeneity). The instrument utilizes VLF air and marine navigational radio signals located throughout the world. The electrical field is measured by inserting two inductive probes into the ground and separated 33 feet apart in the direction of the transmitting station.

The depth of exploration with the EM-16R is dependent upon the resistivity of the subsurface material and the frequency of the electromagnetic fields. Generally, the depth of exploration of the EM-16R increases as the resistivity of the subsurface material increases. This method is commonly used to map subsurface stratigraphy, contaminated soils and contaminant plumes.

Soil Gas Survey

The equipment involved to conduct the soil gas survey will include a power auger fitted with a small diameter auger bit; 4-foot lengths of small diameter (approximately 1-2 inches) PVC pipe; parafilm; and a Photoionization Detector (PID).

The PID instrument measures airborne vapors that are detectable by photoionization. The PID comes equipped with a 10.2 electron volts (ev) ionization source which will charge any compound, having an ionization potential below 10.2 ev, to an exited state from which the compound's relative concentration in ppm (parts per million) can be read (all compounds expected to be encountered at the site have ionization potentials less than 10.2 ev). The PID instrument is not designed to identify individual compounds but is meant to quantify the concentration of total ionizable compounds present. The PID will be calibrated at least twice a day in order to maintain a degree of accuracy and to record the daily drifting of the instrument between calibration.

Once the operating grid has been located over the survey area, each survey point will be drilled as a small diameter borehole, using the power auger, open to a depth of approximately four feet (it is expected that the soil conditions present at the site will allow the shallow boreholes to remain open throughout the survey). Once the borehole has been drilled, one length of PVC pipe will be inserted into the borehole to approximately one foot below grade, and sealed at the surface by backfilling around the pipe with the auger cuttings. An adequate seal is essential in creating a preferential path for volatilized compounds that have diffused from the walls of the open borehole to collect within the headspace of the pipe. The top of the pipe is then fitted with parafilm to prevent the collected vapors from escaping into the air.

The collection pipes will be allowed to stabilize for at least one hour before any readings are taken. Vapors are then measured by inserting the tip of the PID through the parafilm and into the PVC pipe. The pump inside the PID which becomes activated once the instrument is turned on, will draw the air from within the pipe and the open borehole into the ionization chamber. The recorded measurements will reflect both the highest attained instrument reading and the concentration (if encountered) at which it appears to represent a constant state. After the initial readings have been recorded, the collection pipes will be resealed and monitored in order to confirm the first round readings.

The soil gas survey points will be marked and identified with flags to help in locating the position of monitoring wells once the geophysical and soil gas data have been studied and interpreted.

4.4 Drilling Program

The anticipation of difficult drilling conditions at Mooers Landfill warrants the implementation of a flexible two staged drilling program. The first stage of the program will initially confirm the existing geologic conditions using a drilling method and equipment which will efficiently advance a borehole and provide good quality continuous soil sampling. A decision to install a monitoring well in the exploratory borehole will be made based on the borehole's condition. If the exploratory borehole is judged to be unsuitable for monitoring well installation, a second stage of the drilling program will be initiated. The second stage of the program will involve the use of a water well drilling rig which can drill and install single or multi-cased monitoring wells without introducing drilling additives and the uncertainties to groundwater quality associated with these materials. A borehole will be judged unsuitable for monitoring well installation if it cannot be demonstrated, to the satisfaction of Barton & Loguidice, P.C., and the Regional NYSDEC Office, that the drilling methodology and equipment has negligible impact on water quality of samples extracted from the monitoring well.

4.4.1 Exploratory Borings

The following drilling procedures will be utilized to complete the exploratory borings.

1. The boreholes will be advanced utilizing hollow stem augers or rotary methods of advancement until the requisite depth is encountered.

2. Drilling will proceed in a manner to permit continuous split-spoon sampling, and/or undisturbed sampling through the overburden materials until the required depth is achieved.

3. No drilling fluids other than potable water from an approved source will be used unless prior approval is received from the NYSDEC.

4. If, in the case of rotary drilling, difficulties arise in washing coarse materials out of the casing with water, drilling fluid additives mixed with potable water will be used to drill. Prior approval from the NYSDEC will be required and documented before utilizing any drilling additive.

5. All pertinent information and boring logs will be recorded by the observing geologist.

4.4.2 Multi-Cased Wells

If any significant confining layers are identified during the investigation, the installation of permanent steel casing may be necessary. This method is the recommended procedure to minimize the risk of creating a contaminant pathway when drilling to a deeper strata.

1. The borehole will be advanced as described in Section 4.4.1. Upon identification of the confining unit drilling will be temporarily suspended.

2. A six-inch flush joint/single permanent steel casing will be installed into the borehole. The steel will be driven into the confining layer a minimum of one-foot below the bottom of the existing borehole.

3. The borehole annular space will be grouted from the bottom by injecting a cement-bentonite grout mixture via the tremie method or an approved alternate method.

4. The grout will then be allowed to set, up to a minimum of 12 hours, or as determined by the supervising geologist.

5. Following the set-up period, drilling will be continued.

6. The drilling and sampling method will be in accordance with Section 7.1.1.

4.4.3 Shallow and Deep Monitoring Well Boreholes

1. Boreholes for the monitoring well installations will be advanced utilizing an appropriate drilling method of advancement until the requisite depth is encountered.

2. The monitoring wells will be drilled and located within a radial distance no greater than 15 feet away and no less than eight feet from the exploratory boring and/or adjacent monitoring well installation.

3. As with the drilling for the exploratory borings, should rotary drilling be required, only potable water from an approved source will be used unless prior approval is

received from the NYSDEC for use of a drilling additive for removal of drill cuttings from the borehole.

4. The monitoring well boreholes adjacent to an exploratory borehole will be sampled in accordance with the procedures of the Standard Penetration Test (ASTM D 1586-84) across geologic contact zones and in the screened interval.

4.4.4 Material Sampling/Analysis

4.4.4.1 Split-Spoon

1. At each exploratory boring location, continuous split-spoon samples will be taken through the overburden in accordance with the procedures of the Standard Penetration Test (ASTM D1586-84). Before each sample is taken, depth will be confirmed by the supervising geologist.

2. Soils will be classified in accordance with the Modified Burmister Classification System. Field classification will include color, grain size, lithology, relative density, moisture content, soil texture and structure, relative permeability, and local geologic name. Classification will be based on the soils' identification key presented in Table 4-1.

Table 4-1
MOORES LANDFILL
KEY TO SOILS IDENTIFICATON

GRANULAR SOILS – PARTICLE SIZE CLASSIFICATION

Material		Fractions	Passing	Retained On
BOULDERS	Material retained on the 9-inch sieve			9 inch
COBBLES	Material passing the 9-inch sieve and retained on the 3-inch sieve		9 inch	3 inch
GRAVEL	Material passing the 3-inch sieve and retained on the No. 10 sieve	coarse (c) medium (m) fine (f)	3 inch 1 inch 3/8 inch	1 inch 3/8 inch No. 10
SAND	Material passing the No. 10 sieve and retained on the No. 200 sieve	coarse (c) medium (m) fine (f)	No. 10 No. 30 No. 60	No. 30 No. 60 No. 200
SILT	Material passing the No. 200 sieve that is non-plastic in character and exhibits little or no strength when air-dried		No. 200	

CLAY SOILS – PLASTICITY CLASSIFICATION

Material*	Degree of Overall Plasticity	Overall Plasticity Index Sand-Silt-Clay Components
Clayey SILT	Slight	1 to 5
SILT & CLAY	Low	5 to 10
CLAY & SILT	Medium	10 to 20
Silty CLAY	High	20 to 40
CLAY	Very High	40 and greater

* Soils passing the No. 200 sieve that can be made to exhibit plasticity and clay qualities within a certain range of moisture content, and that exhibit considerable strength when air-dried.

PENETRATION RESISTANCE AND SOIL PROPERTIES ON BASIS OF THE STANDARD PENETRATION TEST (AFTER PECK, HANSON, AND THORNBURG, 1974)

Sands (Fairly Reliable)		Clays (Rather Unreliable)	
Number of blows per foot, N	Relative Density	Number of blows per foot, N	Consistency
		Below 2	Very Soft
0 – 4	Very Loose	2 – 4	Soft
4 – 10	Loose	4 – 8	Medium
10 – 30	Medium	8 – 15	Stiff
30 – 50	Dense	15 – 30	Very Stiff
Over 50	Very Dense	Over 30	Hard

TERMS IDENTIFYING COMPOSITION OF SOIL

Written*	Defining Range of Percentage by Weight
and	35 to 50
some	20 to 35
little	10 to 20
trace	0 to 10

* Plus (+) or minus sign (–) used after identifying term denotes extremes of range; e.g., "some (–) Gravel" indicates 20 to 24% Gravel; "some (+) Gravel" indicates 31 to 35% Gravel.

3. HNU and/or OVA readings will be recorded from each split-spoon as soon as the sampler is opened.

4. If VOC concentrations are observed to be greater than 5 ppm on the HNU and/or OVA, samples will be collected for laboratory analysis.

5. Samples for volatile analysis will be transferred directly to 40 ml vials. The remaining soil will be transferred to soil jars for the analysis of the remaining parameters.

6. Follow recordkeeping and chain-of-custody procedures as detailed in Section 5.1.

7. Soil samples not sent for laboratory analysis will be placed in eight-ounce, wide-mouth, moisture-tight glass jars, and sealed with a foil liner and a screw-on cap.

8. Sample jars will be labeled with the following information: project name, project number, well identification, depth interval represented by the sample, blow counts, and date taken. This information will also be recorded in the field notebook.

9. The organic vapor levels in the headspace above the soil sample in each jar will be monitored using a HNU photoionization detector (samples placed in jars should allow a minimum of 1-inch of headspace for analysis). After allowing for some consistent equilibration time, the cap will be gently opened, and the HNU tip immediately inserted through the foil liner. This HNU reading and equilibration time will be recorded by the supervising geologist.

10. Split-spoon samples will be decontaminated following the procedures below when soil samples are to be collected for analytical analysis.

    - Detergent wash with alconox
    - Potable water rinse
    - 1% Nitric acid rinse
    - Deionized or potable water rinse
    - Hexane or methanol (pesticide grade) rinse
    - Air dry
    - Triple deionized water rinse
    - Air dry

11. Laboratory tests will be performed on selected soil samples to include: grain size distribution (ASTM D422), moisture content (ASTM D2216) and Atterberg limits (ASTM D423, D424).

4.4.4.2 Denison Tube

1. Undisturbed Denison tube samples will be attempted if any significant confining layers are encountered.

2. The borehole will be "cleaned out" to the sample target depth and confirmed by the supervising geologist.

3. Only new Denison sample tubes, free of rust or dents, will be used to collect undisturbed samples. Each sample tube will be 24 to 36 inches long, with an internal diameter of 2.4 inches, or as approved by the American Society of Testing Materials.

4. The tube will be advanced a maximum of 24 inches beyond the bottom of the hole at the time of sampling.

5. The Denison sample will be hydraulically pressed if possible. If soils are hard, the sample will be rotated using minimum down pressure. The supervising geologist will determine when to stop attempting a sample in dense soils.

6. Prior to withdrawal, the tube will be allowed to sit undisturbed for two minutes. The tube will then be rotated to shear the

sample from the formation. Care will be taken during borehole removal to limit sample disturbance to a minimum.

7. The undisturbed sample will be sealed airtight immediately upon collection, using wax, plastic end caps, and tape. If the sample does not completely fill the sample tube, the extra space will be filled with a material that will not remove moisture from the sample.

8. The tube will be measured for recovery, and a line drawn directly onto the outside of the sample tube with an indelible marker. The tube will be labeled with project name, project number, boring location, sample number, depth interval, recovery, and a brief description of the material.

9. Specially designed shipping boxes will be used for disposition of the undisturbed samples to the offices of Barton D. Loguidice, P.C. in Syracuse, New York.

10. All pertinent data will be recorded daily by the supervising geologist on the appropriate forms and field book.

11. Vertical permeability will be determined in the laboratory in a constant volume permeameter.

4.4.4.3 NX Core

1. A 15-foot continuous NX core will be taken in each of the deep test borings to confirm the bedrock surface and lithology.

2. All NX coring will be performed by rotary drilling methods using clean water as a drilling fluid.

3. Before coring, the bedrock will be reamed, using a 3-7/8-inch roller bit to at least 1 foot below the top of the bedrock to ensure a clean, competent surface to begin the coring procedure.

4. Individual core runs will not exceed 10 feet in length.

5. Starting depth for every core run will be verified prior to core drilling by the supervising geologist.

6. Core samples will be collected, examined, and logged immediately upon retrieval, and stored in specially-designed wooden boxes.

7. Visual field classification of the rock core will include: lithology and texture, color, hardness, degree of weathering, bedding/joint/fracture spacing, discontinuities, and local geologic name.

8. Rock Quality Designation (RQD) will be recorded for all core samples using USGS recommended procedures.

9. Each core box will be labeled with the project name, project number, boring location, depth interval, run number, recovery, RQD, the top and bottom of the run, and the date.

10. In addition to visual classification, the supervising geologist will record all observations during core drilling, including coring rate in minutes per foot, fluid gain or loss, drill rig reactions, and types of casing and drilling fluid used.

11. The core samples will be stored at a suitable location provided by Clinton County Highway Department.

4.4.5 Installation of Monitoring Wells

The procedures to be utilized for each type of well installation are outlined below.

4.4.5.1 Monitoring Wells

1. A minimum four-inch diameter borehole will be advanced via hollow stem augers or rotary drilling with split-spoon and/or "undisturbed" (Denison tube) sampling. For

bedrock monitoring wells the NX core hole will be reamed to a diameter of approximately four inches.

2. The monitoring well will be constructed of two-inch ID Type 316 stainless steel riser, and Type 316 stainless steel screen.

3. Six inches of clean bottom sand pack will be installed followed by the installation of the well.

4. Using only potable water, the boreholes will be flushed to remove drilling fluid and cuttings by injecting water through the well and out the screen.

5. A six-inch bottom sand pack will be installed upon which the well will rest.

6. Following proper backfill, the well screen and riser will be installed.

7. The well screens will be placed in accordance with Section 4.2.4 of the work plan.

8. A clean, coarse sand pack will be placed in the annular space surrounding that portion of the well occupied by the screen, and for a minimum of two feet above the top of the screen.

9. A two-foot minimum bentonite seal will be placed above the sand pack.

10. The remaining annular space will be filled to the ground surface with cement-bentonite grout using the Tremie installation.

11. A steel locking cap will be fitted to the six-inch ID steel casing extending aboveground to secure the location.

12. The steel protective casing will be clearly and permanently marked with the well identification number.

4.4.5.2 Replacement of Existing Monitoring Wells

The existing monitoring wells will be abandoned in accordance with current NYSDEC requirements. Replacement monitoring wells will be drilled and installed in accordance with Section 4.4.4.1 of the SAP.

4.4.6 Sand Pack, Bentonite Pellet Seal, and Cement-Bentonite Grout

4.4.6.1 Sand Pack

1. The sand pack will consist of uniformly-graded, clean inert fine sand with a 100 percent by weight passing the No. 30 sieve, and less than two percent by weight passing the No. 200 sieve.

2. A sample of the pack material is to be retained and placed in an eight-ounce wide-mouth glass jar, sealed and stored by Barton & Loguidice for a one year period.

4.4.6.2 Bentonite Seal

1. Pure Wyoming sodium bentonite pellets will be used, and will be less than one-half the width of the annular space. An alternative method could be the use of a granular bentonite slurry which would be installed by pressure grouting with tremie rods.

2. After the seal is installed there will be a minimum of a 30-minute waiting time period. This will allow for proper swelling and action of the bentonite before placement of the grout.

4.4.6.3 Cement-Bentonite Grout

1. Cement shall be Portland cement Type I, in conformance with ASTM C150.

2. Bentonite will be a powdered Wyoming sodium bentonite.

3. Proportions of cement/bentonite/water in the grout mix will be approximately 94 pounds/3 to 5 pounds/7.0 gallons, respectively.

4. The grout mix will be installed by pressure grouting through tremie rods.

5. The grouting will be complete when the grout mixture returns to the ground surface.

4.4.7 Boring Logs and Recordkeeping

During the drilling of each borehole and installation of each monitoring well, an accurate log will be kept and include the following:

1. Date and time of construction/drillers and helper's name, and Wehran supervising geologist.

2. Drilling method utilized.

3. The reference point for all depth measurements (i.e., ground surface).

4. The depth at which each change of formation is identified.

5. The depth at which the first water bearing zone is defined.

6. The thickness of each stratum.

7. The description of the material of which each stratum is composed, including:

   a. Depth, sample number
   b. Grain size, as defined by the Modified Burmister System
   c. Color
   d. Degree of weathering cementation, and density
   e. Other physical characteristics

8. The depth interval from which each formation sample was taken.

9. The depth at which hole diameters (bit sizes) change, if applicable.

10. The depth to the static water level (SWL) and changes in SWL with well depth, if possible.

11. Total depth of completed well.

12. The depth and description of the well casing materials, screen and riser lengths, sand pack, pellets, and grout.

13. Depth or location of any lost drilling materials or tools.

14. The nominal hole diameter of the well bore above and below the casing seal.

15. The amount of cement and bentonite (number of bags) installed for the seal.

16. Screen materials and design.

17. Casing and screen joint type.

18. Screen slot size/length.

19. Pack, seal, and grout material used.

20. Type of protective well cap.

21. HNU/OVA readings

Figure 4-1 presents the test boring log to be utilized by Barton & Loguidice.

A daily report will be prepared and will give a complete description of all formations encountered, number of feet drilled, number of hours on the job, standby or shutdown time, the water level in the well at the beginning and end of each shift, water level at each change of formation (if readily measurable with the drilling method used), feet of casing installed, and other pertinent data. Figure 4-2 presents the daily log to be used.

Client ____________________
Project ____________________
____
Project No. ____________________

B&L
BARTON & LOGUIDICE, P.C.
CONSULTING ENGINEERS & LAND SURVEYORS
290 ELWOOD DAVIS ROAD / BOX 3107, SYRACUSE, NEW YORK 13220

SUBSURFACE LOG

FIGURE 4-1

Method of Investigation

Drill Rig ____________________
Casing ____________________
Soil Sampler ____________________
Sample Hammer: Wt. ________ lb.Fall ________ In.
Rock Sampler ____________________
Other: ____________________

Contractor ____________________
Driller ____________________
Inspector ____________________
Start Date ________ Completion Date ________
Surface Elevation ____________________
Boring Location ____________________

Depth ft.	SAMPLE					MATERIAL DESCRIPTION	REMARKS	
	No.	Type	Rec	Blows per 6" / Core Run	N / RQD			USCS

KEY: S = Split Spoon C = Cored A = Auger Cuttings U = Undisturbed W = Washed RQD = Rock Quality Designation
USCS = Unified Soil Classification System REC = Recovery

B&L Form No. 135

FIGURE 4-2

DAILY LOG (SHEET NO. 1)

Contractor ______ **Date** ______ **Shift** ______ **Sheet No.** ___ **of** ___

Drill I.D. ______ **Carrier** ______ **Job. No.** ______

Borehole Number(s) This Date ______ **Client** ______

Drill Time Log

(explain all down and standby time -- who authorized - unusual circumstances, etc.)

Category	Total Hours	A.M.						P.M.												A.M.					
		6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6
Drilling																									
Coring																									
Well Installation																									
Well Development																									
Recovery Testing																									
Water Run																									
Other																									

Remarks

DAILY LOG (SHEET NO. 2)

Expendables
(Itemize quantity, size, etc.)

Item	Quantity

Borehole No.	From (ft.)	To (ft.)	Footage Drilled (ft.)	Drilling Method	Sampling Method	Sampling Interval

Personnel Time Log

Position	Name	Hours
Geologist		
Driller		
Helper		

Geologist	Consultant Representative
Driller	Contractor Representative

4.5 Well Development

The purpose of well development is to remove fine materials from the area of the screen and prepare a monitoring well for future groundwater measurement and sampling activities. This is achieved by various development methods until such time as the water quality obtained from the well is consistent with water quality in the formation from which the water is obtained, usually determined by measurement of pH, specific conductivity, or turbidity. Well development shall be performed using the following outlined field procedures.

4.5.1 Development Field Procedures

1. Inspect locking casing and surface grouting for integrity.

2. Open the well.

3. Measure static water level from top of the well casing and the well bottom depth; and calculate water volume from the formula:

$$V = \quad R^2H$$

Where:

V = volume, (ft^3)
R = well ID radius, (ft)
H = length of water column, (ft).
= 3.14

4. Lower a pre-cleaned teflon bailer connected to new solid braid nylon rope to the bottom of the well.

5. Bail the well until all fines are removed from the well and there is no solid sediment in the bottom of the well. Alternatively, potable water, air or pure nitrogen will be introduced into the well.

6. Insert a pre-cleaned stainless steel submersible pump approximately midway into the water column or, insert a length of new polyethylene hose into the well to approximately two feet from the bottom of the well. Attach the hose to a suction-type pump equipped with a backflow prevention valve.

7. Activate the pump, record time and flow rate.

8. At 15-minute intervals during pumping, record temperature, pH, specific conductivity, and turbidity, utilizing calibrated instruments (see Appendix A for specific instrument calibration procedure).

9. The pump shall be periodically raised and lowered throughout the water column to ensure the screened interval is completely developed.

10. If, as anticipated, low yield and slow recovery do not permit continuous pumping, the well will be pumped or bailed at periodic intervals.

11. Development shall be considered complete when the following conditions are achieved for three successive measurement intervals:

    - Temperature and conductivity to within ±10%
    - pH to ±0.3 pH units
    - Turbidity has reached 50 NTU. In the event that 50 NTU cannot be achieved because of the nature of the formation, the NYSDEC will be notified and an alternative criteria will be mutually agreed upon (e.g., purging to continue until NTU readings have stabilized to within ±10%).

12. When the preceding conditions are met, remove the pump, measure the water level, secure and lock the well.

13. Record all pertinent information in a field book.

4.6 In-Situ Permeability Testing

In order to evaluate the in-place permeability and water-bearing characteristics of the saturated materials, field permeability tests will be performed on wells installed during this investigation.

A technique utilized will be the variable head borehole test developed by Hvorslev (1951) for the United States Army Corps of Engineers, and summarized in Cedergren (1977). The bail or recovery tests will be conducted as follows:

1. The static water level in the well to be tested will be measured and recorded.
2. The well will be evacuated by pumping or bailing.
3. At frequent time intervals, the water level in the wells, and the respective time elapsed from the beginning of the recovery period, will be measured and recorded.
4. This will continue until the recovered water level has reached approximately 90 percent of the static water level.
5. All equipment will be decontaminated between wells, according to applicable procedures outlined in Sections 1.0 and 4.0.

The method of analysis assumes that the rate of inflow to the well after evacuation is proportional to the hydraulic conductivity (K), expressed in cm/sec, and to the unrecovered head distance. A plot of the unrecovered head distance of Head Ratio versus Time (t) indicates an exponential decline in the recovery rate with time:

$$K = \frac{r^2 \ln (h_1/h_2)}{2\ L(t_2-t_1)} \qquad \ln (L/R)$$

Where:

R =sand pack or screen radius, cm

r =riser radius, cm

L =length of sandpack, cm

t_1 =time interval corresponding to h_1, sec

t_2 =time interval corresponding to h_2, sec

h_1 =head ratio at t_1, dimensionless

h_2 -head ratio at t_2, dimensionless

K =permeability (hydraulic conductivity), cm/sec

The above equation indicates that the test data should plot on a straight line on semi-logarithmic graph paper. Hvorslev's analysis indicates, however, that under certain field conditions, the assumptions of the method would not be met during the initial stages of the test. In such cases, Hvorselv suggests that data for the region of head ratios between 0.37 and 0.90 will be the most representative. Our analysis will be consistent with this approach.

A second methodology for the in situ determination of permeability that may be employed is slug testing modeled after the work of Ferris et al. 1980. The tests will be conducted as follows:

1. The static water level in the wells to be tested will be measured and recorded.

2. A pressure transducer is placed near the bottom of the well and connected to a data logger (Hermit Environmental Data Logger (In Situ Model No. SE 1000B)) to measure and record head changes with time.

3. A slug of distilled water of known volume will be added and the dissipation of head with time measured.

4. The head and time data will then be compared to a family of type curves based on the method presented by Cooper, Bredehoeft and Papadopoulos (1967). The comparison is performed using a personal computer and software package prepared by Groundwater Graphics.

5. An estimate of transmissivity and storage will then be calculated.

This methodology assumes that horizontal flow to the intake is occurring. Based on this assumption, either the length of the sand pack or the screen is then used to convert the transmissivity into permeability.

4.7 Monitoring Well Purging

Upgradient wells will be purged prior to downgradient wells to minimize any possibility of cross-contamination. Wells are purged using one of the following:

1. 1-3/4" O.D. lubricant-free stainless steel submersible pump with polyethylene discharge tubing. (Keck Geophysical Instruments, Inc. Model No. SP-81) for 2-inch diameter wells.

2. Peristaltic pump connected to new Teflon tubing will be used if static water levels are higher than 25 feet.

3. Bladder pump connected to new drinking water quality polyethylene tubing.

4. Pre-cleaned Teflon bailer connected to new solid braid nylon rope.

Wells are purged in the following manner:

1. Inspect well protective casing collar and lock for integrity.

2. Open lock protective casing, and remove well casing cap. Make note in field book if cap is missing.

3. Use calibrated steel tape or electronic water level indicator (Slope Indicator Company Model 51453) to measure within 0.01 inches the static water level and depth to bottom from top of protective casing. Record measurements in field book.

4. Thoroughly rinse steel tape or electronic water level indicator with deionized water.

5. Calculate well volume by subtracting static water level from depth to bottom, and multiply by the appropriate well factor on Table 4-2.

TABLE 4-2

WELL FACTOR CHART FOR VOLUME CALCULATIONS

Well Diameter (inches)	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/2	3	4	5	6	8
Factor (gallons/foot)	0.02	0.04	0.06	0.09	0.12	0.16	0.25	0.37	0.65	1.00	1.50	2.60

6. Purge a minimum of three well volumes or completely evacuate the well. The pump or bailer should remove water from the top of the water column so as to assure removal of all stagnant water in the well. Specific conductance, pH, Eh, and temperature will be measured during purging to confirm stabilization of water quality.

7. Direct bailed or pumped water away from the well(s).

8. Remove purging equipment.

9. Replace well cap and lock protective casing.

10. Allow for recovery of well prior to sampling.

4.8 Groundwater Sampling

4.8.1 Monitoring Well Sampling Procedure

The primary objective of field personnel in obtaining groundwater samples is to collect and preserve representative samples, and adhere to proper custody procedures in their prompt shipment to the certified laboratory for analyses within the specified holding times. Upgradient wells will be sampled prior to downgradient wells. Wells are sampled within 24 hours of purging in the following manner:

1. Following adequate recovery, obtain sample with a pre-cleaned Teflon bailer suspended on new, solid-braid nylon rope. Transfer sample directly from the Teflon bailer to the parameter-specific sample vessels labeled appropriately (sample ID Number and preservative), and place in coolers with ice or ice packs. Fill sample bottles in the following order: VOAs, metal filtration

flask, inorganics, indicator parameters, and organics. A specific procedure for metals filtration, should it be required, appears in Section 4.8.2.

2. Record duplicate measurements of pH, Eh, temperature, and specific conductivity at this time, along with the date and the time the sample was obtained. Sample appearance such as color, odor, and turbidity will also be recorded.

3. Calibrate all field chemistry equipment every four hours (see Appendix A). Details on the calibration and calibration frequency will be recorded.

4. Follow recordkeeping and chain-of-custody procedures as detailed in Section 5.1.

5. Replace all well caps, and lock protective well cover.

6. Between wells, clean bailers using the same decontamination procedures as outlined in Section 4.2.1, or use pre-cleaned equipment.

7. At the end of the sampling day, the coolers will be taped shut with the custodian's initials placed on the tape at the points of entry. Samples will be shipped via Federal Express to the contract laboratory for morning delivery or delivered directly to the laboratory by the field personnel at the end of the sampling day.

8. Contact with the laboratory will be made within 24 hours after each sampling event to ensure that samples arrived safely and with proper integrity preserved.

4.8.2 Metals Filtration

Samples for dissolved metals analysis will be field-filtered should a turbidity of 50 NTU not be achieved following well purging. The following procedure will be used:

1. Assemble pre-cleaned filter flask, funnel sections, and vacuum hand pump.

2. Insert a new 0.45 um pore size/47 mm diameter cellulose nitrate membrane filter between the two sections of the filter funnel.

3. Transfer water from bailer to top section of filter funnel. Fill funnel completely or partially, depending on water clarity.

4. Operate hand pump until 50 to 76 cm of mercury vacuum is achieved.

5. Replace filter when top section of funnel is empty, or when filter becomes clogged. With very turbid samples, it may be necessary to change the filter after every 100 mls of water.

6. When sufficient filtered sample is obtained, transfer sample from filter flask to sample bottle containing appropriate preservative, taking care that no sample water enters into the tubing leading to the vacuum hand pump.

7. Between wells, thoroughly field-clean assembly as described in Section 4.2.1.

8. Following field cleaning of the filter assembly, repeat Steps 2 through 7 on next sample.

4.9 Surface Water Sampling

Surface water samples will be collected from various locations on or around the site. Mid-depth samples will be obtained from each station, where possible. Samples will not be collected immediately after periods of heavy rains.

1. Immerse sample bottle in stream with cap on to desired depth.
2. While keeping bottle upright, remove cap, allowing bottle to fill.
3. When bottle is full, replace cap and remove from stream.
4. If stream to be sampled is not sufficient depth to allow full immersion, bottle may be tilted. However, care must be taken to ensure that the preservative in the sample bottle (if any) does not spill out.

5. Place filled bottles in coolers with ice or ice packs as soon as possible.

6. Record duplicate measurements of temperature, pH, and conductivity.

7. Field notes will include a description of sample location, field measurements, sample descriptions, and general flow conditions.

8. Record the flow rate of the stream.

9. Follow recordkeeping and chain-of-custody procedures as followed as detailed in Section 5.1.

10. At the end of the sampling day, the coolers will be taped shut with the custodian's initials placed on the tape at points of entry. Samples will be shipped via Federal Express to the contract laboratory for morning delivery, or

delivered directly to the laboratory by the field personnel at the end of the sampling day.

11. Contact with the laboratory will be made within 24 hours after each sampling event to ensure that samples arrive safely and with proper integrity preserved.

4.10 Sediment Sampling

Sediment samples will be collected from the stream bed in various locations. A stainless steel hand corer will be utilized to extract the sediment in the following manner:

1. Vertically line up the sampler and push the sampler in a smooth and continuous movement through the sediments to the desired penetration (maximum six inches). If stream depth prohibits pushing the corer, the corer will be advanced by gravity fall.

2. If the corer has not been completely submerged, close the flutter valve by hand, and press it shut while the sample is retrieved.

3. Extract the sample into the parameter-specific sample bottle, label appropriately (sample ID Number), and store on ice or ice packs as soon as possible.

4. Follow recordkeeping and chain-of-custody procedures as detailed in Section 5.1.

5. Thoroughly field-clean corer as described in Section 4.2.1.

6. At the end of the sampling day, the coolers will be taped shut with the custodian's initials placed on the tape at points of entry. Samples will be shipped via Federal Express to the contract laboratory for morning delivery, or delivered directly to the laboratory by the field personnel at the end of the sampling day.

7. Contact with the laboratory will be made within 24 hours after each sampling event to ensure that samples arrived safely and with proper integrity preserved.

4.11 Leachate Sampling

Leachate samples will be collected from select locations on the site where active leachate seeps are observed. Samples will be obtained in the following manner:

1. If the leachate seep is of sufficient depth, submerge mouth of appropriate sample container in seep so that discharge leachate will flow undisturbed directly into the sample container. Care must be taken to ensure that the preservative in the sample bottle (if any) does not spill out.

2. If there is not sufficient depth, a small space may be excavated for the sample container with a pre-cleaned steel hand shovel so that undisturbed leachate will flow into the bottle.

3. Place filled sample containers in coolers with ice or ice packs as soon as possible.

4. Record duplicate measurements of temperature, pH, and conductivity.

5. Field notes will include a description of sample location, field measurements, sample descriptions, and general flow conditions.

6. Record the flow rate of the seep.

7. Follow recordkeeping and chain-of-custody procedures as detailed in Section 5.1.

8. Steps 1 through 7 will be accomplished at each leachate sampling location.

9. At the end of the sampling day, the coolers will be taped shut with the custodian's initials placed on the tape at points of entry. Samples will be shipped via Federal Express to the contract laboratory for morning delivery or delivered directly to the laboratory by the field personnel at the end of the sampling day.

10. Contact with the laboratory will be made within 24 hours after each sampling event to ensure that samples arrived safely and with proper integrity preserved.

4.12 Air Quality Screening

Air screening will be conducted in all areas of the landfill where vegetation burnouts indicate the presence of methane migration through cover soils. A qualitative survey will be performed by establishing a 100-foot by 100-foot grid over the area and walking along it with a photoionization detector (HNU, 10.2 eV lamp), which records total VOC (volatile organic compound). Readings will be taken every 10 feet, approximately two feet above ground surface. All readings will be recorded and plotted on sketches of the surveyed areas. The perimeter of the landfill will also be surveyed.

A reference stake will be placed in all areas monitored to allow later surveying and inclusion in the base map.

4.13 Ecological Evaluation

Terrestrial Survey

An evaluation of the ecology of the Mooers Landfill site, as well as the surrounding area, will be conducted. The ecology of the area will be described in terms of on-site and off-site vegetation and wildlife. Where possible, a specific list of plant and animal species (including mammals, birds, and reptiles) occurring in the area will be provided. These lists will be based on field observations (sightings, track counts, nests, etc.), existing ecological surveys (if available), and if necessary, an evaluation of the habitat to determine what species could be found in the area based on individual species habitat requirements.

A general vegetative cover map of the site and surrounding area within 0.5 miles will also be constructed from aerial photos and field observations. The cover map will delineate vegetative communities by comparing species composition and structural diversity (i.e., foliage height, spatial distribution, percent cover, etc.) of each plant community.

Due to the fact that all wastes are presently buried, there appears to be a very limited direct contact route for exposure of wildlife to potential contamination (except leachate). There is undoubtedly a small population of wildlife species occupying the immediate vicinity of the site which could be affected, but their numbers are expected to be small. Subsequently, no provision for tissue analysis from on-site wildlife have been included in this work plan. If significant contamination is detected migrating off the site, or the potential for exposure to wildlife is determined to be greater than previously anticipated, biotic sampling and tissue analysis will be reconsidered.

Aquatic Survey

To evaluate baseline conditions in aquatic habitats in the vicinity of the site, a qualitative survey of the fisheries resources inhabiting the unnamed tributary of English River (located west of the site) and in the unnamed stream which flows east into Beaver Meadows, will be performed. Fish sampling will be performed using an electroshocker and/or seine to obtain a representation of the species present in each stream. Sampling locations will be in similar habitats upstream and downstream, or where leachate outbreaks are known to contact the subject surface waters. A total of three sampling locations are proposed (one upstream, one adjacent to landfill, and one downstream).

Fish captured would be identified by species and measured. Data will be presented in tabular form and will contain an assessment of the aquatic habitat in each sampling location.

A quantitative benthic macroinvertebrate survey will be conducted in the tributary both upstream and downstream of the identified leachate outbreak. Parameters to be measured include taxonomic composition, abundance, species diversity, and richness.

The reporting format for the ecological inventory will consist, in part, of species lists by taxon of invertebrates and vertebrates observed on the site and in the surrounding areas. Designations of general abundance (i.e., abundant, common, uncommon) will be given to each species. Special attention will be given to determining the status of any Federal- or State-listed endangered or threatened species.

Textural material will consist of descriptions of the faunal communities and an assessment of the species richness on the site.

Direct interrelationships (i.e., food chains) between species will be discussed, if relevant. Any gross deviations in species composition from what might be expected in the existing available habitats will be discussed.

During the course of this investigation, it is possible that the presence of significant contamination, combined with utilization of the site by wildlife species, may result in the discovery of a significant route of exposure and migration. In the event that contamination of biological communities is suspect, collection of terrestrial and aquatic biota samples for tissue analysis may be recommended. NYSDEC will be apprised of any developments regarding the need for biota sampling. In the event that biota sampling is deemed appropriate at Mooers Landfill, a separate work plan and budget will be submitted for approval.

4.14 Staff Gauges

Surface water staff gauges will be installed at each surface water and sampling location.

1. Steel fence posts will be driven into the soils until refusal.

2. The staff gauges will be labeled and flagged for future identification.

3. Each gauge will be surveyed to establish its coordinates and vertical elevation (0.01-foot accuracy).

4. The top of the water surface will be measured from the top of the gauge (0.01-foot accuracy).

5. These readings will be taken:

   - Upon initial construction
   - During sampling events
   - Concurrent with any water level readings on the monitoring wells.

4.15 Water Level Monitoring

In order to determine the vertical and horizontal groundwater conditions, water level measurements will be recorded.

1. After noting the general conditions of the well (surface seal, lock, etc.), the bottom will be sounded by lowering a decontaminated probe to the bottom of the screen.

2. Bottom conditions will be noted (silty, foam). The distance from the base of the screen to the top of the casing will be recorded (0.1 inch).

3. The static water level will be measure and noted by sounding with a steel tape of "popper" (0.01 foot accuracy). This method can also be supplemented by recording the water level with an electric water level probe.

4. The water level readings will always be taken from a marked point on the protective casing.

5. Other measurements to be taken are:

   - Stick up of protective casing from ground surface/surface seal.

- Depth to bottom of well from the top of the riser and top of the casing (protective).

6. The date and time will be recorded for these measurements. Also, any pertinent weather conditions will be noted (i.e., significant recent precipitation).

7. Upon completion, the wells will be secured and all down hole equipment will be decontaminated with methanol and deionized water.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

5.1 Recordkeeping and Chain-of-Custody

The sampler's field records will contain sufficient information such that someone else can reconstruct the sampling situation without reliance on the sampler's memory. Entries in the field records will include, at a minimum, the following:

- Site name and location
- Project number
- Name and affiliation of Project Manager and samplers involved
- Sampling point name and description
- Type of sample container(s) used
- Preservative(s) used
- Well purging procedure and equipment
- Well specific(s) such as static water level, depth, and volume purged
- Sample collection procedure and equipment
- Date and time of collection
- Collector's sample identification number(s)

- Laboratory's sample identification number(s)
- References such as maps or photographs of the sampling site, if available
- Field observations
- Pertinent weather factors such as temperature, wind direction, and precipitation
- Any field measurements made, such as pH, specific conductivity, or appearance

Chain-of-custody records for all samples shall be maintained.

A sample shall be considered to be "in custody" of an individual if said sample is either in direct view of or otherwise directly controlled by that individual. Storage of samples during custody shall be accomplished according to established preservation techniques, in appropriately sealed and numbered storage containers. Chain-of-custody shall be accomplished when the samples or sealed sample shuttles are directly transferred from one individual to the next, with the first individual witnessing the signature of the recipient upon the chain-of-custody record.

The chain-of-custody records will contain the following information:

- Respective sample numbers of the laboratory and Barton & Loguidice, if available
- Signature of collector
- Date and time of collection
- Sample type (e.g., groundwater, surface water)
- Identification of well or sampling point
- Number of containers
- Parameters requested for analysis, if appropriate
- Signature of person(s) involved in the chain of possession
- Description of sample bottles and their condition
- Problems associated with sample collection (ie, breakage, no preservatives), if any

5.2 Field Sample QA/QC Procedures

5.2.1 Field and Trip Blanks

To check the integrity of field sampling and equipment cleaning techniques, the following field quality assurance/quality control (QA/QC) procedures will be adhered to for this effort.

A field blank will be performed on site each sampling day during surface water/sediment and soil/waste sampling, and utilize the identical equipment pre-cleaning and sampling techniques. A trip blank will accompany sample containers through all phases of the sampling event to ensure proper bottle preparation and laboratory integrity. Trip blank and field blank samples will receive identical handling and custody procedures as on-site samples.

Field and trip blanks are used as control or external QA/QC samples to detect contamination that may be introduced in the field (either atmospheric or from sampling equipment), in transit to or from the sampling site, or in the bottle preparation, sample log-in, or sample storage stages within the laboratory. The blanks will also show any contamination that may occur during the analytical process.

The trip blanks are samples of analyte-free water, prepared at the same location and time as the preparation of bottles which are to be used for sampling. They remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. At no time during these procedures are they opened. Upon return to the laboratory, they are analyzed as if they were another sample, receiving the same QA/QC procedures as ordinary field samples. If these samples are accidentally opened, it will be noted on the chain-of-custody.

Field blanks are prepared in the field (at the sampling site) using empty bottles and analyte-free water supplied separately (prepared at the same time and place as the bottles used in the sampling). The preferred procedure for non-dedicated sampling equipment is used for sampling, and then into the empty sample bottles supplied for the field blank.

Field and trip blanks are not considered part of the laboratory QA/QC procedures. The latter, used to detect contamination during analytical steps, are only included as part of the laboratory service, and assess the validity of the laboratory analytical procedures. Field and trip blanks are required as part of QA/QC procedures for the overall sampling and analytical program.

5.3 Field Instrument Calibration

The Field Operations Leader is responsible for assuring that a master calibration/maintenance log will be maintained for each measuring device. Each log will include at least the following information where applicable:

. Name of device and/or instrument calibrated

. Device/instrument serial and/or I.D. number

. Frequency of calibration

. Date of calibration

. Results of calibration

. Name or person performing the calibration

. Identification of the calibration gas (HNU and OVA only)

. Buffer solutions (pH meter only)

Preparation and operational check-out and pre-calibration procedures for sampling and safety equipment are contained in Appendix A.

5.4 Sample Analysis QA/QC Procedures

5.4.1 Overview

The purpose of the laboratory QA/QC program is to establish and maintain laboratory practices that will ensure the scientific reliability and compatibility of the data generated in support of the project.

Quality assurance (QA) is the system for ensuring that all information, data, and resulting decisions compiled under an investigation are technically sound, statistically valid, and properly documented. Quality control (QC) is the mechanism through which quality assurance achieves its goals. Quality control programs define the frequency and methods of checks, audits, and reviews necessary to identify problems and dictate corrective action, thus ensuring high quality data.

The laboratory QA/QC program will outline the purpose, policies, organization, and operations established to support the chemical analysis.

The laboratory quality assurance and quality control (QA/QC) procedures will be submitted as part of the laboratory selection process. The QA/QC document submitted by the contracted laboratory will be appended to this document as Appendix B. The laboratory selected will be familiar with NYSDEC ASP 9/89 and maintain DOH ELAP certification for all subcategories of solid and hazardous waste.

5.4.2 Laboratory Selection Criteria

A laboratory will be selected that is qualified to do work required for the site. Examples of selection criteria are as follows:

1. Capabilities (facilities, personnel, instrumentation)

    a. previous use
    b. certifications (as required)
    c. references (recommendations by other uses of the laboratory)

2. Services

    a. turnaround time
    b. completeness of reports
    c. compliance with holding times

3. QA/QC Programs

All laboratories must have a detailed written QA/QC program meeting the minimum requirements of the NYS Department of Environmental Conservation and the NYS Department of Health.

4. Approvals

All laboratories used will be approved by Barton & Loguidice prior to the analysis of samples. The selected analytical laboratory will be committed to providing analytical services for groundwater, soil and hazardous materials which are commensurate with current state-of-the-art analytical procedures, laboratory practices and instrumentation.

REFERENCES

Cedergren, Harry R, 1977. Seepage Drainage and Flow Nets, John Wiley and Son, Inc., New York.

Cooper, H.H., Jr., J.D. Bredehoeft, and I.S, Papadopoulos, 1967. Response of a finite diameter well to an instantaneous charge of water. Water Resources Res., 3, pp 263-269.

Ferris, J.G., and D.B. Knowles, 1963. The Slug Injection Test for Estimating the Coefficient of Transmissibility of an Aquifer in Methods of Determining Permeability, Transmissibility and Drawdown, Geological Survey Water-Supply Paper 1536-I

Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bulletin 36, Waterways Experiment Station, U.S. Army Corps of Engineers.

Appendix A

FIELD EQUIPMENT CALIBRATION

APPENDIX A

FIELD EQUIPMENT CALIBRATION

This Appendix includes manufacturer's literature for all field equipment referenced in the Standard Operating Procedures. These documents have been included to insure that calibration, operational and trouble shooting procedures are available to all project personnel.

LIST OF INSTRUMENTS

INSTRUMENT NO.	DESCRIPTION
1	Photoionization Analyzer (PID)
2	Combustible Gas Meter
3	Organic Vapor Analyzer (OVA)
4	Temperature/Conductivity/pH Meters
5	Dissolved Solid Tester
6	Dissolved Oxygen Meter
7	Oxidation Reduction Potential Tester
8	Water Level Meter

1

hnu

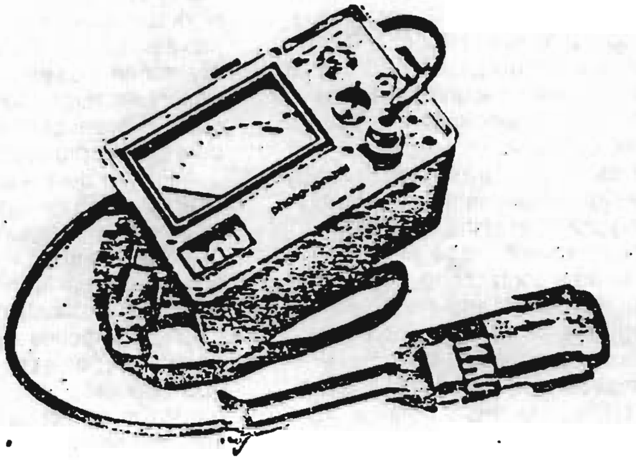
systems inc.

INSTRUCTION MANUAL

FOR

MODEL PI 101

PHOTOIONIZATION ANALYZER



the photo-ionizer is a portable trace gas analyzer that can be used to measure a wide variety of organic vapors including chlorinated hydrocarbons, heterocyclics and aromatics, aldehydes and ketones as well as several inorganic gases including hydrogen sulfide and ammonia.

The instrument uses the principle of photoionization as the analytical technique and overcomes many of the problems inherent in current trace gas analysis instrumentation. These problems presently include poor limits of detection, slow and sluggish time response, background electronic noise or drift and a lengthy series of precise technical operations necessary to properly use the instrumentation. In addition, many of today's portable analyzers remain heavy, cumbersome instruments that require additional portable equipment such as sample pumps or compressed fuel and zero gases or bulky power packs for operation.

The advanced technology employed in the photo-ionizer successfully overcomes these disadvantages. For example, the limit of detection for most species is extended down to 0.1 ppm – an increase of 10–100 fold over many conventional instruments – while still maintaining a wide dynamic operating range (0.2 to 2000 ppm). This improved sensitivity allows industrial hygienists to make measurements at or below the TLV's (threshold limit-values) established by OSHA.

Time response is greatly improved by several design advances. The location of the sensing chamber at the sampling point in the hand-held probe, the fabrication of all sample contact areas with inert fluorocarbon materials and a rapid sample flow through a small analyzing chamber eliminate sample hang up (adsorption) and minimize sample transit time in the instrument. The problems of delayed time response and instrument sluggishness are eliminated. Total time response to 90% of a full scale concentration change (0–2000 ppm) is less than five seconds – a significant feature when the instrument is used to locate plant "hot spots" or to detect leaks.

All solid state electronics and state-of-the-art circuit design have virtually eliminated conventional instrument drift and background noise. Zero drift is less than 1% over 10 hours. The excellent stability and drift free electronics allow accurate measurements, even at very low concentrations.

The Model PI 101 is one of the simplest analytical instruments to use since it has only three operating controls and unskilled personnel are easily and quickly trained to operate it. An easy to read 4½" linear scale provides a readout directly in units of concentration (ppm). Other features include an electronic zero that eliminates the use of a zero gas, and instrument calibrations that hold for weeks. The elimination of a flame, igniters and compressed hydrogen fuel make the photo-ionizer simpler to use than a flame ionization analyzer while providing an unusually safe instrument.

This lightweight (less than nine pounds) instrument was designed primarily as a portable analyzer for survey work and leak detection. However, the unit can also be set up as a continuous stationary monitor powered by 110V through its battery recharger/converter system. A strip chart recorder can be attached to the outputs (0–5V) provided.

Further details about the principle of operation and the significant technical advances this instrument provides are described in the following pages. Additional technical literature regarding your particular application and the photo-ionizer's response and sensitivity to the particular species of interest is available upon request.

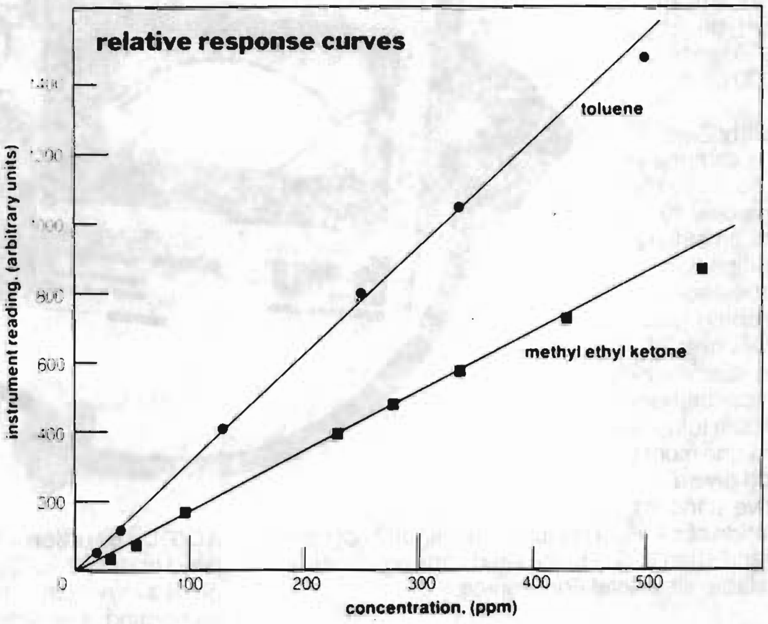
Write, call, or use the attached postage paid reply card for further information.

principle of operation

The photo-ionizer is a trace gas analyzer used to measure the concentration of a wide variety of species in industrial atmospheres. The analyzer employs the principle of photoionization for detection. The process is termed photoionization since the absorption of ultraviolet light by a molecule leads to ionization via: $R + h\nu \rightarrow R^{+} + e^{-}$ where R^{+} is the ionized species and $h\nu$ represents a photon which has an energy $\geq$ the ionization potential of the species.

The sensor consists of a sealed ultraviolet light source that emits photons which are energetic enough to ionize many trace species (particularly organics) but do not ionize the major components of air such as O_2, N_2, CO, CO_2, or H_2O. A chamber adjacent to the ultraviolet source contains a pair of electrodes. When a positive potential is applied to one electrode the field created drives any ions formed by the absorption of UV light to the collector electrode where the current (proportional to the concentration) is measured. Typical calibration curves showing the relative response of toluene and methyl ethyl ketone (at the same gain setting) are shown below.

Information on the relative response factors for other species is available upon request.



the photo-ionizer — accurate measurements, easily obtained

sensitivity A maximum sensitivity of 0–2 ppm. full scale, can be obtained for many species. This scale is readable to 1% (100 division scale).

limits of detection Typical limits of detection are 0.2 ppm. In many cases these lower limits represent a 10–100 fold improvement over conventional portable analyzers.

operating range The linear range for most compounds is from 0.1 ppm to 600 ppm while the useful range typically extends to 2000 ppm.

stability Zero drift is extremely low, normally 1% or less over 10 hours, on battery operation. On AC operation, zero drift is less than 1% over 24 hours. Semiweekly span calibrations (100 ppm toluene) over a one month period give a relative standard deviation of ±4.5%. This long term stability of both zero and span is due to the solid state electronics and stable ultraviolet light source.

photo courtesy of Ecology and Environment, Inc

Intrinsically
Hazardous V
and General
versions als

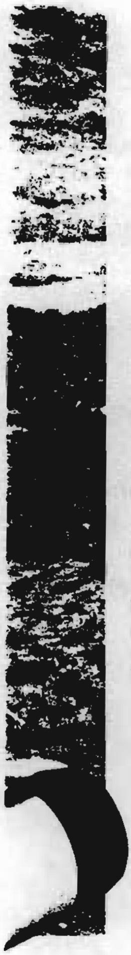
specificity Specificity in photoionization analysis depends on the sensitivity of the detector to the species being measured, the number of interfering species present, and the concentration of the species being measured relative to interferences. The optimum specificity can be obtained by choosing the light source (9.5 eV, 10.2 eV, 11.7 eV) to suit the application, maximizing sensitivity to the species being analyzed and minimizing any possible interference. Return the postcard for details on your application.

rapid response Response to changes in concentration is extremely rapid. A 90% of full scale change (0–2000 ppm) takes less than five seconds. In addition, the sensor is located at the sampling point rather than inside the instrument. This eliminates the problems of hydrocarbon adsorption and transit time through a sampling tube, all of which can delay the real time response by 30–45 seconds or more.

AC/DC operation — The instrument power is supplied from a 12 VDC rechargeable battery which gives a *minimum* of 10 operating hours before recharging is necessary. The AC recharger provides the option of operating the unit continuously from 110V AC so that the instrument can be used either as a portable unit for industrial hygiene surveys and leak detection work or as a continuous stationary monitor. An optional HNU Recorder can also be operated with the 101 battery.

The instrument is equipped with an automatic solid state battery protection circuit to prolong battery life by preventing deep discharging. Both the analyzer and the recorder can be operated during the recharge cycle.

portability The instrument is truly portable, with a total weight of less than 9 pounds (4.1 Kg) complete. No additional bulky power packs, sample pumps or cylinders of fuel gas or zero gas are needed. When not in use, the hand-held sensor is stored in the instrument cover and the total package measures 21 cm wide x 13 cm deep x 24 cm high.



ısically Safe (IS-101),
rdous Waste (HW-101),
General Purpose (GP-101)
ons also available.

direct reading Concentration (ppm) is read out directly on an easy to read 4.5" (11.3 cm) *linear* scale.

three simple operating controls

Function and Range Switch This switch puts the instrument into the STANDBY, BATTERY CHECK, MEASUREMENT modes or OFF position. The MEASUREMENT position allows the choice of a 0-2 ppm, 0-20 ppm, 0-200 ppm or 0-2000 ppm full scale range. The STANDBY mode reduces power consumption between measurements. The BATTERY CHECK allows a manual power check before use while an LED (red indicator light) adjacent to the function switch provides an automatic battery check indicator during operation.

Zero Adjust The zero control allows electronic calibration of the instrument at the zero concentration point without requiring the use of a zero gas.

Span To calibrate the instrument for a particular gas, this control is adjusted to the gain setting which will match the value of a calibration gas to that same reading on the instrument scale. This control also provides the 10 fold increase in gain that allows the 0-2 ppm full scale range.

recorder outputs A signal output of 0—5V full scale is provided on the front panel for the attachment of a strip chart recorder.

electronic zero Zero calibration is done completely electronically. The instrument is switched to the STANDBY mode where the UV light source is turned off but the other electronics remain on. The zero control is adjusted until the meter indication is zero. No zero gas or regulators are needed: no further adjustments are required. Verification tests for this technique against hydrocarbon-free zero gas show perfect agreement.

safety ***The photo-ionizer is extremely safe to use, requiring no flames, igniters, or hydrogen fuel. Versions are available for use in General Purpose, Hazardous Waste; Class I, Division II and Class I, Division I, Group ABCD areas.***

instant warmup Solid state electronics produce stable readings within 20 seconds after turning the instrument on.

selected list of species detected

NR no response
H high response
L low response

class species	**photoionization response** 9.5 eV lamp	 10.2 eV lamp	 11.7 eV lamp
paraffins and unsaturated hydrocarbons			
methane	NR	NR	NR
ethylene	NR	L	H
acetylene	NR	NR	H
1-butene	H	H	H
hexane	NR	L	H
chlorinated hydrocarbons			
methyl chloride	NR	NR	H
carbon tetrachloride	NR	NR	H
chloroform	NR	NR	H
dichloroethane	NR	NR	H
vinylidene chloride	L	H	H
vinyl chloride	L	H	H
trichloroethylene	H	H	H
heterocyclics & aromatics			
phenol	H	H	H
pyridine	H	H	H
benzene	H	H	H
toluene	H	H	H
xylene	H	H	H
styrene	H	H	H
aniline	H	H	H
chlorobenzene	H	H	H
nitrobenzene	NR	L	H
nitrogen compounds			
formamide	NR	H	H
ammonia	NR	L	H
hydrazine	H	H	H
methyl amine	H	H	H
acetonitrile	NR	NR	NR
acrylonitrile	NR	NR	H
sulfur compounds			
sulfur dioxide	NR	NR	NR
hydrogen sulfide	NR	H	H
carbonyl sulfide	NR	NR	H
carbon disulfide	H	H	H
methyl mercaptan	H	H	H
dimethyl sulfide	H	H	H
dimethyl disulfide	H	H	H
aldehydes, ketones, alcohols, acids, esters			
formaldehyde	NR	NR	H
acetaldehyde	NR	H	H
propionaldehyde	L	H	H
acrolein	L	H	H
crotonaldehyde	L	H	H
acetone	L	H	H
methanol	NR	NR	H
ethanol	NR	L	H
formic acid	NR	NR	H
acetic acid	NR	L	H
methyl methacrylate	L	H	H
others			
ethylene dibromide	NR	H	H
ethylene oxide	NR	L	H
tetraethyl lead	H	H	H
phosphine	NR	H	H
arsine	NR	H	H
iodine	H	H	H

hnu HNU Systems, Inc., 160 Charlemont Street, Newton, Massachusetts, 02161-9987 **chemical instrumentation**

specifications

performance (benzene referred)
range 0.2 to 2000 ppm
detection limit 0.2 ppm
sensitivity (max) 0-2 ppm FSD over 100 division meter scale
repeatability ±1% of FSD
linear range 0.1 to 600 ppm
useful range 0.1 to 2000 ppm
response time 5 sec to 90% of full scale

physical
size: probe 6.3 DIA x 28.5L (cm) (2½ x 11¼")
readout 21W x 13D x 16.5H (cm) (8¼ x 5 3/16 x 6½")
stowed 21W x 13D x 24H (cm) (8¼ x 5 3/16 x 9½")
cable 80 cm long (32")
weight probe .55kg (20 ounces)
readout 3.2kg (7 pounds)
total (shipping) 5.4 kg (12 pounds)

controls and functions
mode switch Off. Battery check. Standby (zero) 0-2000. 0-200. 0-20 ppm
low battery indicator light
zero (10 turn ±300% FSD max)
span (10 turn counting dial 1.0 to 10 times nominal sensitivity)
readout 4½" (11.3 cm) meter Taut Band movement graduated 0-5-10-15-20. divisions
outputs recorder 0-5 VDC

power requirements of operating times
continuous use with battery > 10 hours
with HNU Recorder > 6 hours
recharge time. max < 14 hours. 3 hours to 90% of full charge
recharge current. max 4 amps @ 115 VAC

construction Designed to withstand the shock and abuse to which portable instruments are often subjected
The readout is housed in a two piece aluminum case. and finished with a solvent resistant baked acrylic textured paint.
The probe is fabricated from extruded aluminum sections and machined plastic

serviceability The probe and readout are of a modular design allowing rapid servicing and/or replacement of mechanical and electrical components. All module interwiring includes quick disconnects.

maintenance The instrument contains only one moving part and consumes no gases or reagents. The only routine maintenance procedure is cleaning the light source window every several weeks.

applications

industrial hygiene surveys of toxic gases for OSHA (TLV) compliance can be rapidly accomplished with this portable. direct reading instrument. Hood ventilation rates can also be measured accurately because of the sensitivity and wide operating range of the unit.

leak detection is facilitated by the rapid instrument response and extreme sensitivity. This enables the user to locate even small leaks very rapidly.

residual solvent vapors such as trichloroethylene in decaffeinated coffee or degreasing operations hexane from soybean extraction and other vapors from **food, chemical processing, paint spraying** or coating can be easily and rapidly measured

benzene concentrations as low as .1 ppm can be selectively measured using a 9.5 eV lamp. This lamp eliminates most common interferences.

non methane hydrocarbons in the atmosphere can be **measured directly** since the photoionizer does not respond to methane

vinyl chloride measurements in monomer plants can be made without interference from major starting materials or by-products such as ethylene and ethylene dichloride (dichloroethane). Low level vinyl chloride measurements in PVC fabrication processes do not have the 1-2 ppm methane background interference seen in other portable instruments.

For additional information on specific applications, please fill out the attached postage-paid reply card or call us at (617)964-6690. To place an order, call us toll-free at (800)527-4566.

SECTION 3

CALIBRATION

Static or dynamic gas generation systems can be utilized for calibration of the instrument. A number of such systems for generating test atmospheres for various gases have been described by G. O. Nelson in "Controlled Test Atmospheres," Ann Arbor Science Publishers, Ann Arbor, Michigan (1971).

The most convenient packages for calibration are the non-toxic analyzed gas mixtures available from HNU Systems in pressurized containers (Catalogue #101-350).

A rapid procedure for calibration involves bringing the probe and readout in close proximity to the calibration gas, cracking the valve on the tank and checking the instrument reading. This provides a useful spot check for the instrument.

The recommended and most accurate procedure for calibration of the instrument from a pressurized container is to connect one side of a "T" to the pressurized container of calibration gas, another side of the "T" to a rotameter and the third side of the "T" directly to the 8" extension to the photoionization probe (see Figure 5). Crack the valve of the pressurized container until a slight flow is indicated on the rotameter. The instrument draws in the volume of sample required for detection, and the flow in the rotameter indicates an excess of sample. Now adjust the span pot so that the instrument is reading the exact value of the calibration gas. (If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted, if necessary.)

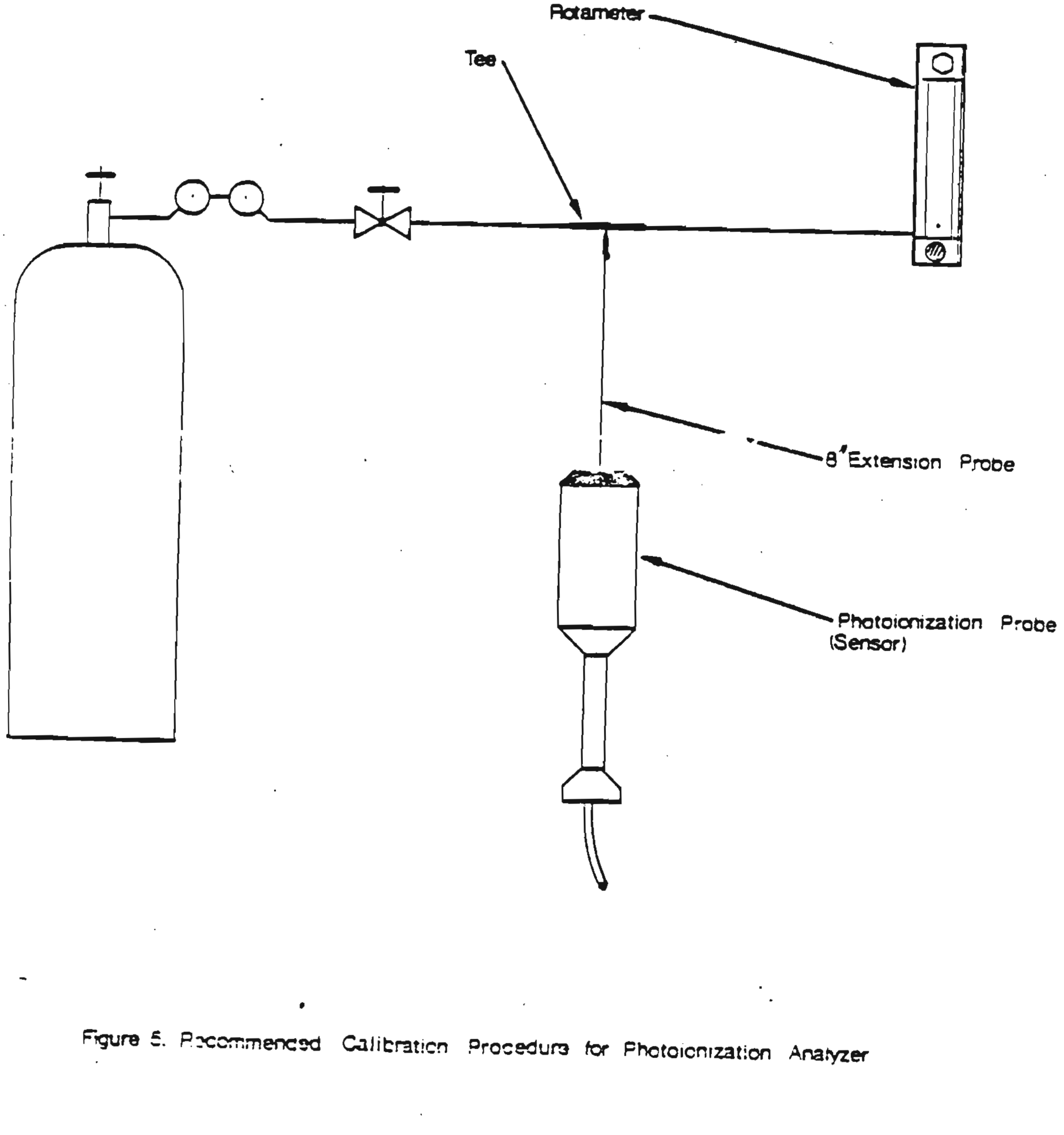


Figure 5. Recommended Calibration Procedure for Photoionization Analyzer

The calibration gas* should be prepared in the same matrix (air, nitrogen, hydrogen, etc.) in which it is to be measured, otherwise an inaccurate reading may be obtained. The increased response which is seen in oxygen free gases can be attributed to a reduction in the quenching of ions by oxygen (actually O_2^-) and is typical of any ionization detector. The quenching effect of oxygen is constant from about ten percent O_2 to very high levels.

If a gas standard prepared in nitrogen is to be used for measurements in air, fill a 0.5 or 1 liter bag with the standard then add 50 or 100 cc of pure oxygen to bring the level to 10-12%.

Any error between this value and 20% oxygen is quite small.

If the sample to be measured is in nitrogen, standards should be prepared in nitrogen. This will result in an increase in sensitivity of approximately 4.

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* Calibration with toxic gases should be performed in a hood since the 101 is a non-destructive analyzer.

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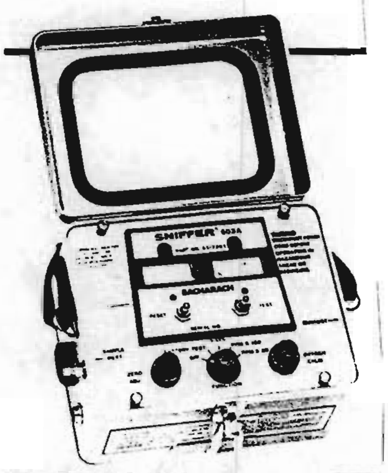


SNIFFER® 503A
Portable Area Monitor

Description

The SNIFFER® 503A (FM) provides 10-hour continuous monitoring for oxygen deficiency (0-25% O_2 range) and combustible gases (0-100% LEL range). It also offers two survey ranges, 0-2,000 PPM and 0-10,000 PPM combustible gas. The function switch offers a battery test position and selects the combustible gas range desired.

The integral pump draws the sample to the catalytic combustible sensor and the electrochemical O_2 sensor. Combustible gases will oxidize when they come in contact with the heated catalytic bead. The resulting increase in bead temperature and resistance causes a signal change across a balanced Wheatstone bridge. The oxygen cell is a transducer that produces a millivolt output in direct proportion to the partial pressure of oxygen present. These signals are then amplified and used to drive the meters and alarm circuits.

The alarm system features a high output (100 dBA at 1 foot), high frequency (3,200 Hz) audible alarm. The latching alarms are activated at user-adjustable levels. A steady tone indicates an oxygen deficient condition and an alternating tone indicates a high combustible gas concentration. The oxygen alarm is the priority alarm. A non-latching alarm with a short duration, rapid pulse tone is provided for low flow and low battery conditions. Visual alarm LED's are also provided for oxygen and combustible gas alarms and an optional remote audible alarm (25 feet) can be connected to provide dual audible outputs (local and remote).

The sealed lead acid battery pack offers dependable service over a long period of time. It tolerates variable usage and charging patterns, eliminating the memory problems of NiCads. It is the most practical power source for a field instrument.

5 CALIBRATION AND MAINTENANCE

5.1 SCOPE

This section describes calibration and maintenance procedures necessary to maintain safe, accurate and reliable operation of the Sniffer 503A. Troubleshooting information is also given if malfunctions should occur.

5.2 OPERATIONAL CHECKOUT

5.2.1 Equipment Required

Flowmeter, tubing and connector from Calibration Kit 51-7297. (See Fig. 5-1).

5.2.2 Battery Charging

Check battery charge by turning the FUNCTION switch on the BATTERY TEST position and observe the indication on the combustible gas/battery test meter. If meter indication is in the RECHARGE zone, select the proper charger from Table 5-1 and plug it into the instruments's charging socket. Allow the battery pack to charge for 14-16 hours, prior to operation.

TABLE 5-1. CHARGERS

Operating Voltage	Charger Part Number
120 VAC 60 Hz	51-2141
220 VAC 50 Hz	51-2142
12 VDC	51-2143

WARNING!

Do not operate the Sniffer 503A in any potentially explosive or hazardous location with a charger attached to it. Disconnect the charger from the instrument before entering the hazardous area. The instrument is designed to be intrinsically safe for operation in Class I, Div. 1, Groups A, B, C and D locations with all chargers disconnected. The instrument is not intrinsically safe with the external charger attached.

CAUTION:

Use of any other type of battery pack may cause the instrument not to meet all of the performance and/or safety specifications published by certain agencies concerning operation in hazardous environments.

5.2.3 Flow System Checkout

Turn the FUNCTION switch to the BATTERY TEST position and verify that the pump is running. To verify approximate flow, use the flowmeter, tubing and connector from Calibration Kit 51-7297. Connect the tubing between the top port of the flowmeter and the connector as shown in Fig. 5.1. Plug the connector onto the Sniffer 503A's SAMPLE INLET fitting and observe that the flowmeter should indicate 1.0 SCFH (500 cc/min.) or more; if not, refer to Table 5-2 for troubleshooting hints. Now simulate a blockage in the probe by placing your finger over the bottom port of the flowmeter. The low battery alarm should sound.

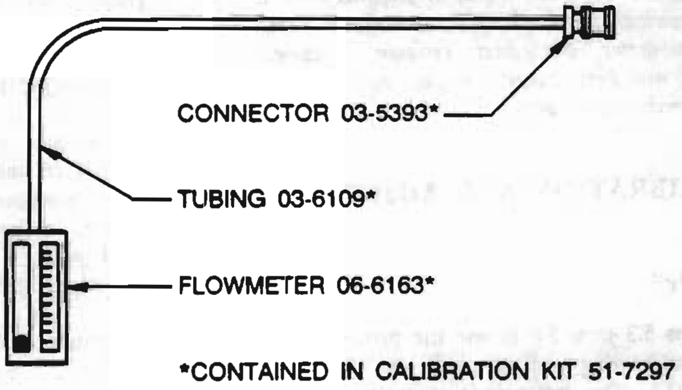


Figure 5-1. Set-Up for Checking Air Flow

5.2.4 General Checkout

1. Make sure the instrument is clean and free from dirt that will obstruct flow or otherwise impair its operation.

2. The audible alarm, located on the side of the instrument, has a 5 to 15 second alarm lockout during warm-up. The alarm function is latching, which means it must be manually reset after the alarm condition has been cleared.

3. Set FUNCTION switch to %LEL and verify that the O_2 meter indication in fresh air can be adjusted to the CAL mark using the OXYGEN CALIB knob.

4. Verify that the combustible gas meter indication can be set to zero using the ZERO ADJ knob.

5. Press the TEST switch. The audible alarm and both visual alarms should activate. Press the RESET switch to clear all alarms.

6. Turn the ZERO ADJ knob. This should produce smooth movement of the combustible gas meter with no signs of the needle sticking. Re-zero the combustible gas meter.

7. Turn the OXYGEN CALIB knob. This should produce smooth movement of the O_2 meter with no signs of the needle sticking. Reset the O_2 meter to its CAL mark.

8. If any steps above produced abnormal results, refer to Table 5-2 for troubleshooting hints.

CAUTION:

Do not use oil or lubricants on the mechanical or electrical parts of this instrument. Some potentiometer lubricants contain silicones, which will permanently impair operation of the combustibles sensor.

5.3 CALIBRATION AND ADJUSTMENT

5.3.1 Scope

Subsections 5.3 thru 5.6 define the procedures necessary for calibrating and adjusting the circuits in the Sniffer 503A. The instrument is designed for direct reading when sampling methane-in-air mixtures. Therefore, to calibrate the ranges of the instrument, a methane-in-air mixture is used. Consult Appendix "A" for conversion factors when a methane calibrated Sniffer 503A is used on combustibles other than methane.

NOTE: *If detection of combustible solvents comprises the bulk of the Sniffer 503A's applications, calibration should be based on hexane for increased sensitivity. Consult Appendix B.*

5.3.2 Equipment Required

- Calibration Kit - Part No. 51-7297 (See Fig. 5-2).

- Gas Cylinder, 500 PPM Methane-In-Air - Part No. 51-1816

- Gas Cylinder, 1.0% Methane-In-Air - Part No. 51-1818

- Gas Cylinder, 2.5% Methane-In-Air - Part No. 51-1121

- Gas Cylinder, Zero Calibration Gas - Part No. 51-7131

- Small Screwdriver, 3/32" Blade, Xcelite R3323 or equivalent

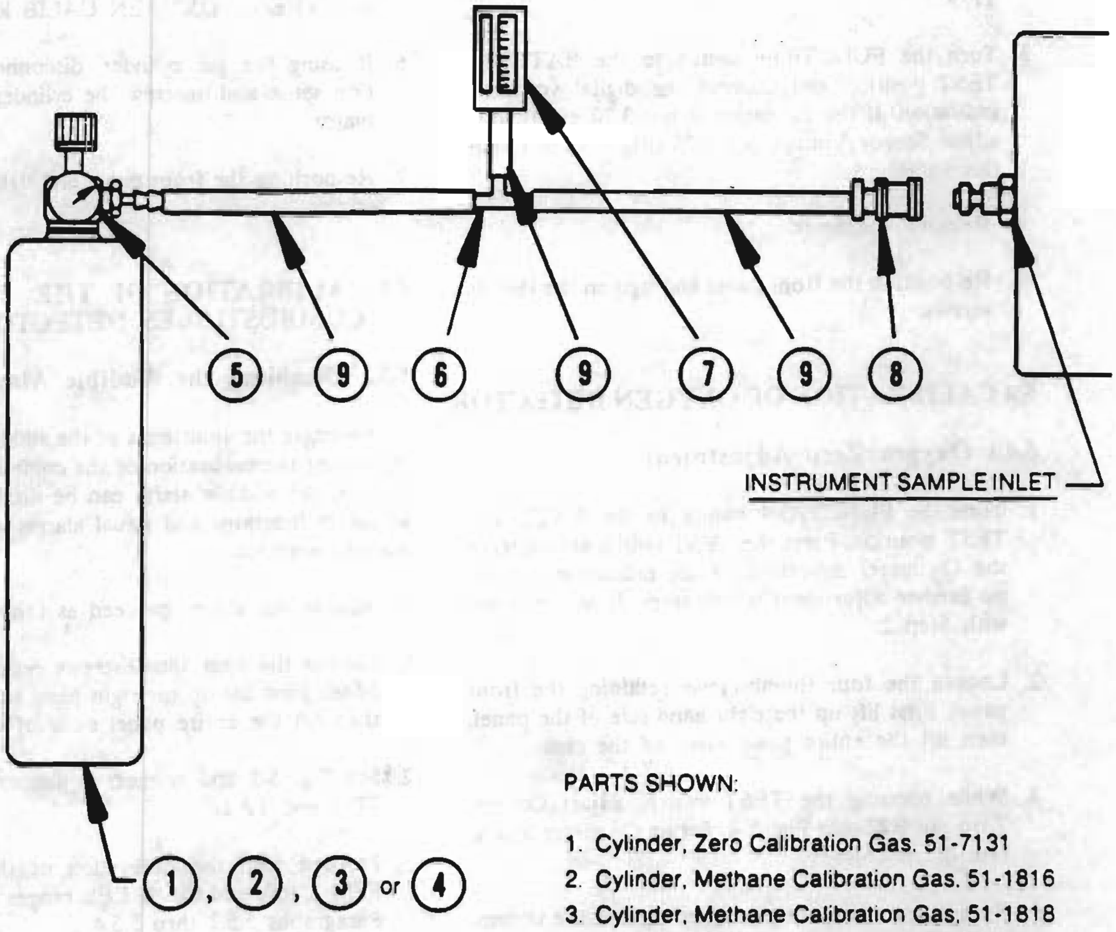
- Digital Voltmeter, ±0.5% Accuracy or Better*

*Needed only when performing the optional sensor voltage adjustment procedure as described in Paragraph 5.3.3.

5.3.3 Adjusting Sensor Voltage

The sensor voltage is factory adjusted to 3.70 ±0.10 VDC and should never need further adjustment, unless components on the printed circuit board are replaced or the adjustment itself (R25) has been tampered with. If it becomes necessary to make this adjustment, proceed as follows:

1. Loosen the four thumbscrews retaining front panel. First lift up right-hand side of panel, then lift entire panel clear of case.



PARTS SHOWN:

1. Cylinder, Zero Calibration Gas, 51-7131
2. Cylinder, Methane Calibration Gas, 51-1816
3. Cylinder, Methane Calibration Gas, 51-1818
4. Cylinder, Methane Calibration Gas, 51-1121
5. Regulator, 03-4318 *
6. Tee, 03-5532 *
7. Flowmeter, 06-6163 *
8. Connector, 03-5393 *
9. Tubing, 03-6109 *

* CONTAINED IN CALIBRATION KIT 51-7297

Figure 5-2. Calibration Set-Up Block Diagram

2. See Fig. 5-3 and connect a digital voltmeter as follows: positive lead to TP-6, negative lead to TP-9.

3. Turn the FUNCTION switch to the BATTERY TEST position and observe the digital voltmeter indication. If the indication is not 3.70 ±0.10 volts, adjust Sensor Voltage pot R25 (Fig. 5-4) to obtain this value.

4. Remove voltmeter.

5. Re-position the front panel and tighten the thumbscrews.

5.4 CALIBRATION OF OXYGEN DETECTOR

5.4.1 Oxygen Zero Adjustment

1. Turn the FUNCTION switch to the BATTERY TEST position. Press the TEST switch and observe the O_2 meter indication. If the indication is zero, no further adjustment is necessary. If not, proceed with Step 2.

2. Loosen the four thumbscrews retaining the front panel. First lift up the right-hand side of the panel, then lift the entire panel clear of the case.

3. While pressing the TEST switch, adjust Oxygen Zero pot R22 (see Fig. 5-4) for an O_2 meter indication of zero.

4. Re-position the front panel and tighten the thumbscrews.

5.4.2 Oxygen Calibrate Adjustment

1. Turn the FUNCTION switch to the BATTERY TEST position.

2. Place the instrument in fresh air. If there is doubt about the quality of the surrounding air, proceed with Step 3. If not, proceed to Step 5.

3. Connect a Zero Calibration Gas Cylinder (Part No. 51-7131) and the Calibration Kit (Part No. 51-7297) together as shown in Fig. 5-2. Connect the gas output of this setup to the instrument's SAMPLE INLET.

4. Adjust the regulator on the calibration setup for a flowmeter indication of 2 SCFH.

5. Unlock the OXYGEN CALIB knob and adjust it for an O_2 meter indication of 21 or at the CAL mark. Relock OXYGEN CALIB knob.

6. If using the gas cylinder, disconnect the calibration setup and unscrew the cylinder from the regulator.

7. Re-position the front panel and tighten the thumbscrews.

5.5 CALIBRATION OF THE COMBUSTIBLES DETECTOR

5.5.1 Disabling the Audible Alarm

To eliminate the annoyance of the audible alarm sounding during the calibration of the combustibles detector circuits, the audible alarm can be disabled. Note that all meter functions and visual alarms will continue to operate normally.

To disable the alarm, proceed as follows:

1. Loosen the four thumbscrews retaining the front panel. First lift up the right-hand side of the panel, then lift the entire panel clear of the case.

2. See Fig. 5-5 and connect a jumper wire between TP-1 and TP-2.

3. Proceed with the calibration of the PPM x 20, PPM x 100, and the % LEL ranges as described in Paragraphs 5.5.2 thru 5.5.4.

4. After calibration, remove the jumper. Press the TEST switch to verify operation of the audible alarm.

5.5.2 Calibrating the PPM x 20 Range

1. Turn the FUNCTION switch to the BATTERY TEST position. Verify that the batteries have a sufficient charge. If not, refer to Paragraph 5.2.2 and charge the batteries.

2. Allow 15 minutes for the instrument to warm up.

3. Turn the function switch to the PPM x 20 position.

4. See Fig. 5-2 and connect the zero calibration gas cylinder 51-7131 to the instrument. Adjust the regulator for a flowmeter indication of 2 SCFH.

5. Allow the zero calibration gas to flow for 1 minute and use the ZERO ADJ control to zero the combustibles meter.

6. Unscrew the calibration gas cylinder from the regulator and replace it with the 500 PPM Methane-in-Air cylinder 51-1816. Adjust the regulator for a flowmeter indication of 2 SCFH.

7. Allow the gas to flow for 1 minute and read the combustibles meter.

8. The methane cylinder has a concentration value stamped on its label. This is the desired calibration value.

9. Compare the combustibles meter indication in Step 7 to the calibration value in Step 8. If the meter indication is within ±50 PPM of the calibration value, no further adjustment is required. Otherwise proceed with Step 10.

10. Loosen the four thumbscrews retaining the front panel. Lift up the right-hand side of the panel, without disconnecting the calibration setup, to gain access to the Combustibles PPM x 20 SPAN pot R6 shown in Fig. 5-4.

11. Adjust pot R6 using a small screwdriver until the meter indication matches the calibration value from Step 8.

12. Re-position the front panel and secure the four thumbscrews. Remove the calibration setup and disconnect the gas cylinder from the regulator.

5.5.3 Calibrating the PPM x 100 Range

1. Turn the FUNCTION switch to the BATTERY TEST position. Verify that the batteries have a sufficient charge. If not, refer to Paragraph 5.2.2 and charge the batteries.

2. Allow 5 minutes for the instrument to warm up.

3. Turn the function switch to the PPM x 100 position.

4. See Fig. 5-2 and connect the zero calibration gas cylinder 51-7131 to the instrument. Adjust the regulator for a flowmeter indication of 2 SCFH.

5. Allow the zero calibration gas to flow for 1 minute and use the ZERO ADJ control to zero the combustibles meter.

6. Unscrew the calibration gas cylinder from the regulator and replace it with the 1.0% Methane-in-Air cylinder 51-1818. Adjust the regulator for a flowmeter indication of 2 SCFH.

7. Allow the gas to flow for 1 minute and read the combustibles meter.

8. The methane cylinder has a concentration value stamped on its label. To determine the desired meter indication, use the formula:

   % Methane x 10,000 PPM = Calibration Value.

9. Compare the combustibles meter indication in Step 7 to the calibration value in Step 8. If the meter indication is within ±500 PPM of the calibration value, no further adjustment is required. Otherwise proceed with Step 10.

10. Loosen the four thumbscrews retaining the front panel. Lift up the right-hand side of the panel, without disconnecting the calibration setup, to gain access to the Combustibles PPM x 100 SPAN pot, R8, shown in Fig. 5-4.

11. Adjust pot R8 using a small screwdriver until the meter indication matches the calibration value from Step 8.

12. Re-position the front panel and secure the four thumbscrews. Remove the calibration setup and disconnect the gas cylinder from the regulator.

5.5.4 Calibrating the % LEL Range

1. Turn the FUNCTION switch to the BATTERY TEST position. Verify that the batteries have a sufficient charge. If not, refer to Paragraph 5.2.2 and charge the batteries.

2. Allow 5 minutes for the instrument to warm up.

3. Turn the function switch to the % LEL position.

4. See Fig. 5-2 and connect the zero calibration gas cylinder 51-7131 to the instrument. Adjust the regulator for a flowmeter indication of 2 SCFH.

5. Allow the zero calibration gas to flow for 1 minute and use the ZERO ADJ control to zero the combustibles meter.

6. Unscrew the calibration gas cylinder from the regulator and replace it with the 2.5% Methane-in-Air cylinder 51-1121. Adjust the regulator for a flowmeter indication of 2 SCFH.

7. Allow the gas to flow for 1 minute and read the combustibles meter.

8. The methane cylinder has a concentration value stamped on its label. To determine the desired meter indication, use the formula:

   % Methane x 20% LEL =
   % LEL Calibration Value.

9. Compare the combustibles meter indication in Step 7 to the calibration value in Step 8. If the meter indication is within ±5% LEL of the calibration value, no further adjustment is required. Otherwise proceed with Step 10.

10. Loosen the four thumbscrews retaining the front panel. Lift up the right-hand side of the panel, without disconnecting the calibration setup, to gain access to the Combustibles % LEL SPAN pot, R10, shown in Fig. 5-4.

11. Adjust pot R10 using a small screwdriver until the meter indication matches the calibration value from Step 8.

12. Re-position the front panel and secure the four thumbscrews. Remove the calibration setup and disconnect the gas cylinder from the regulator.

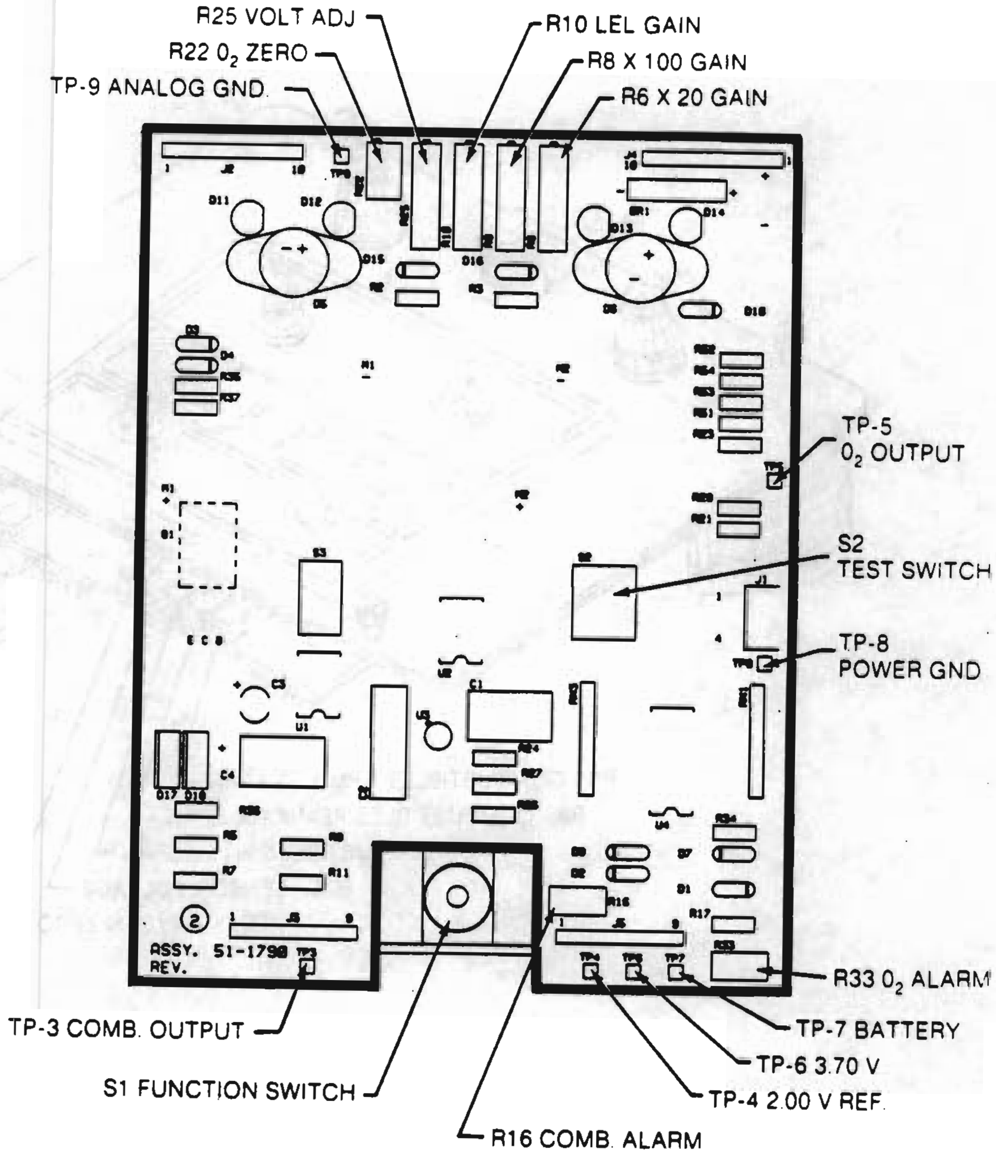


Figure 5-3. Test Point and Potentiometer Layout

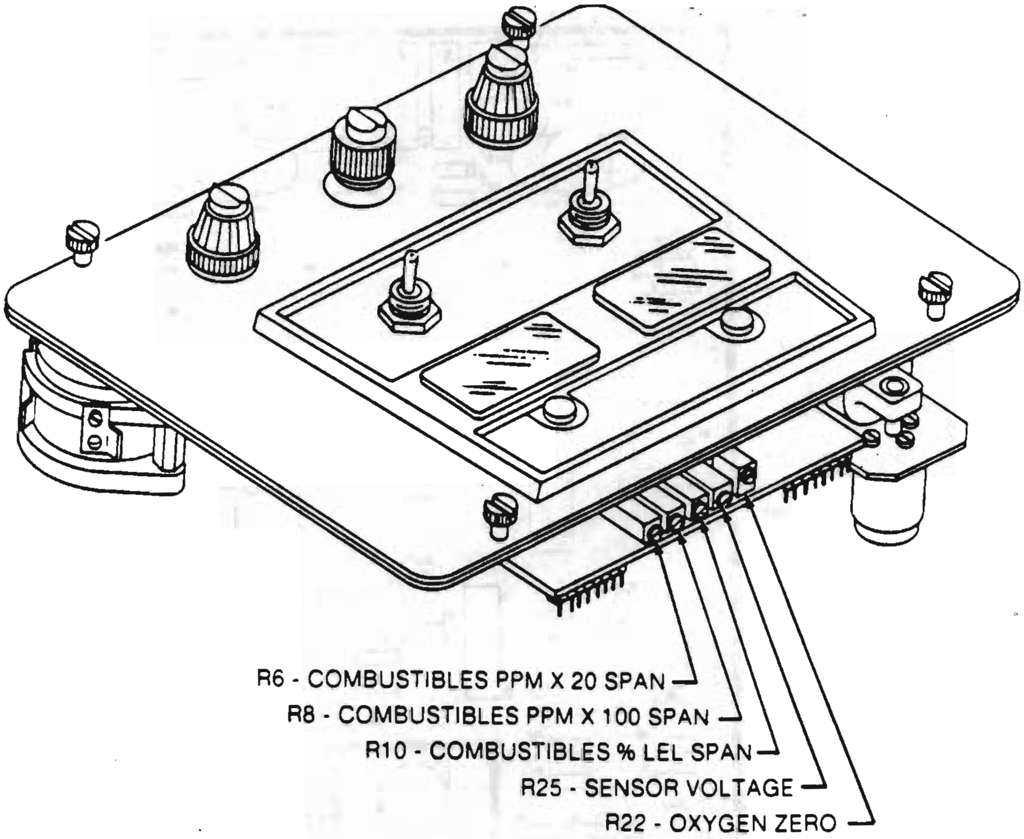
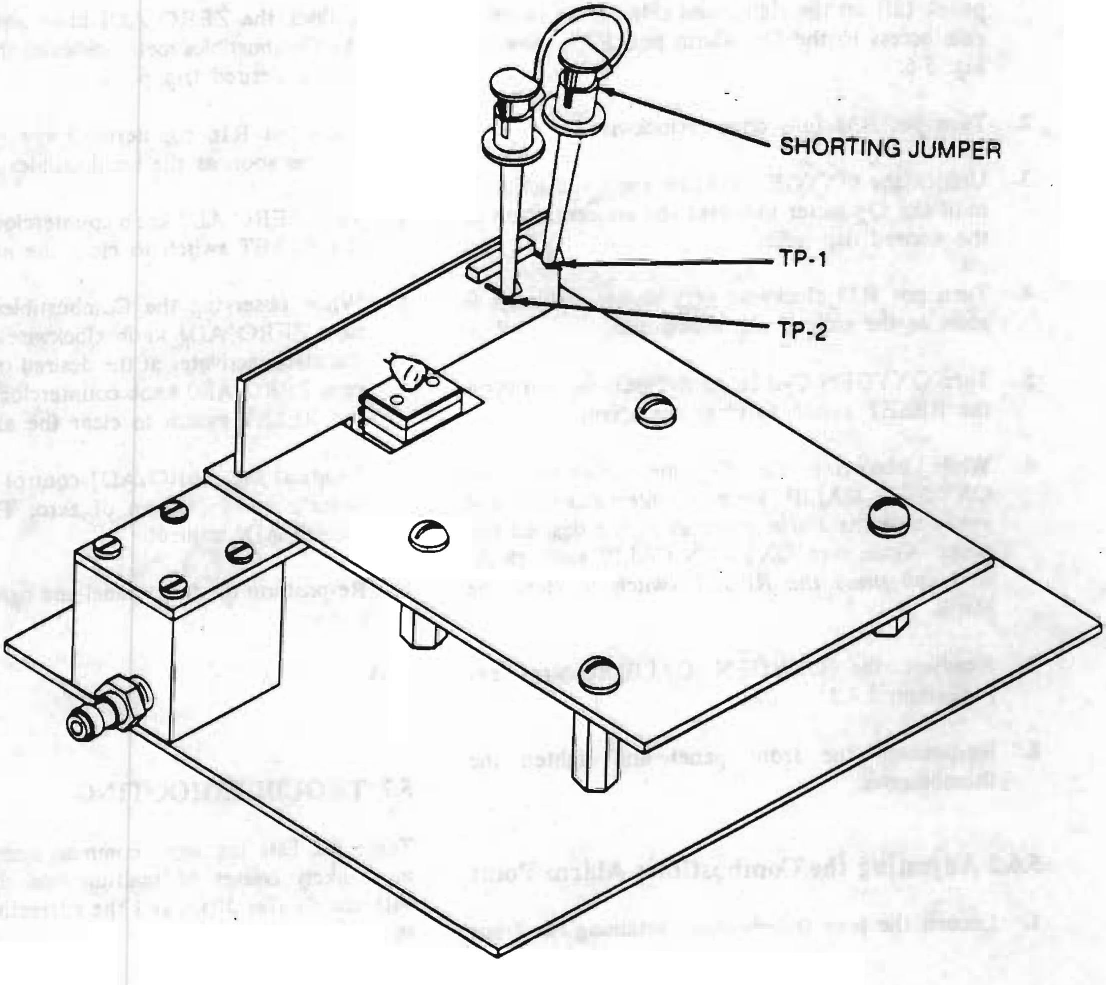


Figure 5-4. Calibration Adjustments



JUMPER TP-1 AND TP-2 TOGETHER TO DISABLE AUDIBLE ALARM.

Figure 5-5. Location of Alarm Disable Test Points

5.6 ADJUSTING THE ALARM TRIP POINTS

5.6.1 Adjusting the Oxygen Deficiency Alarm Point

1. Loosen the four thumbscrews retaining the front panel. Lift up the right-hand side of the panel to gain access to the O_2 Alarm pot, R33, shown in Fig. 5-6.

2. Turn pot R33 fully counterclockwise.

3. Unlock the OXYGEN CALIB knob and adjust it until the O_2 meter indicates the concentration of the desired trip point.

4. Turn pot R33 clockwise very slowly and stop as soon as the oxygen alarm activates.

5. Turn OXYGEN CALIB knob clockwise and press the RESET switch to clear the alarm.

6. While observing the O_2 meter, slowly turn OXYGEN CALIB knob counterclockwise and verify that the alarm activates at the desired trip point. Again turn OXYGEN CALIB knob clockwise and press the RESET switch to clear the alarm.

7. Readjust the OXYGEN CALIB control per Paragraph 5.4.2.

8. Re-position the front panel and tighten the thumbscrews.

5.6.2 Adjusting the Combustibles Alarm Point

1. Loosen the four thumbscrews retaining the front panel. Lift up the right-hand side of the panel to gain access to the Combustibles Alarm pot, R16, shown in Fig. 5-6.

2. Turn pot R16 fully clockwise.

3. Unlock the ZERO ADJ knob and adjust it until the Combustibles meter indicates the concentration of the desired trip point.

4. Turn pot R16 counterclockwise very slowly and stop as soon as the combustibles alarm activates.

5. Turn ZERO ADJ knob counterclockwise and press the RESET switch to clear the alarm.

6. While observing the Combustibles meter, slowly turn ZERO ADJ knob clockwise and verify that the alarm activates at the desired trip point. Again turn ZERO ADJ knob counterclockwise and press the RESET switch to clear the alarm.

7. Readjust the ZERO.ADJ control for a Combustibles meter indication of zero. Then relock the ZERO ADJ control.

8. Re-position the front panel and tighten the thumbscrews.

5.7 TROUBLESHOOTING

Table 5-2 lists the most common symptoms and the most likely causes of malfunctions that may occur with the Sniffer 503A and the corrective action to be taken.

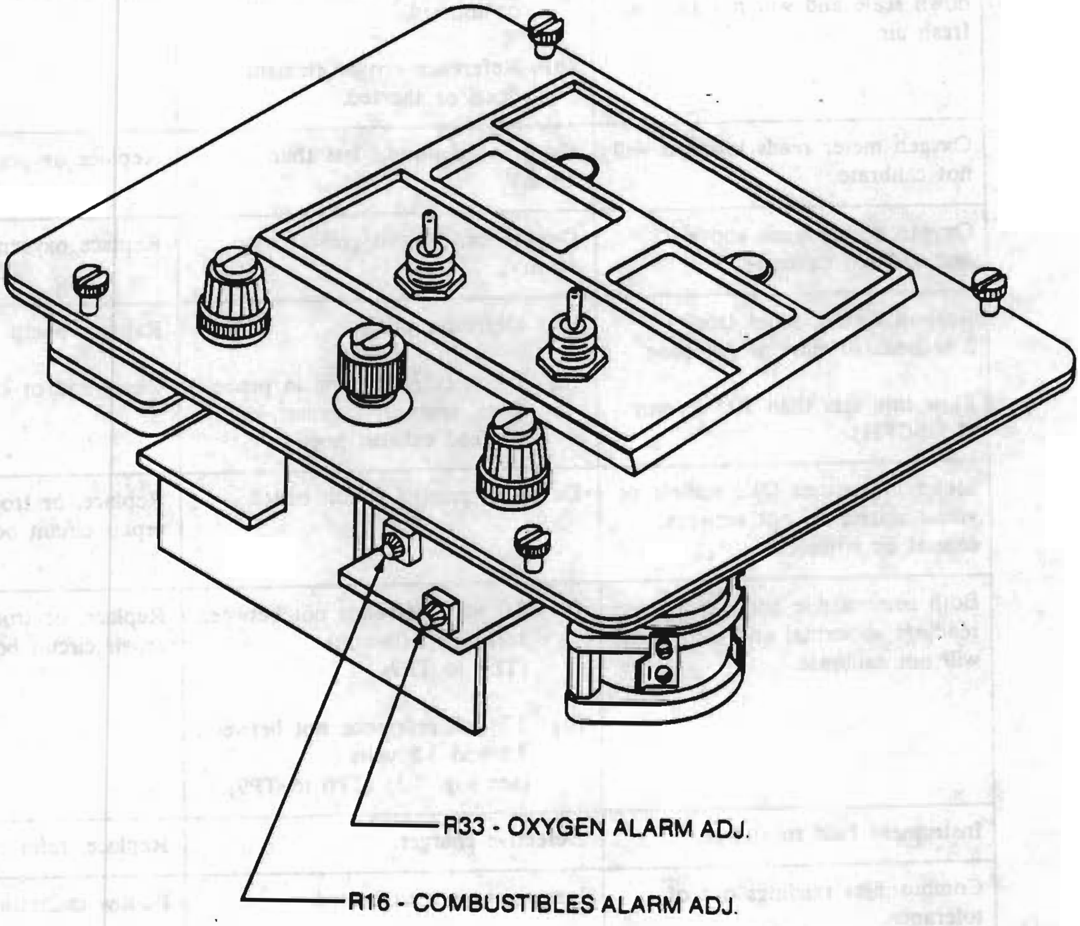


Figure 5-6. Alarm Adjustment Locations

TABLE 5-2. TROUBLESHOOTING

Trouble	Probable Cause	Remedy
Combustibles meter pegs up or down scale and will not zero in fresh air.	(a) Active sensor element open or shorted. (b) Reference sensor element open or shorted.	Replace sensor 51-1057.
Oxygen meter reads low and will not calibrate.	Oxygen cell output less than 19 mV.	Replace oxygen cell 51-7331.
Oxygen meter reads above 21 and will not calibrate.	Oxygen cell output greater than 60 mV.	Replace oxygen cell 51-7331.
Response slow, more than 5 seconds to start of response. Flow rate less than 700 cc/min (1.5 SCFH).	(a) Defective pump. (b) Dirty, clogged parts in probe hose, reaction chamber, or blocked exhaust port.	Replace pump. Clean and/or clear blockages.
Meter indications OK, audible or visual alarms do not activate, cannot be adjusted.	Defective printed circuit board.	Replace, or troubleshoot and repair circuit board 51-2180.
Both combustible and oxygen readings abnormal and instrument will not calibrate.	(a) 2.0 volt reference not between 1.95 and 2.05 volts (TP4 to TP9). (b) 3.7 volt reference not between 3.6 and 3.8 volts (see Fig. 7-3) (TP6 to TP9).	Replace, or troubleshoot and repair circuit board 51-2180.
Instrument fails to charge.	Defective charger.	Replace, refer to Table 5-1.
Combustibles readings out of tolerance.	Instrument not calibrated.	Follow calibration Section 5.5.
Cannot calibrate combustibles section.	Defective combustibles sensor.	Replace sensor 51-1057.
Instrument dead, no power.	(a) Dead battery. (b) Defective battery or charger.	Charge battery per Paragraph 5.2.2. Replace.

5.8 SENSOR REPLACEMENT

5.8.1 Oxygen Cell

The life of an oxygen cell is conservatively estimated at six months. Its life is not affected by the amount of time the instrument is used. Oxygen cells are shipped in a sealed envelope purged of all oxygen to inhibit the cell's chemical action. Once the seal is broken and the cell is exposed to air, the cell starts to operate and will deplete at a fixed rate, regardless of whether the instrument is used or not.

Whenever it becomes necessary to replace the oxygen cell, follow the procedure below. When placing the instrument in operation for the first time, omit Step 2.

Equipment Required

- Replacement Oxygen Cell, Part No. 51-7331
- Screwdriver, 3/16" Blade
- Scissors

Procedure

1. Loosen the four thumbscrews retaining the front panel. First lift up the right-hand side of the panel, then lift the entire panel clear of the case.

2. See Fig. 5-7. Using a small screwdriver, remove the two screws retaining the oxygen cell flange and then remove the flange. Remove and discard the old oxygen cell.

WARNING!

The oxygen cell contains a solution of potassium hydroxide. Do not puncture. If solution contacts the skin, flush with water and vinegar immediately. If solution contacts the eyes, flush with a boric acid solution and get immediate medical attention!

3. Position the O-ring in the oxygen cell base.

4. The new oxygen cell (Part No. 51-7331) is shipped in a sealed foil envelope. Use a pair of scissors to cut open the envelope and remove the cell.

5. Look at the contacts of the oxygen cell base (see Fig. 5-7). Three contacts have dimples and one has a hole. Line the oxygen cell up so that its plastic screw is in line with the contact that has the hole, mesh end toward the base. Snap the cell into the base so the three stainless steel screwheads line up in the dimples in the contacts. The plastic screw head should protrude through the hole in the contact. If properly positioned, the label on the rear of the cell should be readable.

6. Position the flange over the rear of the cell. Insert the two screws and tighten with a screwdriver. DO NOT overtighten these screws!

7. Calibrate the oxygen detector per Section 5.4.

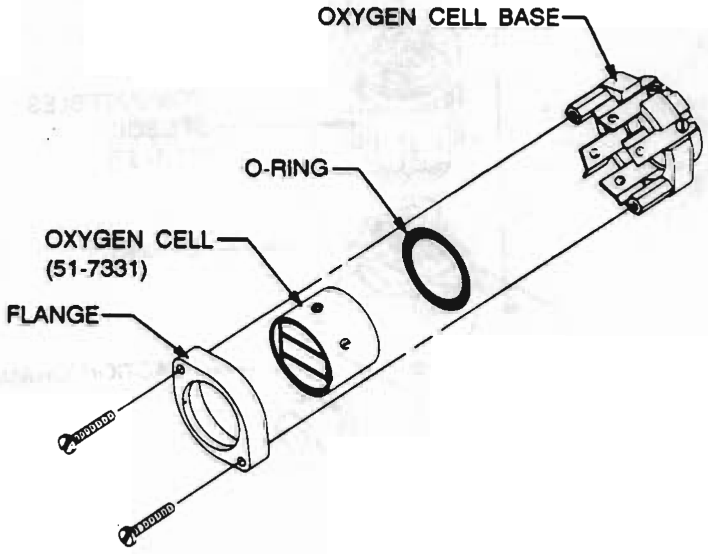


Figure 5-7. Oxygen Cell Installation

5.8.2 Combustibles Sensor

The combustibles sensor should last at least one year when operated eight hours a day and when only sampling small quantities of combustible gases and vapors. Operation for long periods of time in areas with combustible gas concentrations near or above the lower explosive limit may shorten sensor life. The sensor should be replaced when the % LEL SPAN pot, R10, will no longer calibrate the instrument as described in Paragraph 5.5.4.

Equipment Required

- Replacement Combustibles Sensor, Part No. 51-1057
- Screwdriver, 3/16" Blade

Procedure

1. Loosen the four thumbscrews retaining the front panel. First lift up the right-hand side of the panel, then lift the entire panel clear of the case.
2. See Fig. 5-8. Remove four retaining screws from the sensor socket and pull the socket free.
3. Unplug and discard the old sensor.
4. Plug the new combustibles sensor (Part No. 51-1057) into the socket. Make sure the spring is in place in the reaction chamber.
5. Position the socket into the reaction chamber so the four screw holes line up.
6. Insert and tighten the four retaining screws.
7. Calibrate the combustibles detector per Section 5.5.

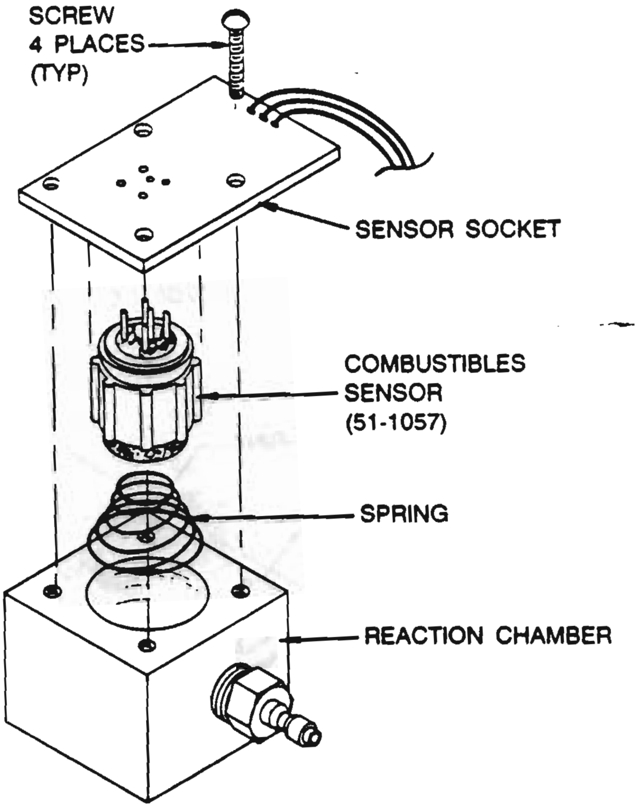


Figure 5-8. Combustibles Sensor Installation

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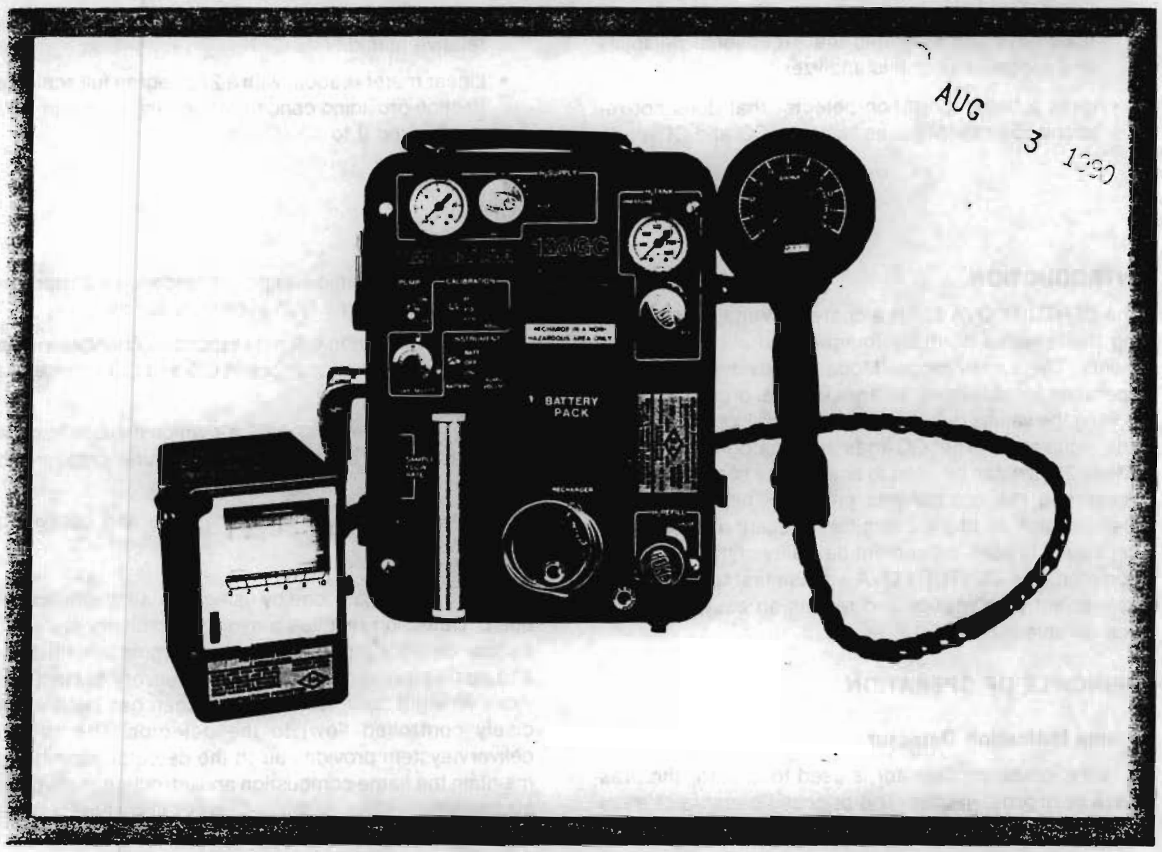
Product Specifications

PSS 6-12Z1 F



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CENTURY OVA 128 PORTABLE ORGANIC VAPOR ANALYZER

With intensifying public concern over the increasing use of organic chemicals in the U.S.A., EPA and OSHA have proposed and enacted regulations to govern their use. The need to rapidly assess the environmental impact of these volatile chemicals has generated a demand for field-portable, direct reading instruments. The dual mode CENTURY OVA 128 Portable Organic Vapor Analyzer was designed to meet this demand, and to respond to the requirements for immediate on-site evaluation of organics using methods similar to, and approaching, the accuracy of laboratory instruments.

Several of the many OVA 128 features are:

- Provides continuous, direct readout of total organic vapor concentrations for survey purposes (Mode 1).
- Allows qualitative and quantitative analysis using the gas chromatographic mode (Mode 2).
- Sensitivity to sub-parts per million concentrations in air, and parts per billion concentrations in head-space of water.
- FM and BASEEFA certified intrinsically safe for use in Class I, Groups A, B, C, and D, Division 1 hazardous locations.
- It is a light-weight, completely field-portable instrument weighing approximately 5.5 kg (12 lb), that provides eight hours of continuous operation per battery charge.

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- Many hundreds of successful field-proven applications have demonstrated the exceptional reliability and ruggedness of this analyzer.
- Uses a flame ionization detector that does not respond to ambient gases, such as CO and CO_2, and exhibits no sensitivity changes due to variations in relative humidity.
- Linear meter readout with a 270 degree full scale deflection providing concentration ranges of 0 to 10, 0 to 100, and 0 to 1000 ppm.

GENERAL DESCRIPTION

INTRODUCTION

The CENTURY OVA 128 is a dual-mode analyzer combining the features normally found in two separate instruments. The survey mode (Mode 1) provides continuous operation for screening an area for total organics and reporting the values directly in parts per million (ppm) methane equivalent. The GC (gas chromatographic) mode (Mode 2) then can be used to analyze the same sample by separating the components present. This provides for identification as to the chemicals present and their concentration in ppm. Instrument flexibility of this type is uncommon. The CENTURY OVA was the first to provide this convenient combination and remain an easy to operate and durable instrument.

PRINCIPLE OF OPERATION

Flame Ionization Detector

A flame ionization detector is used to monitor the presence of organic vapors. The principle benefits of monitoring with a flame ionization detector are:

- Universal organic compound response with approximately the same high sensitivity for all
- Flame ionization will not respond to changes in relative humidity or changes in CO and CO_2 concentration.
- It is a mass sensing detector which exhibits minimal effects from changes in temperature, pressure, or flow.
- Provides excellent dynamic range and concentration linearity

Sample gathering is done by using a small diaphragm air pump. Detection requires a hydrogen delivery system, a sample delivery system, and an electronic amplification and display system. The hydrogen delivery system provides an eight hour supply of hydrogen gas (with a precisely controlled flow) to the detector. The sample delivery system provides air to the detector chamber to maintain the flame combustion and introduce the organic air contaminants for analysis. Figure 1 illustrates both the hydrogen flow and air flow patterns in the OVA 128.

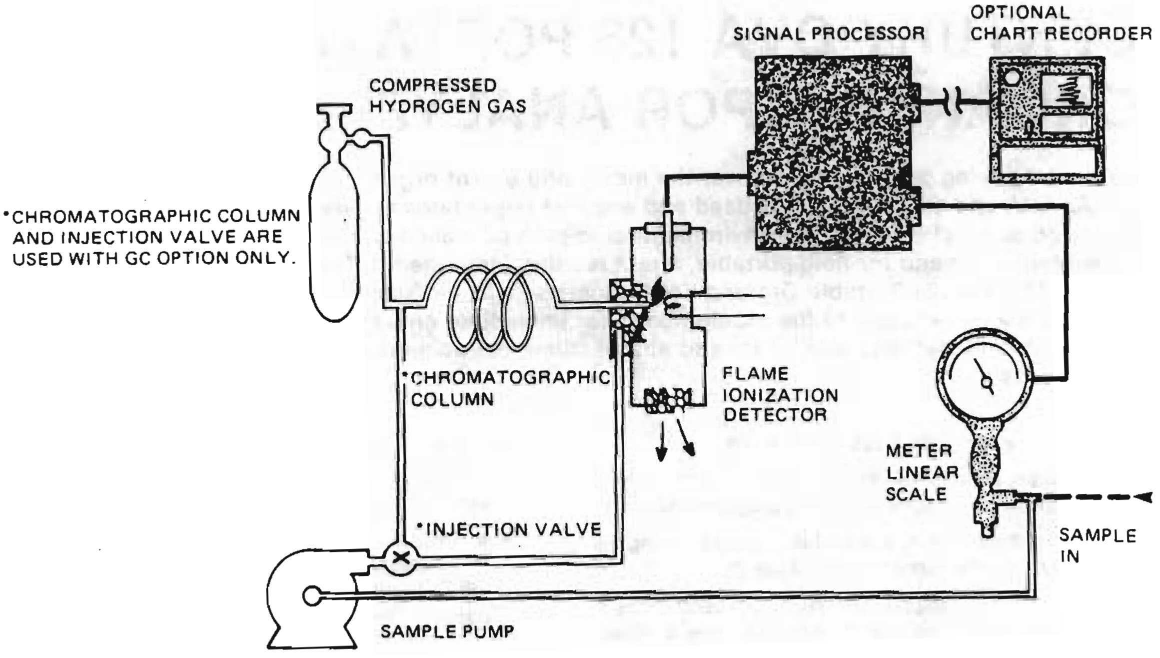


Figure 1. OVA 128 Schematic Diagram

Survey Analysis — Mode 1

In Mode 1, the air sample is delivered continuously to the detector chamber. When an organic vapor is exposed to the hydrogen flame via the air flow, the carbon molecules ionize and a current is carried between the detector electrodes. This current is proportional to the concentration of vapor in the sample. Different compounds will ionize to varying extents in the flame. The OVA 128 is internally calibrated for methane gas, and all survey responses are expressed in methane equivalent. The OVA 128 can be calibrated to read directly for other compounds, through the gas select adjustment dial on the instruments front panel.

Chromatographic Analysis — Mode 2

With Mode 2, the OVA 128 functions as a portable gas chromatograph utilizing hydrogen as a carrier gas and a flame ionization detector as the sensor. In this mode, a fixed volume of sample air is injected (by means of an injection valve) into the chromatographic column which contains a suitable packing material. At the same time that a sample is introduced into the column, the remaining sample air is directed through an integral charcoal filter (not shown in Figure 1) to provide the detector with a supply of pure air.

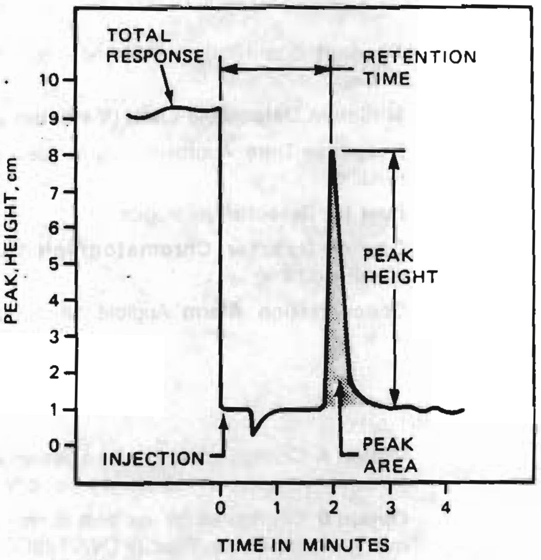


Figure 2. OVA 128 Generalized Chromatogram

While moving through the chromatographic column, the sample constituents are separated based on their interaction with the column packing material. As the constituents leave the column, they are carried to the detector and register on the linear meter and the attached optional chart recorder. The time, measured from the moment of sample injection until the compound of interest exits the column, is known as the retention time and serves to identify the compound. The area under the chromatographic peak is proportional to the concentration of the compound in the air sample. The peak height can also be used to determine sample concentration since it closely correlates with peak area. Figure 2 illustrates an example of a linear chromatogram.

OVA 128 APPLICATIONS

The OVA 128 Portable Organic Vapor Analyzer is well-suited for use in the following typical industrial and hazardous waste applications.

Industrial Applications

- Industrial hygiene monitoring
- Leak source identification and measurement
- Monitoring of confined entry areas
- Arson investigation and solvent-accelerant identification
- Survey of spills (accident) locations for problem identification

Hazardous Waste Applications

- Rapid identification of imminent threats to health and safety
- Determination of the extent of contamination in air, water, and soil
- Identification of potential sampling points
- Determination of level of respiratory protection required

PRODUCT SAFETY SPECIFICATIONS

FM certified intrinsically safe for use in Class I, Groups A, B, C, and D, Division 1 hazardous locations.

BASEEFA certified intrinsically safe, Ex ib, for IIC, Zone 1. Temperature Class T6.

STANDARD SPECIFICATIONS

Readout 0 to 10, 0 to 100, and 0 to 1000 ppm linear scales

Minimum Detectable Limit (Methane) 0.2 ppm

Response Time Approximately two seconds for 90% of reading

Fuel for Detector Hydrogen

Carrier Gas for Chromatograph Hydrogen (self-contained tank)

Concentration Alarm Audible alarm, user-selectable level

Sample Flow Rate Approximately 2 L/min

Electric Power 12 V dc rechargeable battery

Voltage Output to Recorder 0 to 5 V dc

Flame Out Indication Audible and visual

Operation Time in Portable Mode Eight hours

Filters Sintered metal, user-cleanable

Nominal Dimensions (Sidepack)
230 × 300 × 100 mm (9 × 12 × 4 in)

Approximate Mass 5.5 kg (12 lb)

INSTRUMENT TYPES

Option A Configured for use as a Survey Mode Analyzer for total hydrocarbon monitoring. Specify OVA 128.

Option B Configured for use as a Survey and Gas Chromatograph Analyzer. Specify OVA 128GC.

Option C Tri-column option for the specific analysis of benzene. Specify OVA 128TRI.

INSTRUMENT ACCESSORIES

(Also Refer to Figure below)

Dilutor Kit Used to monitor inert atmospheres, or extend the concentration range of the instrument. The dilution ratios are adjustable from 5 to 50 times. Specify Part Number 511745-1.

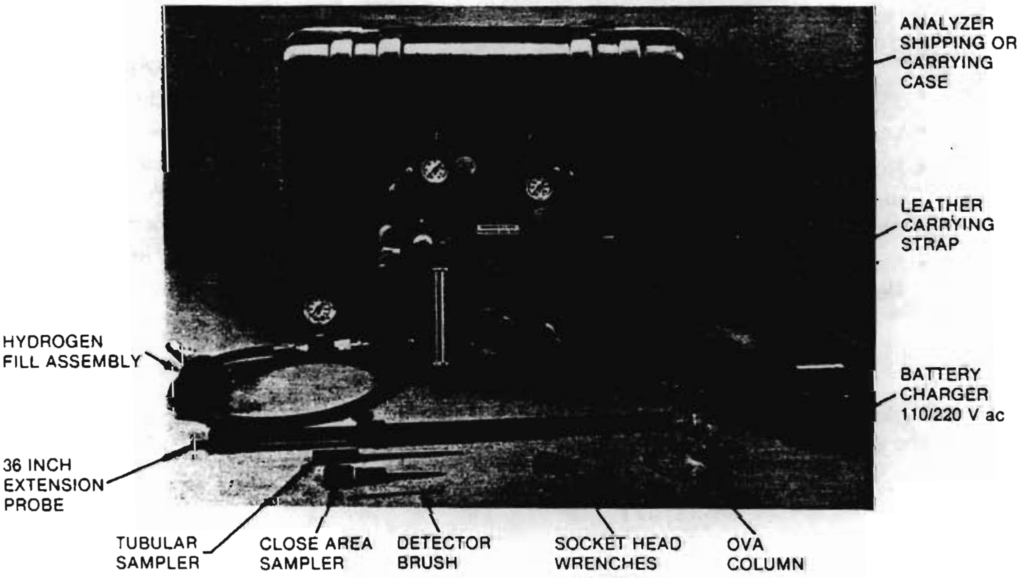
Septum Adapter Used for making syringe injections of gases into the instrument. Specify Part Number 510645-1.

Charcoal Filter Adapter Used for zeroing the instrument in contaminated environments. Specify Part Number 510095-1.

Portable Strip Chart Recorder Used for making hard copy records for all configurations. Specify Part Number 510445-4 for FM certification, and Part Number 510445-6 for BASEEFA certification.

Portable Isothermal Kit (PIP Kit) Used for the temperature control of the OVA columns at 0, 40, and 100°C (32, 104, and 212°F). Specify Part Number 511800-1.

Standard Chromatographic Columns Various column packings available. Specify Part Number 510454, also type and length of column.

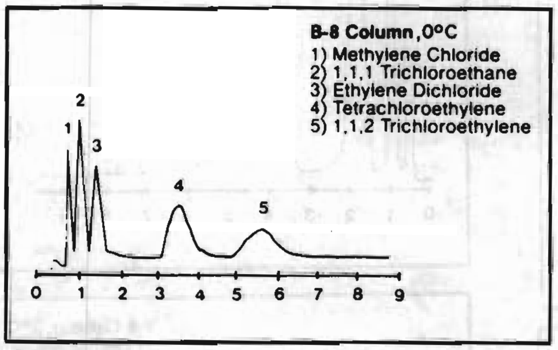


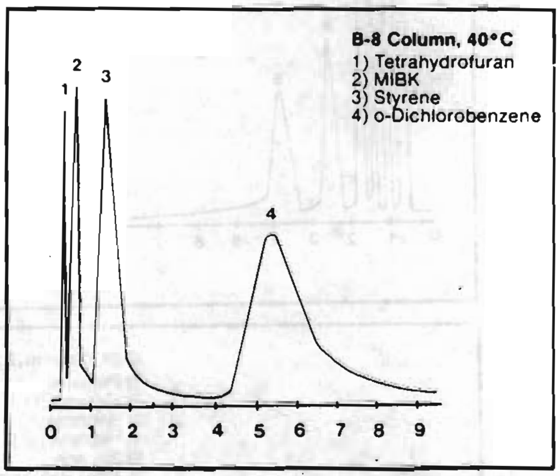
TYPICAL OVA 128 CHROMATOGRAMS

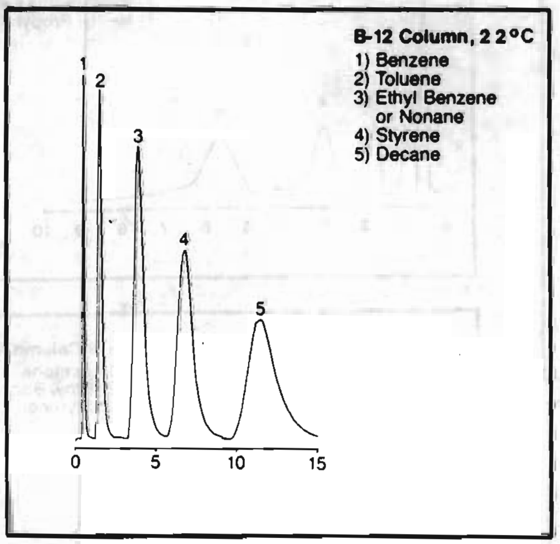
In the following chromatograms, all retention times are in minutes.

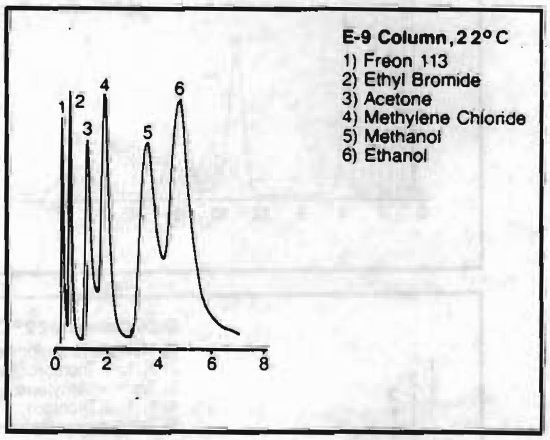
Column Code Description:

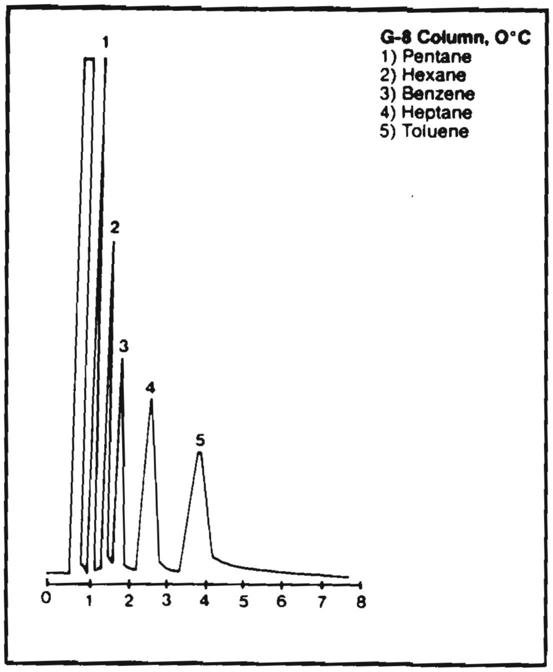
- B—3%, Diisodecyl Phthalate on ANAKROM A, AW, 60/80 mesh.
- E—20% Carbowax 400 on ANAKROM C22A, AW, 60/80 mesh.
- G—10% OV-101 on ANAKROM Q, 60/80 mesh.
- T—10%, 1,2,3-tris(2-cyanoethoxy) Propane on ANAKROM C22A, AW, 60/80 mesh.
- PT—Porapak T, 60/80 mesh.

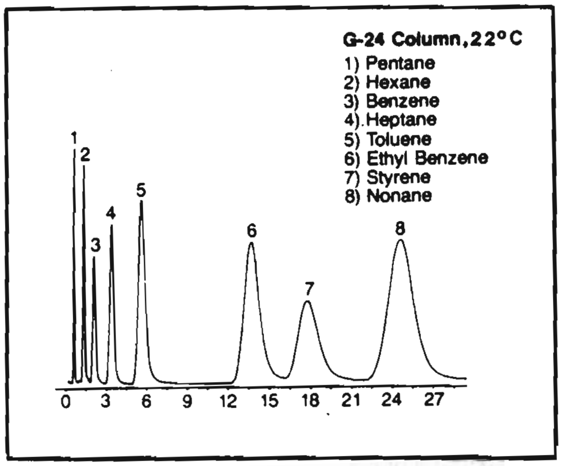


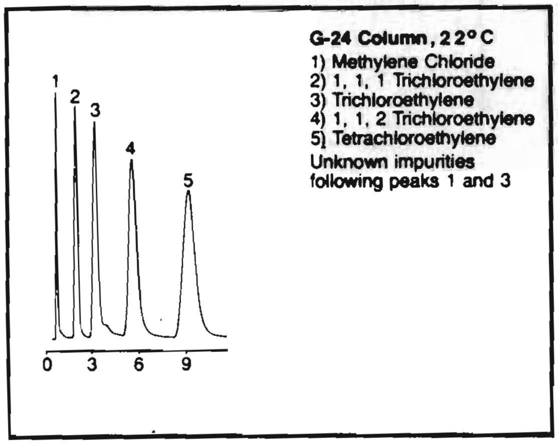


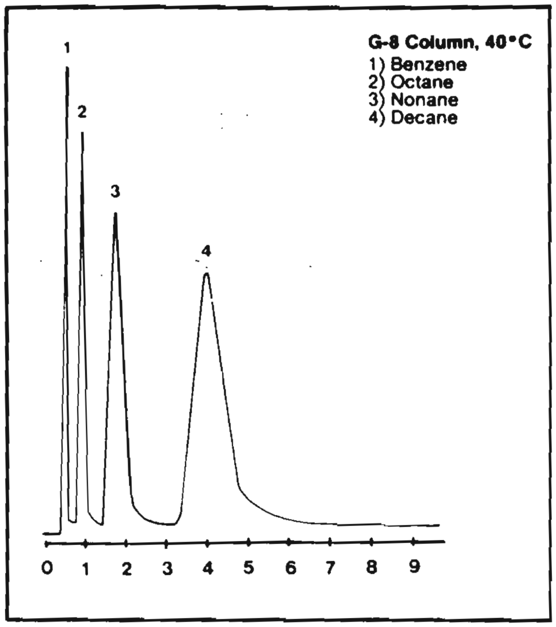


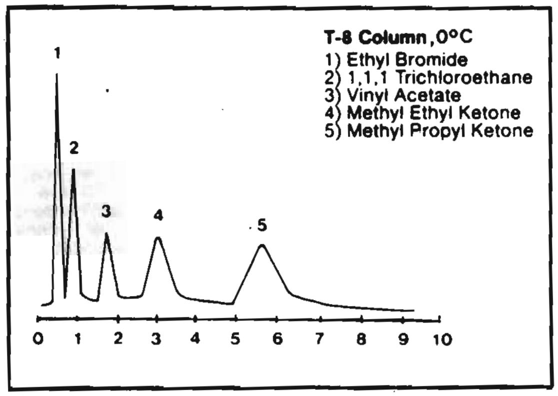


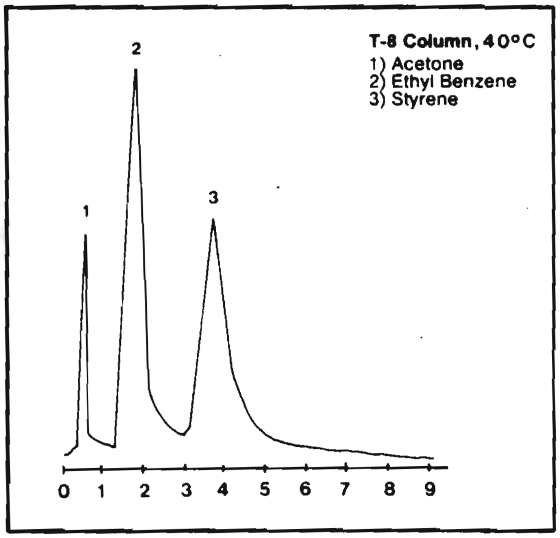

G-8 Column, 0°C
1) Pentane
2) Hexane
3) Benzene
4) Heptane
5) Toluene

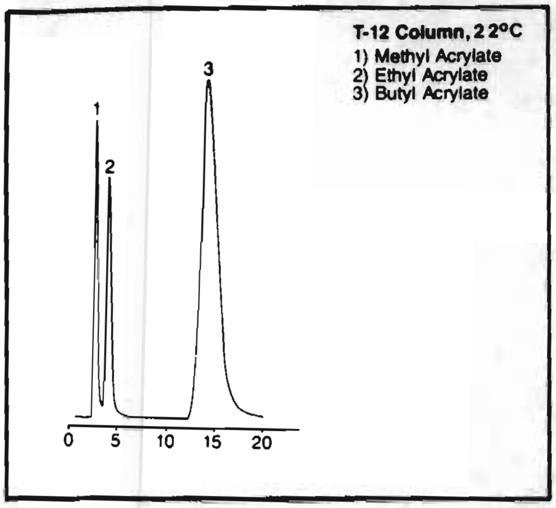

G-24 Column, 22°C
1) Pentane
2) Hexane
3) Benzene
4) Heptane
5) Toluene
6) Ethyl Benzene
7) Styrene
8) Nonane

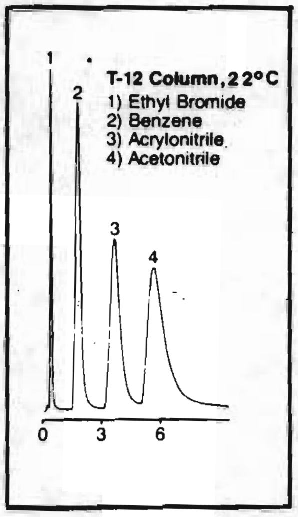

G-24 Column, 22° C
1) Methylene Chloride
2) 1, 1, 1 Trichloroethylene
3) Trichloroethylene
4) 1, 1, 2 Trichloroethylene
5) Tetrachloroethylene
Unknown impurities following peaks 1 and 3

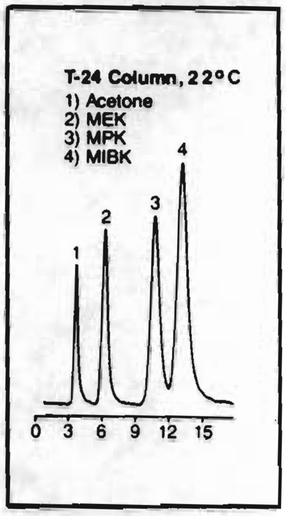

G-8 Column, 40°C
1) Benzene
2) Octane
3) Nonane
4) Decane

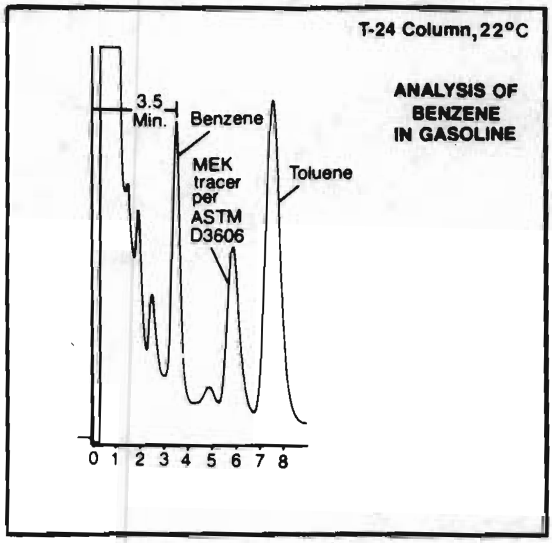

T-8 Column, 0°C
1) Ethyl Bromide
2) 1,1,1 Trichloroethane
3) Vinyl Acetate
4) Methyl Ethyl Ketone
5) Methyl Propyl Ketone


T-8 Column, 40°C
1) Acetone
2) Ethyl Benzene
3) Styrene

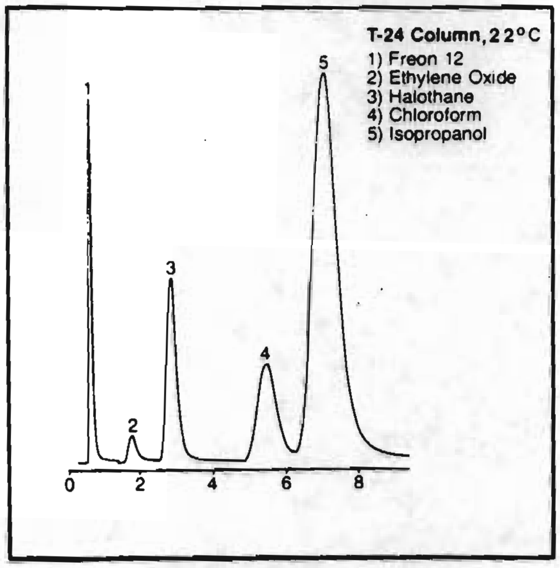

T-12 Column, 22°C
1) Methyl Acrylate
2) Ethyl Acrylate
3) Butyl Acrylate

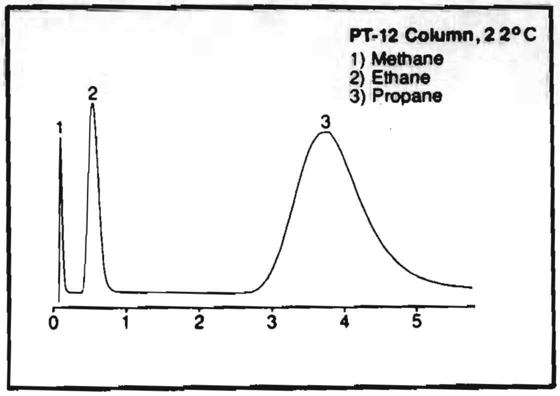

T-12 Column, 22°C
1) Ethyl Bromide
2) Benzene
3) Acrylonitrile
4) Acetonitrile


T-24 Column, 22°C
1) Acetone
2) MEK
3) MPK
4) MIBK


T-24 Column, 22°C

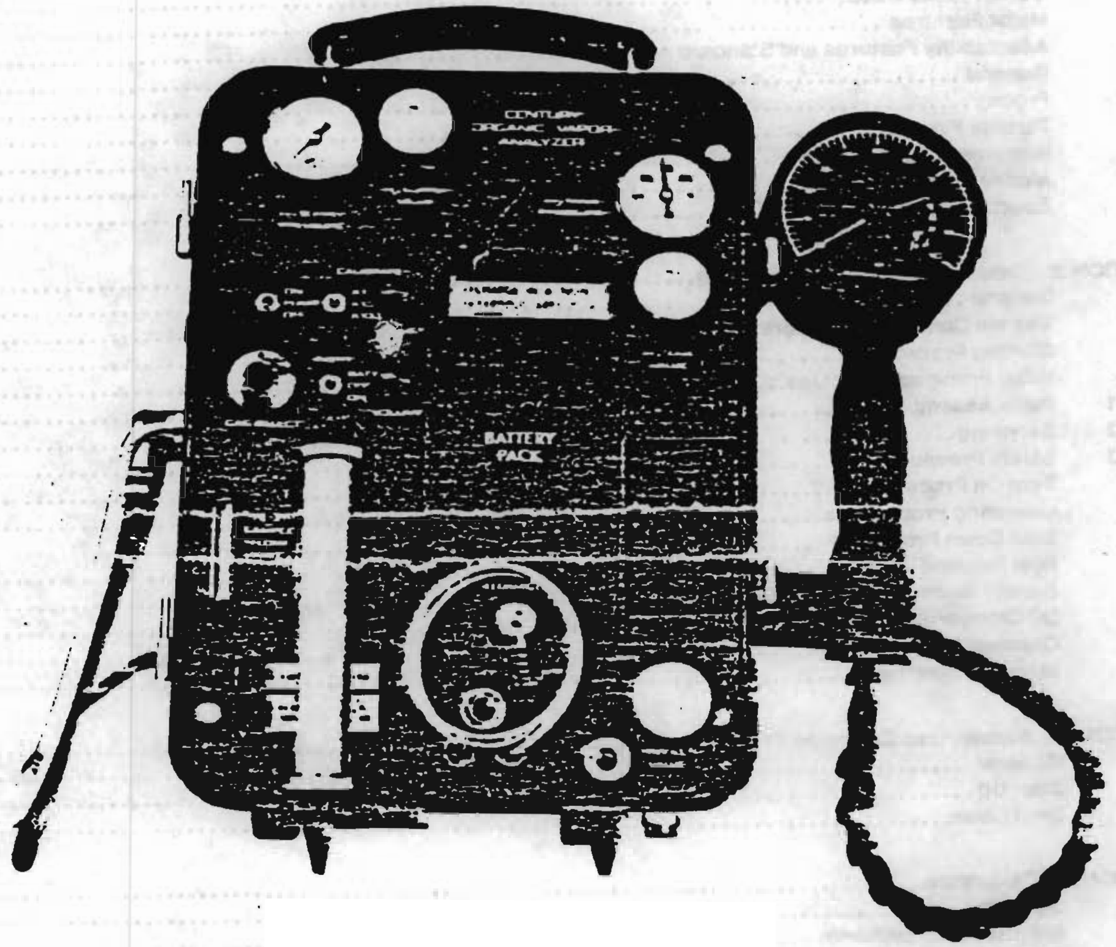
ANALYSIS OF BENZENE IN GASOLINE


T-24 Column, 22°C
1) Freon 12
2) Ethylene Oxide
3) Halothane
4) Chloroform
5) Isopropanol


PT-12 Column, 22°C
1) Methane
2) Ethane
3) Propane

Instruction & Service Manual

MI
2R900AC



CENTURY SYSTEMS

Portable Organic Vapor Analyzer
Model OVA-128

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A Division of The Foxboro Company

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CENTURY SYSTEMS CORPORATION

P.O. BOX 818 / ARKANSAS CITY, KANSAS 67005 / 316-447-3311 / TWX 910-740-6740

SECTION 1

DESCRIPTION AND LEADING PARTICULARS

1.1 GENERAL

The Century Portable Organic Vapor Analyzer (OVA), illustrated in Figure 1-1, is designed to detect and measure hazardous gases found in almost all industries. It has broad application, since it has a chemically resistant sampling system and can be calibrated to almost all organic vapors. It is extremely sensitive and can provide accurate indication of gas concentration in one of three ranges: 0 to 10 ppm; 0 to 100 ppm; and 0 to 1,000 ppm. While designed as a lightweight portable instrument, it can readily be adapted to remote monitoring applications.

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 normal survey mode operation, a continuous sample is drawn into the probe and transmitted to the detector chamber by an internal pumping system. The sample flow rate is metered and passed through particle filters before reaching the detector chamber. Inside the detector chamber, the sample is exposed to a hydrogen flame which ionizes the organic vapors. 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 linear electrometer preamplifier which has an output signal proportional to the ionization current. A signal conditioning amplifier is used to amplify the signal from the preamp and to condition it for subsequent meter or external recorder display. The meter display is an integral part of the Probe/Readout Assembly and has a scale from 0 to 10.

1.2 TYPICAL APPLICATIONS

(1) Measurement of most toxic organic vapors sent in industry for compliance with Occu tional Safety and Health Administration (OS requirements.
(2) Process monitoring and evaluation.
(3) Evaluation and monitoring applications in air pollution field.
(4) Leak detection in storage, transportation handling equipment.
(5) Survey of gas distribution and transmiss lines and equipment for compliance with Off of Pipeline Safety (OPS) requirements
(6) Forensic science applications.

1.3 OTHER TYPICAL USES

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

1.4 MAJOR FEATURES

The basic instrument consists of two ma assemblies, the Probe/Readout Assembly and the Si Pack Assembly (see Figure 1-1). The recorder is tional on all models, but is normally used with all struments which incorporate the GC Option. The outp meter and alarm level adjustments are incorporated the Probe/Readout Assembly which is operated w one hand. The Side Pack Assembly contains the maining operating controls and indicators, the ele tronic circuitry, detector chamber, hydrogen fuel supp and electrical power supply. It is a quantitative type strument with sensitivity to 0.1 ppm methane.

Other major features are: 250° linear scale readou less than two second response time and minimum eig hour service life for fuel supply and battery pack. A ba tery test feature allows charge condition to be read the meter. Hydrogen flame-out is signified by an aud ble alarm plus a visual indication on the meter. The i strument contains a frequency modulated detectio alarm which can be preset to sound at a desired co centration level. The frequency of the detection alar 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 and weighs less than 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.

1.5 ADAPTABILITY FEATURES AND STANDARD ACCESSORIES

1.5.1 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.

1.5.2 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 replaced with a Close Area Sampler, which is supplied as a standard accessory.

1.5.3 PARTICLE FILTERS

The primary filter is of porous stainless and located behind the sample inlet connector, see Side Pack Assembly drawing in Appendix "A". In addition, replaceable porous metal filters are installed in the "close area" sampler, the pickup funnel and the tubular sampler.

1.5.4 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.

1.5.5 MOBILE INSTALLATION

The instrument is readily adaptable to a mobile application by simply plugging into vehicle power and hydrogen fuel supply and making provisions for drawing sample from the vehicle primary sampling system.

1.6 SPECIFICATIONS

Sensitivity: 0.1 ppm (methane)

Response time: Less than 2 seconds

Readout: 0 to 10 ppm, 0 to 100 ppm, 0 to 1,000 ppm, 250° linear scaled meter; external monitor connector

Sample flow rate: Nominally 2 units

Fuel supply: 75 cubic centimeter tank of pu hydrogen at maximum pressure of 2300 PS fillable while in case

Primary electrical power: Rechargeable a replaceable battery pack at 12VDC

Service life: Hydrogen supply and battery power hours operating time minimum

Size: Standard Unit: 8-5/8 x 11-5/8 x 4-1/4 F Unit: 8-5/8 x 11-5/8 x 4-1/2 Probe/Reado Assembly: Variable (see Figure 1-2)

Weight: Standard Unit: Side Pack Assembly, le than 10 lbs. FM Unit: Side Pack Assemb less than 11 lbs. Probe/Reado Assembly: less than 2 lbs.

Operator requirements: One man, one hand oper tion

Detection alarm: Frequency modulated audib alarm. Can be preset to desired level. Fr quency varies as a function of detection leve

Flame-out indication: Audible alarm plus visu meter indication

Battery test: Battery charge condition indicated o readout meter or battery recharger

Pickup fixtures: Variety of types for various applic tions

Probe: Telescoping adjustment over 8 inches c probe can be completely removed fro Readout Assembly

Umbilical cord: Cable between readout an sidepack with connectors for electrical cabl and sample hose

Filtering: In-line particle filter and optional ac tivated charcoal filter.

Side Pack case: Molded high impact plastic case with carrying handle and shoulder strap

Electrical protection: Refer to Section 5

Standard accessories:

1) Instrument carrying and storage case
2) Fuel filling hose assembly
3) A.C. battery charger
4) Earphone
5) Various pickup fixtures

Optional accessories:

1) Gas chromatograph option
2) Portable strip chart recorder
3) Activated charcoal filter; also used with desiccant as a moisture trap
4) Dilution valve
5) Septum adapter for use with ga chromatograph option

SECTION 2

DETAILED OPERATING PROCEDURES

2.1 GENERAL

The procedures in this section are broken into five parts: (1) Starting, (2) Operating, (3) Shut Down, (4) Fue Refilling, and (5) Battery Charging. After familiarizatio

INTRODUCTION

The Century Model OVA-128 Portable Organic Vapor Analyzer (OVA) is a highly sensitive instrument designed to measure trace quantities of organic materials in air. It is essentially a hydrogen flame ionization detector such as utilized in laboratory gas chromatographs and has similar analytical capabilities. 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 monoxide 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. It has a single linearly scaled readout from 0 ppm to 10 ppm with a X1, X10, X100 range switch. Designed for use as a portable survey instrument, it can also be readily adapted to fixed remote monitoring or mobile installations. It is ideal for the determination of many organic air pollutants and in the monitoring of air in potentially contaminated areas.

The OVA-128 is certified intrinsically safe by Factory Mutual Research Corporation (FM) for use in Class I, Division 1, Groups A, B, C & D hazardous environments. Similar foreign certifications have been obtained, cluding BASEEFA and Cerchar approval for Group Temperature Class T4 and equivalent approval from Japanese Ministry of Labor. This requirement especially significant in industries where volatile fla mable petroleum or chemical products are manuf tured, processed or used and for instruments which actually used in portable surveying and in analyz concentrations of gases and vapors. Such instrumen must be incapable, under normal or abnormal con tions, of causing ignition of the hazardous atmosphe mixtures. In order to maintain the certified safety, it important that the precautions outlined in this manu be practiced and that no modification be made to the instruments.

Sections 1 through 6 herein apply to the basic instr ment. Section 7 contains information relative to optio which are available and which may or may not ha been purchased with your OVA.

It is highly recommended that the entire manual read before operating the instrument. It is essential th all portions relating to safety of operation ar maintenance, including Section 5, be thorough understood.

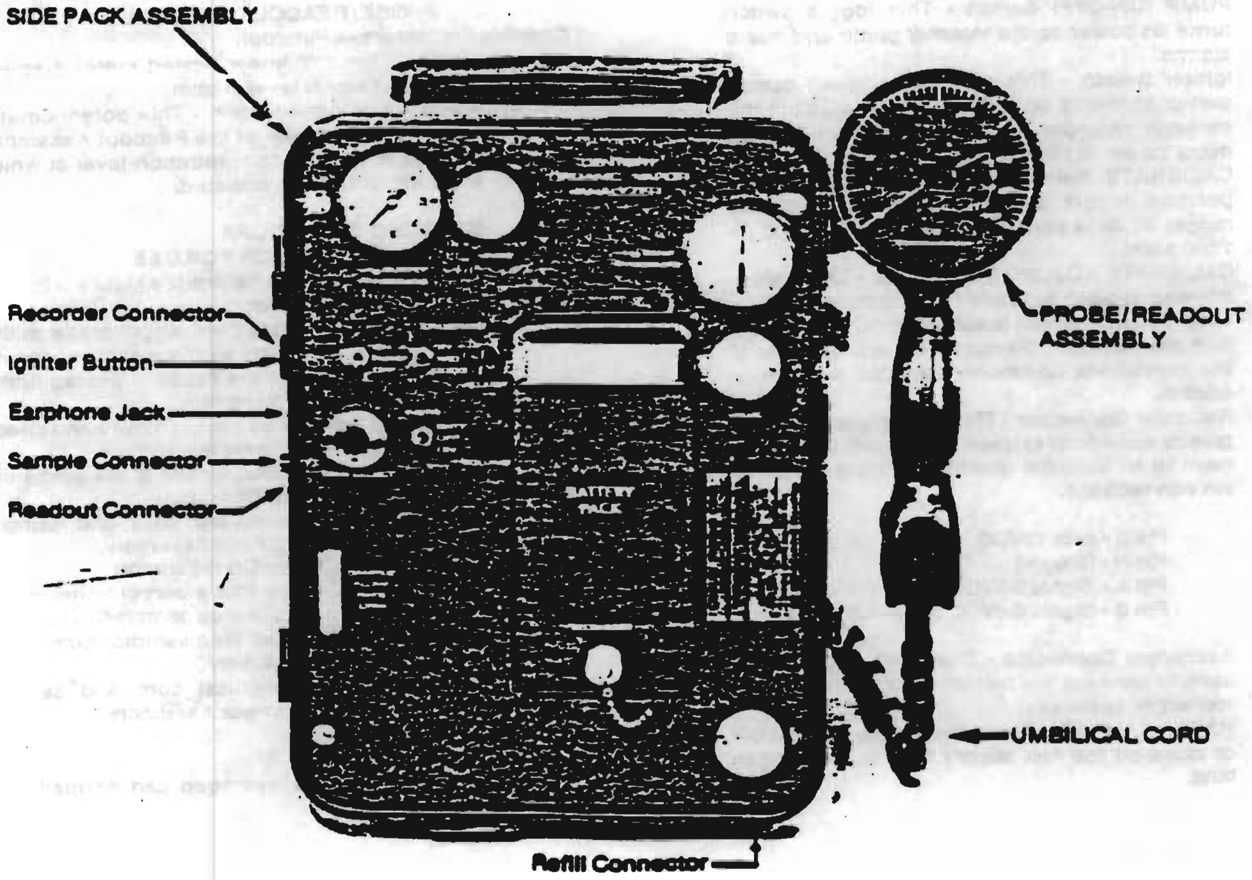


FIGURE 1-1. PORTABLE ORGANIC VAPOR ANALYZER
Model OVA-128

with the instrument, the summarized procedures described in Section 3 may be used for simplicity. Because of the many optional applications for the instrument, the comprehensive detailed procedures described in this section may seem complex. However, in normal applications the operating procedures are quite simple. A condensed operating procedure check list is provided inside the cover of the Side Pack Assembly. Refer to Section 7 for operating procedures relative to major optional accessories such as the Gas Chromatograph Option.

2.2 SYSTEM CONTROLS, INDICATORS AND CONNECTORS

Tables 2-1 and 2-2 describe the functions of the various controls, indicators and connectors illustrated in Figure 1-1. Unless otherwise noted, the listings in Tables 2-1 and 2-2 are applicable to both the Model OVA-118 and OVA-128.

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 pump.
4) CALIBRATE Switch (range selector) - This 3 position toggle switch selects the desired range: X1 (0-10 ppm); X10 (0-100 ppm); X100 (0-1,000 ppm).
5) CALIBRATE ADJUST (zero) Knob - This potentiometer is used to "zero" the instrument.
6) GAS SELECT Knob (span control) - This ten-turn dial readout potentiometer sets the gain of the instrument commonly referred to as span control.
7) Recorder Connector - This 128 series 5-pin Amphenol connector is used to connect the instrument to an external monitor with the following pin connections.

   Pin E - plus 12VDC
   Pin H - Ground
   Pin A - Signal 0-5VDC (OVA-118 only)
   Pin B - Signal 0-5VDC (OVA-128 only)

8) Recharger Connector - This BNC connector is used to connect the battery pack to the battery recharger assembly.
9) H2 TANK VALVE - This valve is used to supply or close off the fuel supply from the hydrogen tank.
10) H2 TANK PRESSURE Indicator - This high pressure gauge measures the pressure in the hydrogen fuel tank which is an indication of fuel supply.
11) H2 SUPPLY VALVE - This valve is used to supply or close off the hydrogen fuel to the detector chamber.
12) H2 SUPPLY PRESSURE Indicator - This low pressure gauge is used to monitor the hydrogen pressure at the capillary restrictor.
13) SAMPLE FLOW RATE Indicator - This indicator is used to monitor the sample flow rate.
14) Refill Connection - This 1/4" AN fitting is used to connect the hydrogen refill hose to the instrument.
15) REFILL VALVE - This valve is used to open one end of the instrument fuel tank for refilling with hydrogen.
16) Earphone Jack - This jack is used to connect the earphone: it turns off speaker when used.
17) VOLUME Knob - This potentiometer adjusts the volume of the internal speaker and earphone.
18) Readout and Sample Connectors - These connectors are used to connect the sample hose and umbilical cord from the Probe/Readout Assembly to the Side Pack Assembly.

TABLE 2-2
PROBE/READOUT ASSEMBLY

Controls/Indicators — Function

A) Meter - This 250° linear scaled meter displays the output signal level in ppm.
B) Alarm Level Adjust Knob - This potentiometer (located on the back of the Readout Assembly is used to set the concentration level at which the audible alarm is actuated.

2.3 STARTING PROCEDURE

2.3.1 INITIAL PREPARATION FOR USE

2.3.1.1 INITIAL ASSEMBLY (Reference Figure 1-2)

a) Normal Survey Configuration
   (1) Connect the adjustable length probe to th Readout Assembly with the captive lockin nut. Ensure that the probe is seated firmly in the Readout Assembly.
   (2) Select the desired pickup fixture and chec 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 samp hose to the Side Pack Assembly.
b) "Close Area" Survey Configuration
   (1) Check to ensure that a particle filter is i stalled in the close area sampler.
   (2) Connect the close area sampler directly to the Readout Assembly.
   (3) Connect the umbilical cord and samp hose to the Side Pack Assembly.

2.3.1.2 SERVICING

a) Fueling: Pure, dry hydrogen can normally r purchased locally or in a high grade from the Matheson Company of East Rutherford, New Jersey. 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 in Section 2.8 of this manual.

b) Battery Check: Move INSTR/BATT Test Switch to the BATT position and ensure battery is charged by reading the indication on the readout meter.

c) Calibration: Standard factory calibration is performed using methane in air. The GAS SELECT (span) Control is set and locked to the position for calibration to methane (factory setting is 300). If the instrument is calibrated for other organic vapors, the reading on the GAS SELECT Control must be set for that particular vapor.

2.3.1.3 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. Section 5 of the manual provides detailed safety precautions.

2.3.2 TURN ON PROCEDURE

The GAS SELECT control should be preset to the desired dial indication prior to turn on. The procedure for determining this setting is contained in Section 4 of this manual. The instrument, as received from the factory, is set to measure in terms of methane in air.

a) Move the INSTR Switch to ON and allow five minutes 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 alarm level, using the CALIBRATE ADJUST (zero) Knob. Turn the Alarm Level Adjust Knob on the back of the Readout Assembly until the audible alarm just comes on. Adjust speaker volume with VOLUME Knob. If earphone is used, plug in and readjust the volume as desired. The instrument is then preset to activate the alarm when the level exceeds that of the setting.

c) Move the CALIBRATE Switch to X10 and adjust the meter reading to zero with the CALIBRATE ADJUST (zero) Knob.

d) Ensure the PUMP Switch is ON and observe the SAMPLE FLOW RATE Indicator. Indication should be approximately 2 units.

e) Open H2 TANK VALVE one (1) turn and observe the reading on the H2 TANK PRESSURE Indicator. (Approximately 150 psi of pressure is needed for each hour of operation.)

f) Open H2 SUPPLY VALVE 1/2 to 1 turn an observe the reading on the H2 SUPPL PRESSURE Indicator.

CAUTION

Do not leave H2 SUPPLY VALVE ope when the pump is not running, as this wi allow hydrogen to accumulate in the detec tor chamber.

g) Confirm that meter is still reading zero (readjus if required).

h) Depress igniter button. There will be a slig "pop" as the hydrogen ignites and the mete pointer will move upscale of zero. Immediate after ignition, release the igniter button. Do n depress igniter button for more than 6 second If burner does not ignite, let instrument run f several minutes and try again. After ignitio the meter pointer will indicate the backgrou concentration. This background level is null out using the CALIBRATE ADJUST (zero) Kno Reference paragraph 6.2.5.1.

NOTE

Since the OVA utilizes the sample air draw by the pump into the detector chamber the only source of air to support t hydrogen flame, without adjustment the i strument will read the actual backgrou concentration (ppm) of all hydrocarbo present at a given location.

i) Move instrument to an area which is represe tative of the "lowest ambient background c centration" (cleanest air) to be surveyed. Mo the CALIBRATE Switch to X1 and adjust t meter to read 1 ppm with the CALIBRATE A JUST (zero) Knob.

NOTE

Adjustment to 1 ppm (rather than 0) necessary in the X1 range because of t sensitivity of the OVA. This permits min downward fluctuations in the nor background level without dropping be 0, which would actuate the flame-out ala It is important, therefore, to remember d ing the subsequent survey that 1 ppm m be subtracted from all readings. Therefo a 1.5 ppm reading would actually be only ppm.

j) If the alarm level is to be set above the nor background detection level, turn the Ala Level Adjust Knob on the back of the Read Assembly until it actuates slightly ab background.

THE INSTRUMENT IS NOW READY FOR USE

2.4 OPERATING PROCEDURES

a) Set the CALIBRATE Switch to the desi

range. Using one hand operation, survey the areas of interest while observing the meter and/or listening for the 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 preset 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 H2 flame to extinguish. If this is the case, reignition is all that is required.

Another possible cause for flame-out would be restriction of the sample flow line which would not allow sufficient air into the chamber to support combustion of the H2 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.

2.5 SHUT DOWN PROCEDURE

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

1) Close H2 SUPPLY VALVE.
2) Close H2 TANK VALVE.
3) Move INSTR Switch to OFF.
4) Wait 5 seconds and move PUMP Switch to OFF. INSTRUMENT IS NOW IN A SHUT DOWN CONFIGURATION.

2.6 FUEL REFILLING

a) The instrument should be completely shut down as described in Section 2.5 herein 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.

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 N2 or H2 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 when possible. 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 th Side Pack Assembly.

d) Open the hydrogen supply bottle valve slightl Open the REFILL VALVE and the H2 TAN VALVE on the instrument panel and place th FILL/BLEED Valve on the filling hose assemb in the FILL position. The pressure in the instrument tank will now be indicated on the H2 TAN PRESSURE indicator.

e) After the instrument fuel tank is filled, shut o the REFILL VALVE on the panel, th FILL/BLEED Valve on the filling hose assemb and the hydrogen supply bottle valve.

f) The hydrogen trapped in the hose should no be bled off to atmospheric pressure. CAUTIO should be used in this operation as describe in Step (g) below, since the hose will contain significant amount of hydrogen at hig pressure.

g) The hose is bled by turning the FILL/BLEE Valve on the filling hose assembly to th BLEED position. After the hose is bled down t atmospheric pressure, the FILL/BLEED Valv should be turned to the FILL position to allo the hydrogen trapped in the connection fitting to go into the hose assembly. Then, again, tur the FILL/BLEED Valve to the BLEED positio and exhaust the trapped hydrogen. Then tur the FILL/BLEED Valve to OFF to keep th hydrogen at one atmosphere in the hose s that at the time of the next filling there will b no air trapped in the filling line.

h) Close the H2 TANK VALVE.

i) With the H2 TANK VALVE and the H2 SUPPLY VALVE closed, a small amount of H2 at hig pressure will be present in the regulators an plumbing. As a leak check, observe the H TANK PRESSURE indicator while the remainder of the system is shut down and ensur that the pressure indication does not go dow rapidly, indicating a significant leak. If it doe decrease rapidly (greater than 350 PSIG/hr.), there is a significant leak in the H2 suppl system.

2.7 BATTERY RECHARGING

a) Plug charger BNC connector into mating connector on battery cover and insert AC plug int 115 VAC wall outlet. Never charge in a haza dous area or environment.

b) Move the battery charger switch to the ON pos tion. The light above the switch button shou illuminate.

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

d) Approximately one hour of charging time is r quired for each hour of operation. However, a overnight charge is recommended. The charger can be left on indefinitely without

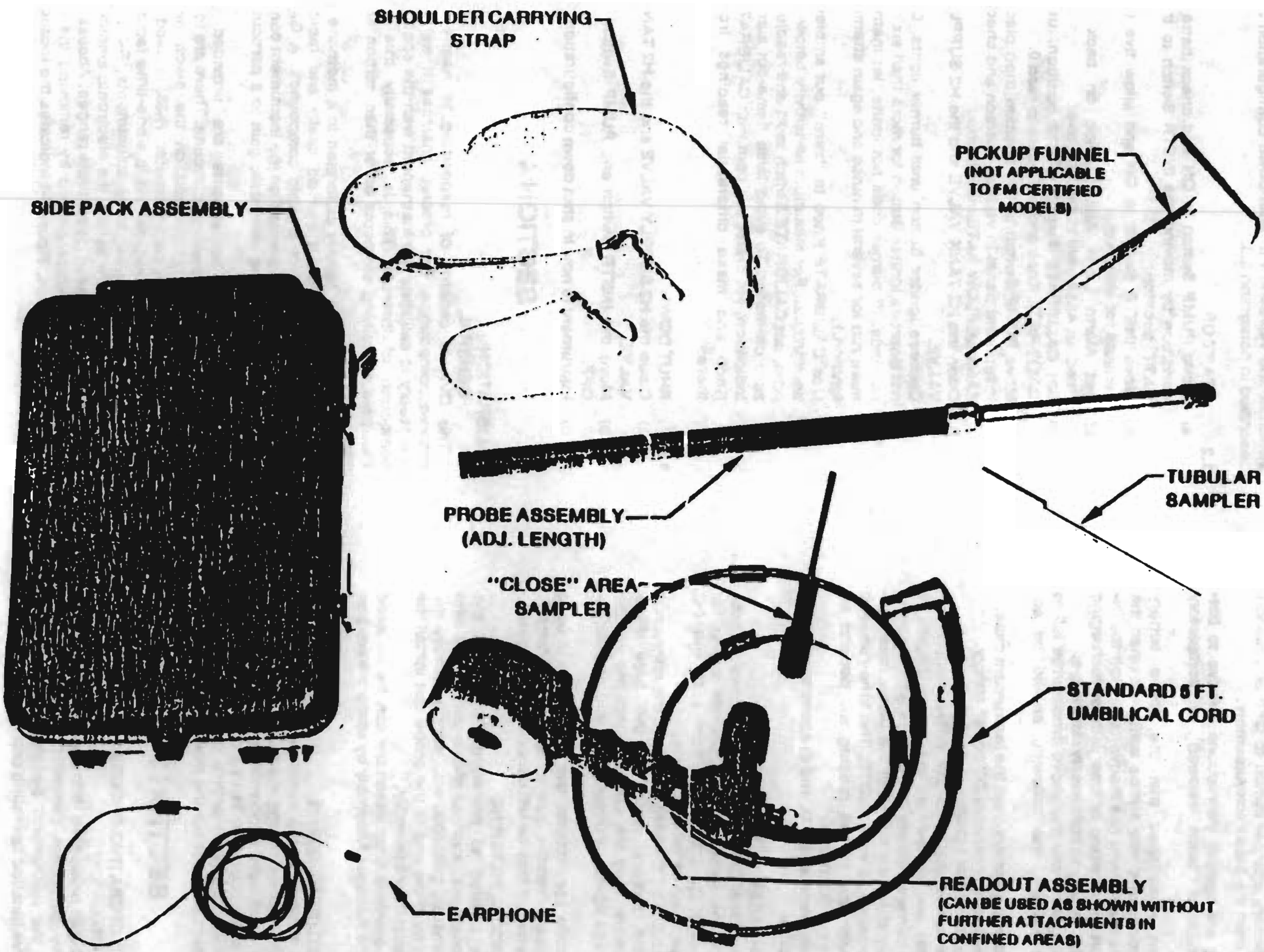


FIGURE 1-2

INSTRUMENT DISASSEMBLED

damaging the batteries. When finished, move the battery charger switch to OFF and disconnect from the Side Pack Assembly.

The following are special instructions relative to batteries which have been allowed to completely discharge.

It has been established that the above battery recharging procedures may not be sufficient when the operator of the instrument has inadvertently left the INSTR Switch ON for a period of time without recharging and allowed the battery to completely discharge.

When this happens and the above procedures fail to recharge the battery, the following should be accomplished:

1) Remove the battery from the instrument case.
2) Connect to any variable DC power supply.
3) Apply 40 volts at 1/2 amp maximum.
4) Observe the meter on the power supply frequently and as soon as the battery begins to draw current, reduce the voltage on the power supply at a slow rate until the meter reads approximately 15 volts. NOTE: The time required to reach the 15 volt reading will depend on degree of discharge.
5) Repeat steps a), b), c), and d) above to continue charging.

2.7.2 DC CHARGER

a) The optional DC charger is designed to both charge the battery and to provide power for operating the instrument from a 12 volt DC source, such as vehicle power.
b) Connect the DC charger cord to the connector on the battery cover of the Side Pack Assembly. Plug the line cord into the vehicle cigarette lighter or other power source connection.
c) In mobile applications, the DC charger is used to supply vehicle power to the instrument. Therefore, it may be left connected at all times.

2.8 CHARCOAL FILTERING

When it is desired to preferentially remove the heavier hydrocarbons, such as those associated with automobile exhaust, gasoline, etc., simply remove the pickup fixture from the end of the probe and install the optional charcoal filter assembly.

This same charcoal filter assembly can be installed directly into the Readout Assembly by using the adapter provided.

2.9 MOISTURE FILTERING

Filtering of moisture in the sample is not normally required. However, when moving in and out of buildings in cold weather, excessive condensation can form in the lines and detector chamber. In this case, the charcoal filter adapter can be filled with a desiccant such as "Drierite" which will filter out the moisture contained in the sample.

SECTION 3

SUMMARIZED OPERATING PROCEDURES

3.1 GENERAL

The procedures presented in this section are intended for use by personnel generally familiar with the operation of the instrument. Section 2 presents the comprehensive detailed operating procedures.

It is assumed that, prior to start up the positions of switches and valves are in shut down configuration described in paragraph 3.3.

3.2 START UP

a) Move PUMP Switch to ON and check batte condition by moving the INSTR Switch to th BATT position.
b) Move INSTR Switch to ON and allow five (minutes for warm-up.
c) Set Alarm Level Adjust Knob on back Readout Assembly to desired level.
d) Set CALIBRATE Switch to X10 position, us CALIBRATE Knob and set meter to read 0.
e) Move PUMP Switch to ON position then plac instrument panel in vertical position and chec SAMPLE FLOW RATE indication.
f) Open the H2 TANK VALVE and the H2 SUPPL VALVE.
g) Depress Igniter Button until burner lights. D not depress Igniter Button for more than six (seconds. (If burner does not ignite, let instru ment run for several minutes and again attem ignition.)
h) Use CALIBRATE Knob to "zero" out ambie background. For maximum sensitivity below ppm, set CALIBRATE Switch to X1 and readju zero on meter. To avoid false flame-out alar indication, set meter to 1 ppm with CALIBRAT Knob and make differential readings fro there.

3.3 SHUT DOWN

a) Close the H2 SUPPLY VALVE and the H2 TAN VALVE.
b) Move the INSTR Switch and PUMP Switch OFF.
c) Instrument is now in shut down configuration.

SECTION 4

CALIBRATION

4.1 GENERAL

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

The instrument is factory calibrated to a methane air standard. However, it can be easily and rapid calibrated to a variety of organic compounds. A GA SELECT control is incorporated on the instrument pan which is used to set the electronic gain to a particul organic compound.

Internal electronic adjustments are provided calibrate and align the electronic circuits. There are fo (4) such adjustments all located on the electroni board. One adjustment potentiometer, R-38, is used set the power supply voltage and is a one-time facto adjustment. The remaining three adjustments, R-31, 32 and R-33 are used for setting the electronic amplifi gain for each of the three (3) calibrate ranges. Access the adjustments is accomplished by removing the i strument from its case. Figure 4-1 indicates the locatio of the adjustments.

4.2 ELECTRONIC ADJUSTMENTS

Primary calibration of this instrument is accomplished at the factory using methane in air sample gases.

4.2.1 GAIN ADJUSTMENT

a) Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT control set to 300.

b) Use the CALIBRATE ADJUST (zero) Knob and adjust the meter reading to zero.

c) Introduce a methane sample of a known concentration (near 100 ppm) and adjust trimpot R-32 on circuit board (see Figure 4-1 for location) so that meter reads equivalent to the known sample.

d) This sets the instrument gain for methane with the panel mounted gain adjustment (GAS SELECT) set at a reference number of 300.

e) Turn off H2 SUPPLY VALVE to put out flame.

4.2.2 BIAS ADJUSTMENT

a) Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to 4 ppm.

b) Place CALIBRATE Switch in X1 position and, using trimpot R-31 on circuit board, adjust meter reading to 4 ppm. (See Figure 4-1)

c) Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) Knob to adjust meter to a reading of 40 ppm.

d) Move CALIBRATE Switch to X100 position and use trimpot R-33 on circuit board to adjust meter reading to 40 ppm.

e) Move CALIBRATE Switch to X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to zero.

f) Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

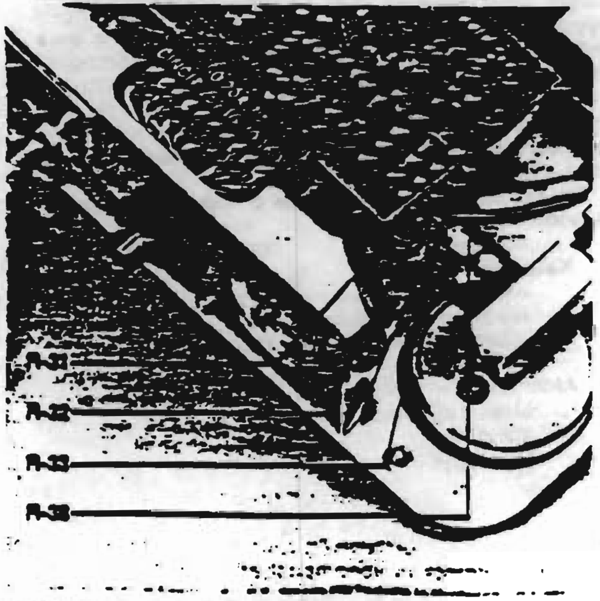


FIGURE 4-1. LOCATION OF ELECTRONIC ADJUSTMENTS
(Model OVA-118 shown; location typical to OVA-128)

4.3 CALIBRATION TO OTHER ORGANIC VAPORS

4.3.1 SETTING GAS SELECT CONTROL (Span)

Primary calibration of the instrument is accomplish using a known mixture of a specific organic vapor co pound. After the instrument is in operation and t "normal background" is "zeroed out", draw a samp of the calibration gas into the instrument. The GA SELECT Knob on the panel is then used to shift t readout meter indication to correspond to the conce tration of the calibration gas mixture.

The instrument is then calibrated for the vapor mi ture being used. After this adjustment, the setting c the "digidial" is read and recorded for that particul organic vapor compound. This exercise can be perform ed for a large variety of compounds and when desirin to read a particular compound the GAS SELECT contr is turned to the predetermined setting for the com pound. Calibration on any one range automaticall calibrates the other two ranges.

4.3.2 USING EMPIRICAL DATA

Relative response data may be obtained, which ca then be used to estimate concentrations of variou vapors. With the instrument calibrated to methane, ob tain the concentration reading for a calibration sampl of the test vapor. The relative response, in percent, fo that test vapor would then be the concentratio read/concentration of the calibrated sample X 100.

4.3.3 PREPARATION OF CALIBRATION STANDARDS

4.3.3.1 COMMERCIAL SAMPLES

Commercially available standard samples offer the most convenient and reliable calibration standards an are recommended for the most precise analyses Always remember to obtain the cylinder with th desired sample and the "balance as air". Sample should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument t prevent a pressure or vacuum at the sample inlet.

4.3.3.2 PURE GASEOUS SAMPLES

Obtain a large collapsible sample bag, preferabl polyethylene such as a 40 gallon trash can liner. Insert tube into the bag opening and tie shut around the tube. The tubing should have a shut-off valve or plug and be suitable for connecting the OVA input tube. Determin the volume of the bag by appropriate means (i.e., wet test meter, dimensions of the bag, etc.). Forty gallon polyethylene bags provide a volume of approximatel 140-160 liters. For gas samples, flush a 10 cc hypodermi syringe with the compound to be tested and then injec a 10 cc sample through the wall of the air-filled bag. Immediately after withdrawing the needle, cover the hol with a piece of plastic tape. Allow a few minutes for th sample to completely diffuse throughout the bag. Agita tion will ensure complete diffusion. Connect the outlet tube to the OVA and take a reading. To veri repeatability of sampling technique, disconnect the ba and inject a second sample of the gas into the ba without emptying. Since only 2 or 3 liters will have been removed, the overall volume change will be small an the instrument reading should now be twice that of th original. The concentration in ppm (V/V) will be equal to the sample size in cc divided by the volume of the bag in liters times 1000. For example, a 10 cc gas sample when placed in a 160 liter bag will provide a sample of 63 ppm, i.e., 10 X 1000/160 equals 63 ppm.

4.3.3.3 GASEOUS AND LIQUID SAMPLES (Alternate Method)

Obtain a five (5) gallon glass bottle and determine its volume by measuring the volume of water needed to fill it (use of a 1000 ml graduated cylinder, obtainable from scientific supply houses, is convenient). Another approach is to weigh the empty bottle, fill it with water and weigh again. The difference between the two values is the weight of water. By multiplying the weight of water in pounds by 0.455, you obtain the volume of the bottle in liters. Empty the water out and allow the bottle to dry. Place a one-foot piece of plastic tubing in the flask to aid in mixing the vapors uniformly with the air. The volume of such a bottle should be about 20 liters, which is 20,000 ml. If the volume were 20,000 ml, then a 2 ml sample of a gas placed in the bottle would be equivalent to 200 ml per 2 million ml or 100 ppm (V/V). Use of a gas tight syringe, readable in 0.01 ml, allows the preparation of mixtures in the 1 - 2 ppm range, which are sufficient for the quantitative estimation of concentrations. A rubber stopper is loosely fitted to the top of the bottle and the needle of the syringe placed inside the jug neck and the stopper squeezed against the needle to decrease leakage during sample introduction. Inject the sample into the bottle and withdraw the needle without removing the stopper. Put the stopper in tight and shake the bottle for a few minutes with sufficient vigor that the plastic tubing in the bottle moves around to ensure good mixture of the vapors with the air.

For liquid samples, use of the following equation will allow the calculation of the number of microliters of organic liquid needed to be placed into the bottle to make 100 ppm (V/V) of vapor.

V1 equals V2 X Mw/244D

V1 - Volume of liquid in microliters needed to make an air mixture of 100 ppm (V/V)
V2 - Volume of bottle in liters
Mw - Molecular weight of substance
D - Density of substance

This procedure has the advantage that you can see when all of the organic liquid has vaporized and the volume can be determined readily.

For liquid samples, an alternate procedure involves the use of a diffusion dilution device such as that described by Desty, Geach and Goldup in "Gas Chromatography", R.P.W. Scott, ed., Academic Press, New York, 1961.

4.4 THEORY

Theoretical background and empirical data related to the Century Organic Vapor Analyzer is presented in 4.4.1 and 4.4.2.

4.4.1 HYDROCARBONS

In general, a hydrogen flame ionization detector more sensitive for hydrocarbons than any other class organic compounds. The response of the OVA var from compound to compound, but gives excell repeatable results with all types of hydrocarbons: i. saturated hydrocarbons (alkanes), unsaturat hydrocarbons (alkenes and alkynes) and aroma hydrocarbons.

The typical relative response of various hydrocarbo to methane is as follows:

Compound	Relative Response (perce
Methane	100 (reference)
Propane	64
N-butane	61
N-pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Ethane	90

4.4.2 OTHER ORGANIC COMPOUNDS

Compounds containing oxygen, such as alcoho ethers, aldehydes, carbolic acid and esters give somewhat lower response than that observed hydrocarbons. This is particularly noticeable with tho compounds having a high ratio of oxygen to carb such as found in the lower members of each seri which have only one, two or three carbons. With co pounds containing higher numbers of carbons, the fect of the oxygen is diminished to such an extent the response is similar to that of the correspondi hydrocarbons.

Nitrogen-containing compounds (i.e., amine amides and nitriles) respond in a manner similar to th observed for oxygenated materials. Halogenated co pounds also show a lower relative response as co pared with hydrocarbons. Materials containing hydrogen, such as carbon tetrachloride, give the lowe response; the presence of hydrogen in the compoun results in higher relative responses. Thus, $CHCl_3$ giv a much higher response than does CCl_4. As in the oth cases, when the carbon to halogen ratio is 5:1 greater, the response will be similar to that observed f simple hydrocarbons.

The typical relative response of various compoun to methane is as follows:

Methane	100 (calibration sampl
Ketones	
Acetone	60
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
Alcohols	
Methyl alcohol	15
Ethyl	25
Isopropyl	65

Halogen compounds

Carbon tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

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

SECTION 5

SAFETY CONSIDERATIONS

5.1 GENERAL

The Models OVA-108, OVA-128 and OVA-138 have been tested and certified by Factory Mutual Research Corporation (FM) as intrinsically safe for use in Class I, Division 1, Groups A, B, C & D hazardous atmospheres. Similar foreign certifications have been obtained, including BASEEFA and Cerchar approval for Group IIC, Temperature Class T4 on the Models OVA-108, OVA-128 and OVA-138, and equivalent approval from the Japanese Ministry of Labor for the Model OVA-128. Special restrictions must be strictly adhered to, to ensure the certification is not invalidated by actions of operating or service personnel.

All flame ionization hydrocarbon detectors are potentially hazardous since they burn hydrogen (H2) or H2 mixtures in the detector cell. Mixtures of H2 and air are flammable over a wide range of concentrations whether an inert gas such as nitrogen (N2) is present or not. Therefore, the recommended precautions and procedures should be followed for maximum safety. Safety considerations was a major factor in the design of the Organic Vapor Analyzer (OVA).

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 the sample input and the exhaust ports as well as on the H2 inlet connector. The standard battery pack and other circuits are internally current limited to an intrinsically safe level.

5.2 OPERATING, SERVICING AND MODIFYING

It is imperative that operation and service procedures described in this manual be carefully followed in order to maintain the intrinsic safety which is built into the OVA. No modification to the instrument is permissible. Therefore, component replacement must be accomplished with the same type parts.

5.3 ELECTRICAL PROTECTION

The 12V battery power supply circuit is current limited to an intrinsically safe level. Fuses are not utilized and all current limiting resistors and other components which are critical to the safety certification are encapsulated to prevent inadvertent replacement with components of the wrong value or specification. Under no circumstances should the encapsulation be removed.

5.4 FUEL SUPPLY & TANK

The OVA fuel tank has a volume of 75 to 85 cc which, when filled to the maximum rated pressure of 2300 PSIG, holds approximately 5/8 cubic foot of gas. The fuel used in the OVA is pure hydrogen which can be readily purchased in a highly pure form at nominal cost. The H2 tanks used in the instrument are made from stainless steel, proof-tested to 6,000 PSIG and 100% production tested to 4,000 PSIG.

5.5 H2 FLOW RESTRICTORS

Hydrogen gas gains heat when expanding therefore, should not be rapidly released from a pressure tank to a low pressure environment. restrictors are incorporated in the H2 refill fitting an is restricted on the output side of the tank by the flow rate control system. In addition, a special restrictor is incorporated in the FILL/BLEED valve o hydrogen filling hose assembly. These precaut limit the flow rate of the H2 to prevent ignition du self-heat from expansion.

5.6 DETECTOR CHAMBER

The OVA has a small flame ionization chamber ca with sintered metal flame arrestors on both the ir and output ports. The chamber is ruggedly construc of teflon such that even if highly explosive mixture H2 and air are inadvertently created in the chamber ignited, the chamber would NOT rupture.

5.7 H2 FILLING AND EMPTYING OPERATIONS

Precautions should be taken during H2 filling or tank emptying operations to ensure that there are sources of ignition in the immediate area. Since the strument tank at 2300 PSIG holds only 5/8 cu. ft. of the total quantity, if released to the atmosphere, wo be quickly diluted to a non-flammable level. There however, the possibility of generating flammable m tures in the immediate vicinity of the instrument dur the filling or emptying operations if normal care is exercised.

5.8 VENTING

The OVA case is vented to eliminate the possibility trapping an explosive mixture of H2 and air inside t case.

SECTION 6

MAINTENANCE

6.1 GENERAL

This section describes the routine maintenance schedule recommended and provides procedures for trouble shooting malfunctions or failures in the instrument.

Appendix "A" to this manual contains the assembly drawings and associated parts list for the Side Pack Assembly and two major subassemblies; the Electronic Component Assembly and the Cylinder Assembly. These drawings and parts lists may be used for locating and identifying components. Also included in Appendix "A" is a schematic wiring diagram showing interconnecting wiring between major electronic assemblies and typical signal levels at selected points on the certified instruments. The enclosed drawings and parts lists are subject to change without notice and part replacement on any certified instrument should be verified to comply with the "no modifications permitted" requirement.

CAUTION

Maintenance personnel should be thoroughly familiar with instrument operation before performing maintenance. It is essential that all portions of this manual relating to safety of operation, servicing and maintenance, including Section 5, be thoroughly understood. There should be no potential igniters or flame in the area when filling, emp: ing or purging the hydrogen system and the instr ment should be turned off.

Extreme care should be exercised to ensure tr required parts replacement is accomplished wi the same parts specified by Century. This especially necessary on the Models OVA-108, OV 128 and OVA-138 in order that their certification f use in hazardous atmospheres be maintained. ŀ modifications are permitted. Disassemble instr ment only in a non-hazardous atmosphere.

6.2 ROUTINE MAINTENANCE

Note that Figure 6-1 is a flow diagram of the basic gi handling system.

6.2.1 FILTERS

6.2.1.1 PRIMARY FILTER

This filter is located behind the sample inlet conne tor (Fitting Assembly) on the Side Pack Assembly and removed for cleaning by using a thin wall socket unscrew the Fitting Assembly. The filter cup, "O" rir and loading spring will then come out as shown in tr Side Pack Assembly drawing in Appendix "A". Tr porous stainless filter cup can then be cleaned by blov ing out or washing in a solvent. If a solvent is used, ca: should be taken to ensure that all solvent is removed t blowing out or heating the filter. Reassemble in revers order ensuring that the "O" ring seal on the Fittir, Assembly is intact.

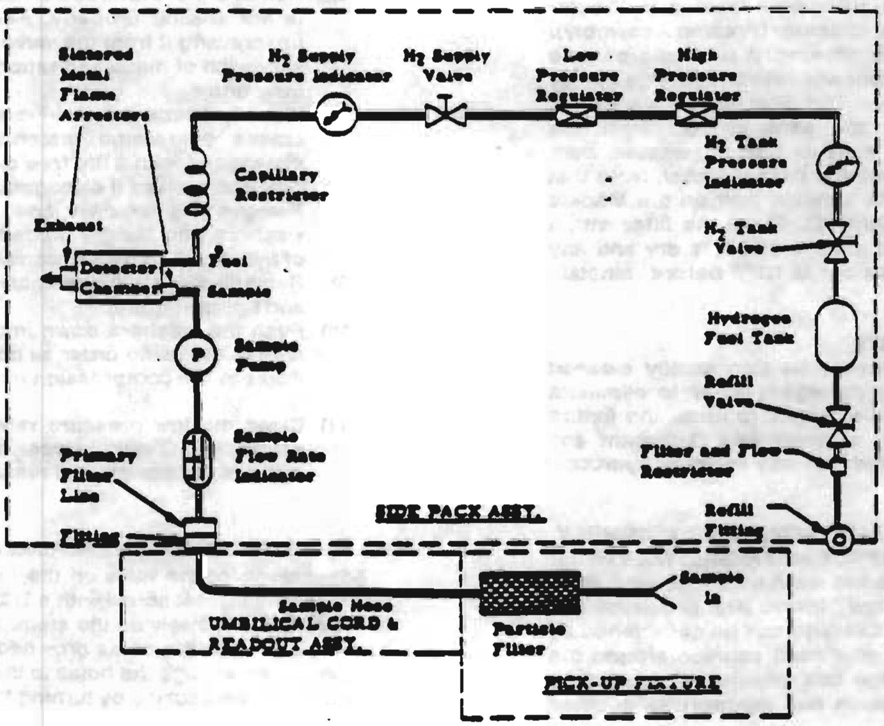


FIGURE 6-1. Flow Diagram - Gas Handling System

6.2.1.2 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 Models OVA-88 and OVA-138 use a disposable cellulose filter which should be changed as often as required. The Models OVA-98, OVA-108, OVA-118 and OVA-128 use a porous metal filter which can be replaced or cleaned using the cleaning procedure in paragraph 6.2.1.1.

6.2.1.3 MIXER/BURNER ASSEMBLY FILTER

Another porous metal particle filter is incorporated in the Mixer/Burner Assembly which screws into the Preamp Assembly. See Side Pack Assembly drawing. 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 the assembly replaced if necessary.

Access to this filter for output surface cleaning is gained by simply unscrewing the exhaust port from the Preamp Assembly without removing the instrument from the case. The OVA-108, OVA-128 and OVA-138 instruments require removal of the safety cover prior to unscrewing the exhaust port. The Filter Assembly can now be seen on the side of the chamber (Preamp Assembly) and can be scrapped or cleaned with a small wire brush.

If filter replacement is required, install a new or factory rebuilt Mixer/Burner Assembly. In several OVA models, this requires removal of the Preamp Assembly.

6.2.1.4 EXHAUST FLAME ARRESTOR

A porous metal flame arrestor is located in the exhaust port of the detector chamber (Preamp Assembly). See Side Pack Assembly drawing. It 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 exhaust port from the Preamp Assembly. The exhaust port is removed from the bottom of the case without case removal. Note that the filter is captive to the exhaust port on the Models OVA-108, OVA-128 and OVA-138. Clean the filter with a solvent or detergent but ensure that it is dry and any solvent completely baked out at 120°F before reinstalling.

6.2.2 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.

6.2.3 SEAL MAINTENANCE - CYLINDER ASSEMBLY

6.2.3.1 H2 TANK, H2 SUPPLY AND REFILL VALVES

After some time, the teflon washers under each valve packing nut can "cold flow" (move with pressure) and allow hydrogen to leak. Leakage can be determined by using Leak-Tec, Snoop or a soap solution around the valve stems. This leakage can usually be stopped by tightening the compression nut (adapter) as outlined below. See Side Pack Assembly and Cylinder Assembly drawings.

1) Remove instrument from the case by unlocking the four (4) 1/4 turn fasteners on the panel and removing the exhaust safety cover (if included), exhaust port and refill cap nut. Be sure refill valve is closed before removing refill cap nut.
2) Remove the valve knob screw and knob.
3) Loosen the panel nut 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 two teflon washers, as follows:

1) Drain hydrogen system slowly and to the extent necessary to work on the leaking valve(s). Observe safety precautions (see Section 5). There should be no potential igniters in the area.
2) Disconnect the capillary tube from the manifold at low pressure gauge (H2 Supply Pressure).
3) Remove all three (3) knob screws and knobs.
4) Remove the three (3) panel nuts and washers.
5) Carefully remove the tank assembly from the panel. NOTE: If OVA has GC Option installed, the GC valve assembly must be loosened or removed in order to 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, i 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.
10) Push the washers down into the compression area in the same order as noted upon removal. Replace the compression nut and tighten snugly.
11) Close the low pressure valve and fill the tank assembly. Check valves for leaks. Tighten again, if necessary, and reassemble the unit.

6.2.3.2 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 (2) 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.

6.2.4 AIR SAMPLING SYSTEM MAINTENANCE

6.2.4.1 GENERAL

A potential problem associated with the OVA instrument is that leaks can develop in the air sample pumping system. These leaks can result in either dilution or loss of sample, causing low reading of vapor concentration and slow response time.

6.2.4.2 TESTING FOR LEAKS

The OVA's are equipped with a flow gauge, which provides a method to check for air leaks. Assemble the pickup probe selected for use to the readout assembly and then position the sidepack vertically so the flow gauge may be observed. Cover the end of the pickup probe with your finger and observe that the ball in the flow gauge goes to the bottom, indicating no air flow (If ball has slight chatter while on bottom, this is acceptable). Cover the center of the chamber exhaust port with your thumb and again observe the ball going to the bottom. Another simple check is to expose the pickup probe to cigarette smoke or a light vapor (butane) and observe that the meter responds in approximately 1.5 - 2.0 seconds. It should be noted that slow meter response may also indicate a restriction in the air sampling system.

6.2.4.3 LEAK ISOLATION

Failure of the ball to go to the bottom when the inlet is blocked indicates a leak in the system between the probe and the pump inlet or the inlet check valve. To isolate the problem, remove parts, one at a time, and again block off the air inlet. Remove the pickup probe(s) and cover the air inlet at the Readout Assembly. If the ball goes to the bottom, check that the "readout to probe" seal washer is in place and replace the probes, holding them back against this seal while tightening the nut. Recheck, and if leakage is still present, it is probably in the probe (pickup fixture), which should be repaired or replaced.

If leakage is indicated as being past the readout handle when the connection to the sidepack is tight, disconnect the sample line at the fitting on the sidepack and cover this inlet with your finger. If the flow gauge ball goes to the bottom, the problem should be a leak in the umbilical cord/Readout Assembly, which should be investigated and repaired. There is also the possibility of a leaking check valve in the pump which would not show up on this test. If the leakage is not found in the umbilical cord, it is most likely in the pump check valve which should be repaired or replaced.

If the ball does not go to the bottom, the leak will be either in the flow gauge or it's connecting tubing. Visually check that the tubing is connected and if so, the flow gauge should be repaired or replaced. Check the "O" ring installation in the sample inlet connector (Fitting Assembly).

As an alternate approach, leaks on the inlet side of the pump can be detected by using alcohol on a "Q" Tip and lightly swabbing the connections one at a time or by directing organic vapor or smoke at the potential leakage points and observing the meter response or audible alarm.

Leaks (beyond the pump) are easier to locate, as any of the commercially available leak detection solutions can be used. Cover the exhaust port, which will place the exhaust system under pressure, and check each connection, one at a time. Replace the teflon tubing or retape the threaded connections with teflon joint tape. Check the igniter and Mixer/Burner Assembly where they screw into the detector, the high voltage terminal screw on the side of the Mixer/Burner and exhaust port itself. If after these checks, the flow gauge ball still will not go to the bottom with the exhaust blocked, the problem is likely a leaking exhaust check valve in the pump, which should be repaired or replaced.

6.2.5 CONTAMINATION CONTROL AND MAINTENANCE

6.2.5.1 GENERAL

On occasion, the background reading of the OVA may be relatively high under normal ambient conditions. Ambient background readings will vary somewhat depending on the geographical location where the instrument is being used. However, the background reading normally should be in the range of 3 to 5 ppm as methane. The acceptable background reading consists of 1 to 1-1/2 ppm of methane which is present in the normal air environment. In addition to the measurement of a normal methane background, there will normally be 2 to 4 ppm of equivalent methane background caused by acceptable levels of contamination in the hydrogen fuel and/or hydrogen fuel handling system resulting in a total equivalent methane reading of 3 to 5 ppm in clean air.

If the background reading goes above 5 ppm to 6 or 7 ppm, this is normally still acceptable since any measurement is additive to that background reading, i.e., 2 ppm on top of 5 or 2 ppm on top of 7 provides the same differential reading, however, the lower background is obviously desirable.

The background reading on the linear OVA's is zeroed out or nulled out—even though in reality the background still exists. The background reading on the linear OVA's is measured by zeroing the meter with the flame out and noting the meter indication after the flame is on. However, on the logarithmic scaled OVA's the background reading is observed on the meter at all times. This is considered desirable since it assures the operator that the instrument is, in fact, operating properly. The background reading on the OVA's serves as a low level calibration point since it does represent the measurement of ambient levels of methane in the air, which are extremely stable and predictable any place in the world.

The cause for a high background reading is usually associated with contamination in the hydrogen fuel system. This will, of course, cause a background reading since this is the function of the basic detector "to measure contamination entering the detector chamber". In addition, contamination present in the hydrogen will many times leave a small unobservable deposit on the burner face which can continue to generate a background reading when the detector is in operation and the burner assembly is heated.

Another possible cause of contamination is the mixer/burner assembly when the contamination is trapped in the porous bronze sample filter. This is not a common problem and usually only happens when an unusually high level of contaminant is drawn into the assembly. Another possible cause of high background reading is contamination someplace in the air sample line to the detector. This is also uncommon but can be the source of the problem.

NOTE

OVA's that include the Chromatograph Option installed can also have an indication of high background related to saturation or contamination of the activated charcoal filter, which is in the line during chromatograph analysis, or of the column which is in the hydrogen line at all times.

8.2.5.2 ANALYSIS AND CORRECTION

Prior to analyzing the problem, the OVA should be checked for proper electronic operation. Check logarithmic instruments for proper high and low calibration points and for proper gas selector operation (see Section 4). On logarithmic OVA's, check Gas Selector by turning to 500 and observing the flame-out alarm comes on as the needle goes below 1 ppm. It should be ensured that the instrument is calibrated to methane as referenced.

If, after checking that the OVA is properly calibrated, the background is still higher than normal for ambient conditions, the following procedure should be followed to isolate the cause of the problem.

1) Let the OVA run for a period of time (15 to 30 minutes) and see if the background level decreases as a function of time. The background could go down and stay down as a result of clearing line contamination which is removable simply by the normal flow of air through the sample line.

2) Take a reading in a known, relatively clean air environment. Normally, outside air environment is clean enough to assess by compar
whether the background reading is interna
the instrument or is present in the laborato
office or location where the instrument is bei
used.

3) If the OVA includes the Gas Chromatograph C
tion, depress the sample inject valve so that t
activated charcoal is in the line and obser
whether the background reading goes do
and stays steady after the elution of the
peak. The reading should always go down
stay the same but never be a high
background reading with the sample va
depressed, since the charcoal filter will ta
out any trace elements of organic vapors in t
air heavier than a C_2. If another activated cha
coal filter is available, this may be attached
the end of the probe to scrub the air so that
clean air sample would be going to the dete
tor. The external activated charcoal can be u
ed on any instrument, with or witho
chromatograph, for providing a clean air sar
ple to assess background level.

4) If background still stays up and cannot
reduced by any of the previous steps, the saf
ty cover (if included) and the exhaust port c
the detector chamber (Preamp Assembly) c
the bottom of the case should be removed ar
the Mixer/Burner Assembly scraped or brus
ed with a small wire brush. (Referenc
paragraph 8.2.1.3.) This will remove any sma
quantities of contamination that are on the Mi
er/Burner Assembly which could be the sourc
of the background vapor. After cleaning t
face of the burner and tube, replace the e
haust port and safety cover (if included) ar
reignite the OVA. If contamination on th
burner face was the cause, the problem shou
be immediately resolved and the ambie
background will drop to an acceptable level.

5) If the background is still present, place you
finger over the inlet of the probe so as
reduce the flow of air to the detector chambe
Reduced flow rate may be observed either o
the sample flow gauge or can normally b
observed by the sound of the pump motor.

6) If the background drops immediately
response to the reduced flow of air to th
chamber, this is an indication that the con
tamination is in the air sample line. Therefor
the various parts of the sample flow line su
as pickup probes, umbilical cord to the instru
ment, etc., should be investigated by the pro
cess of elimination to see if the contaminati
can be isolated.

7) Serious contamination in the air sample line is
very uncommon. However, if very large doses
of very heavy compounds are sampled, there
a possibility of a residual contamination whi
would eventually clear itself out but may take a
considerable period of time. A typical cause for
the high background from the sample line is

contaminated Mixer/Burner Assembly. See paragraph (4) above for cleaning procedure. If heavy contamination of the Mixer/Burner is still indicated by a high background, replace the Mixer/Burner Assembly. In several OVA models, this will require removal of the Preamp Assembly. The old Mixer/Burner Assembly should be either discarded or returned to the factory for cleaning and rebuilding.

8) In the event there is contamination in the pump or other internal parts of the sample flow lines which cannot be removed, the sample flow components would have to be disassembled and cleaned. This is normally a factory type operation. However, the components such as the pump can be replaced in the field along with any contaminated tubing in the sample lines.

9) High background readings on OVA's which include the Gas Chromatograph Option can be caused by other sources of contamination. If the charcoal in the charcoal filter mounted on the panel of the instrument is contaminated or saturated, contaminated air would be supplied to the detector and raise the ambient level background. To check for this, the charcoal filter cartridge can be removed from the panel and either a bypass tube put between the two connectors or the charcoal can be removed from the charcoal cartridge and the cartridge refilled with clean activated charcoal. This would determine if the charcoal was the source of the background reading. It is possible that an apparent high background reading could be due to contamination in the column that is on the instrument. This background could be caused by compounds that are slowly eluting from a column which has become contaminated. The easiest way to check for column contamination is to replace the column with a known clean column or a short empty piece of column tubing and see if the high background reading drops.

10) If all the above steps do not correct the high background problem, the cause will normally be contamination in the hydrogen fuel system.

Contamination in the hydrogen fuel system is usually the direct result of contamination in the hydrogen gas used or contamination introduced during the filling operation. Filling hose contamination can be caused by storing the hose in a contaminated area.

To remove contamination from the hydrogen fuel system, it should be purged with hydrogen. Effective purging of the hydrogen system is accomplished by disconnecting the capillary tube fitting which attaches on to the manifold block which has the low pressure gauge (H2 Supply Pressure Gauge and H2 Supply Valve). This disconnects the capillary tubing from the hydrogen line so that hydrogen may be purged at a reasonable rate from the tank assembly through the regulators, gauges and valves. After disconnecting the capillary, the hydrogen tank can be filled in the normal manner. The tank valve and H2 supply valve can then t opened which will bleed the hydrogen from the tar through the H2 fuel system purging out the contamin tion which is in vapor form. There is the possibility th contamination has been introduced into the hydroge fuel system which is not readily purged out by th hydrogen gas but this is unlikely. After purging wi clean hydrogen, approximately two or three times, th capillary tube should be reconnected and th background again checked. Five or ten minutes shou be allowed before assessing the background readin since contaminated hydrogen may still have been tra ped in the capillary tube.

If another tank assembly in a clean instrument available, the fuel system from the clean instrument ca be connected to the contaminated instrument to a solutely verify that it is or is not in the hydrogen fu supply system. The interconnection should be made the capillary tube of the contaminated instrument.

6.2.6 FUSE REPLACEMENT

This paragraph applies only to the standard (no certified) OVA's. There are two (2) overload fuses i corporated in the Battery Pack Assembly, one is a 3A 1 AMP Slo-Blo in the power line to the pump and ignit and the other a 3AG-1/4 AMP in the power line to th electronics. Both fuses follow the current limitir resistors which provide primary short circuit protectio However, in the event of an excessive overload, th fuses will open and prevent overheating of the curre limiting resistors. It should be pointed out that the AMP Slo-Blo fuse will blow in approximately 8 to seconds if the igniter switch is kept depressed. Norm ignition should take place in not more than 6 seconc Therefore, do not depress igniter button for more thar seconds. If ignition does not occur, wait 1 to 2 minut and try again. If the required 1 AMP Slo-Blo fuse cann be readily obtained, replace temporarily with a 3 AMF AG standard fuse.

6.3 TROUBLE SHOOTING

Table 6-1 presents a summary of recommended fie trouble shooting procedures. If necessary, the instr ment can be easily removed from the case by unlocki the four (4) 1/4 turn fasteners on the panel face a removing the refill cap and exhaust port. The batte pack is removed by taking out the four (4) screws on t panel and disconnecting the power connector at t battery pack.

6.4 FACTORY MAINTENANCE

To ensure continuous trouble-free operation, Centu recommends a periodic factory maintenance, overha and recalibration. The recommended schedule is eve six (6) to nine (9) months. This maintenance program cludes replacement of plastic seals and parts as quired, pump overhaul, motor check, new batterie sample line cleaning, H2 leak check, recalibratic replacement of plastic hose as required, and detail examination of the unit for any other requir maintenance and repair.

The recommended procedure for maintenance and repair beyond the scope of this manual is to send the complete instrument or subassembly to the Century factory for repairs. The assemblies will be handled expeditiously for rapid turn-around.

6.5 FIELD MAINTENANCE

Although not recommended, where field maintenance beyond that described herein is considered essential, the assembly drawings, parts lists and schematics in Appendix "A" will be of assistance.

6.6 RECOMMENDED SPARES

Century does not recommend that spares be maintained for its instruments. However, if the instrument is to be used in a remote area or spares are desired for other reasons, the following list should be used as a guide.

RECOMMENDED SPARES

Item	Description	Part No.	Recommended Quantity					
			Standard			Approved		
			88	98	118	108	128	138
1	Igniter	510027-1	2	2	2			
2	Igniter	510461-1				2	2	2
3	Pump Valve	510007-3 (10/pkg.)	1	1	1	1	1	1
4	Pump Diaphragm (Buna-N)	510091-1	1					1
5	Pump Diaphragm (Teflon)	510063-1		1	1	1	1	
6	Cup, Filter (3/8 OD, SS)	510318-1 (5/pkg.)	1	1	1	1	1	1
7	Mixer/Burner Assy	510557-2	1					
8	Mixer/Burner Assy	510557-1		1	1			
9	Mixer/Burner Assy	510513-1				1	1	1
10	Wafer, Teflon, H_2 Valve	510160-1 (10/pkg.)	1	1	1	1	1	1
11	Washer, Brass, H_2 Valve	510160-2 (10/pkg.)	1	1	1	1	1	1
12	Exhaust Port Assy	510425-1	1	1	1			
13	Exhaust Port Assy	510530-1				1	1	1
14	Battery Pack Assy	510070-1	1	1	1			
15	Battery Pack Assy	510542-1				1	1	1
16	Sample Line Assy	510316-1		1	1	1	1	1
17	Particle Filters	510114-1	1					1
18	Particle Filters	510116-1		1	1	1	1	

NOTE: Unit quantity is each unless otherwise noted.

LE	TROUBLE SHOOTING PROCEDURE	REMEDY
Low sample flow rate on flow indicator. Nominally 2 units on flow gauge. (See also 6 below and refer to paragraph 6.2.4)	a) Check primary filter in sidepack and particle filters in the pickup assembly.	Replace or clean filter if clogged. (See paragraph 6.2.1)
	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. Note: The inherent restrictions due to length of sample line, flame arrestors, etc., must be taken into account when trouble shooting.	If in the detector chamber, remove and clean or replace porous metal flame arrestors. If pump is found to be the problem, remove and clean or replace.
H2 flame will not light. (See also 6 below)	a) Check sample flow rate (see 1 above).	If sample flow rate is low, follow procedure 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. If igniter still does not light, check the battery and wiring.
	c) Check for rated H2 Supply Pressure. (Listed on calibration plate on pump bracket.)	If low, remove battery pack and adjust to proper level by turning the allen wrench adjustment on the low pressure regulator cap.
	d) Check H2 flow rate by observing the PSI decrease in pressure on the H2 Tank Pressure gauge. The flow rate should be about 130 PSI decrease in pressure per hour. (Approximately 12 cc/min. at detector.) On instruments with GC Option, disconnect column and measure H2 flow rate with a bubble meter.	The normal cause for H2 flow restriction would be a blocked or partially blocked capillary tube. If flow rate is marginally low, attempt to compensate by increasing the H2 Supply Pressure by one-half or one PSI. If flow rate cannot be compensated for, replace capillary tubing.
	e) Check all H2 plumbing joints for leaks using soap bubble solution. Also, shut off all valves and note pressure decay on H2 tank gauge. It should be less than 350 PSIG per hour.	Repair leaking joint.
	f) Check to see if H2 supply system is frozen up by taking unit into a warm area.	If there is moisture in the H2 supply system and the unit must be operated in subfreezing temperatures, purge the H2 system with dry N2 and ensure the H2 gas used is dry.

	g) Remove exhaust port and check for contamination. (See Figure 6-2.)	If the chamber is dirty, clean with ethyl alcohol and d by running pump for approximately 15 minutes. If t fuel jet is misaligned, ensure the porous metal flame a restor is properly sealed.
	h) Check spacing between collecting electrode and burner tip. Spacing should be 0.1 to 0.15 inches.	Adjust by screwing Mixer/Burner Assembly in or ou This spacing problem should only occur aft reassembling a Mixer/Burner Assembly to a Pream Assembly.
H2 flame lights but will not stay lighted	a) Follow procedures 2 (a), (c), (d), (e), (g) and (h) above. Also refer to 5 below.	
Flame-out alarm will not go on when H2 flame is out	a) Check instrument calibration setting and GAS SELECT control setting. Refer to paragraphs 2.3.1.2 and 2.3.2.	Readjust as required to proper setting. Note that o linear OVA's the flame-out alarm is actuated when th meter reading goes below zero. On logarithmic OVA's the alarm is actuated when the signal level goes below ppm methane or equivalent.
	b) Remove exhaust port and check for leakage current path in chamber (probably moisture or dirt in chamber).	Clean contamination and/or moisture from the chambe using a swab and alcohol, dry chamber by runnin pump for approximately 15 minutes.
	c) If above procedures do not resolve the problem, the probable cause is a malfunction in the preamp or power board assemblies.	Return preamp chamber or power board assembly t the factory for repair.
	d) Check volume control knob is turned up.	Adjust for desired volume.
False flame-out alarm. (Applies to linear OVA's)	a) Flame-out alarm is actuated on linear instruments when signal goes below electronic zero (eventhough flame is still on). This can be due to inaccurate initial setting, drift or a decrease in ambient concentration. Verify if this is the problem by zeroing meter with flame out and reigniting. (See paragraph 2.3.2)	When using the X1 range, adjust meter to 1 ppm rather than zero. See paragraph 2.3.2. Be sure instrument has been zeroed to "lowest expected ambient background level".
Slow response time, i.e., time to obtain response after sample is applied to input. (Refer to paragraph 6.2.4)	a) Check to ensure that probe is firmly sealed on the rubber seal in the readout assembly.	Reseat by holding the probe firmly against the rubber seal and then lock in position with the knurled locking nut.
	b) Check sample flow rate per procedure 1 above.	See 1 above.

7) Slow recovery time, i.e., too long a time for the reading to get back to ambient after exposure to a high concentration of organic vapor.	a) This problem is normally caused by contamination in the sample input line, requiring pumping 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. (See 1 (b)).	Clean or replace contaminated sample line or ass as required.
	b) Check flame chamber for contamination.	Clean as required.
8) Ambient background reading in clean environment is too high. (Refer to paragraph 6.2.5)	a) An ambient background reading can be caused by hydrocarbons in the H2 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 H2 fuel.	Use a higher grade of hydrocarbon free hydro Check for contaminated fittings on filling assembly.
	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 8 (a) above produces a large drop in reading, this is usually the cause.	Remove the exhaust port (it is not necessary to re instrument from case), use small wire brush fron tool kit or a knife blade and lightly scrub surface of ple 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 contaminant absorbed or condensed in the sample line. Note: It should be emphasized 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.	Clean and/or replace the sample input lines. Nor the lines will clear up with sufficient running.
9) Pump will not run	a) Check 1 AMP Slo-Blo fuse on the battery pack cover. NOTE: Certified OVA's do not have fuses.	Replace fuse. IMPORTANT: Note that fuse is a Slo type. If fuse continues to blow when igniter swit closed, check igniter for short circuit. If igniter is not problem, there is a short in the wiring or pump mo Return OVA to factory or authorized repair facility.
10) No power to electronics but pump runs	a) Check 1/4 AMP fuse on the battery pack cover. NOTE: Certified OVA's do not have fuses.	Replace fuse. If fuse continues to blow, there is a s in the electronics assembly. Return OVA to factor authorized repair facility.
11) No power to pump or electronics.	a) Place battery on charger and see if power is then available. Recharge in a non-hazardous area only.	If power is available, battery pack is dead or op Recharge battery pack. If still defective, replace bat pack. Reference paragraph 2.7.

SECTION 7

OPTIONAL ACCESSORIES

7.1 GAS CHROMATOGRAPH (GC) OPTION

7.1.1 INTRODUCTION

The Century Portable Organic Vapor Analyzers (OVA's), when used as described in the previous sections of this manual, are very efficient and accurate indicators of total organic compound concentrations on a continuous sampling basis for a period of eight (8) hours minimum and with a response time of one to two seconds. However, in areas where mixtures of organic vapors are present, it often becomes necessary to determine the relative concentration of the components and/or to make quantitative analysis of specific compounds.

To provide this additional capability, a built-in gas chromatograph (GC) system has been added as an option to the OVA series of instruments. See Figure 7-1-1 for the location of the major components and controls associated with the GC Option. When the GC Option is used as described in this section, the capability of the OVA will include both qualitative and on-the-spot quantitative analysis of specific components present in the ambient environment. The Strip Chart Recorder option, which is used with the GC Option, is described separately in paragraph 7.2.

This section is applicable only to OVA's with the optional gas chromatograph system. It is recommended that this entire section be read, along with the corresponding sections of the basic Operating and Service Manual, prior to operating the instrument.

7.1.2 DESCRIPTION AND LEADING PARTICULARS

7.1.2.1 GENERAL

When the GC Option is installed on a Century OVA, the OVA will have two modes of operation. The first mode is the measurement of total organic vapors in the same manner as described in the basic operating manual for the OVA instrument. This mode is referred to as the "Survey Mode". The OVA will be in the "Survey Mode" of operation whenever the Sample Inject Valve is in the "out" position.

The second mode of operation is called the "GC Mode". The OVA is in this mode of operation any time a sample has been injected into the GC system and the sample is being transported through the GC column. This section provides a brief description of how a gas chromatograph (GC) operates and specifically how the Century instruments perform the required operations. A complete, comprehensive discussion of gas chromatography theory, column selection and data analysis is beyond the scope of this manual.

It should be pointed out that the GC Option was designed to extend the capabilities of the Century OVA as a field type instrument. A "field type" instrument as used herein is defined as a fully portable, self-contained instrument capable of making direct on-site analysis of organic vapors in air. The OVA with GC Option can be utilized for many types of analysis in the outdoor or indoor ambient environment or for specific laboratory type analysis. The OVA was not designed compete with the research or process type ga chromatograph but to compliment these instruments eliminate their need in field type applications.

This manual is intended to provide an operator wit sufficient information to operate and maintain the Cer tury instrument. Century further publishes Applic tion/Technical Notes to assist the operators in applyin the instrument to actual field monitoring situations. Th criteria for the design of the GC Option was the same the basic OVA, that is, simplicity, ease of operatior high reliability, field ruggedness and minimized poter tial for operator error.

7.1.2.2 PRINCIPLE OF OPERATION

a) GENERAL

For those not specifically trained or familia with gas chromatography, the techniqu employed in the OVA during GC Mode opera tion is basically a separation of components a sample gas contacted with the material in column. When non-interference can be achiev ed, each component of the sample mixtur elutes from the column singly into the flam ionization detector chamber to provide its ow measurable response on the meter an recorder. When used as directed in thi manual, the GC Option can drastically reduc and in most cases eliminate the need fc elaborate grab sample and laboratory analys techniques and the analysis can be made on the-spot at the point of interest.

All flame ionization detector (FID) gas chromatographs require certain elements to their operation. These elements include thre flow regulated gas supplies as follows: 1) A car rier gas (normally nitrogen or helium) t transport the sample through the columns; 2 Hydrogen gas for operation of the FID; 3) clean air or oxygen supply to support combustion of the FID. In addition, a method for injec ting a known volume of sample air (aliquot) t be analyzed is required.

In standard gas chromatographs these three (3 flow regulated gases are individually supplie from pressurized cylinders equipped wit regulators and flow control apparatus. The Century GC system differs in that the hydrogen (H2 fuel for the FID is also used as the carrier gas The clean air supply is simply the normal a sample pumped to the FID. But, during GC analysis, the air is scrubbed in a charcoal filte to provide a clean air supply. The end result is that no additional gas supplies are required t adapt the GC Option to the basic OVA instrument.

A valving arrangement is incorporated to provide a method for transferring a fixed volume of the air normally being pumped to the FID in the Survey Mode into the GC system for analysis. The sample air injected into the GC system is the same sample being analyzed by the OVA for total organic vapor concentration. Therefore, the instrument provides the unique capability to observe the total organic vapor concentration of the sample prior to injecting it into the GC system. This operating feature is invaluable in field work where the environment is continually changing and where valuable GC analysis time must be expended only on the samples of concern.

b) SAMPLE FLOW

Figure 7-1-2 is a flow diagram illustrating the flow paths of the hydrogen (H2) fuel, sample air supply and GC injected sample aliquot. There are two push-pull valves used in the GC system, the Sample Inject Valve and the Backflush Valve.

Block D of Figure 7-1-2 illustrates the flow paths with the Sample Inject Valve in the "out" position which leaves the OVA in the Survey Mode. With this valve in the "out" position, the OVA will function in its normal manner as a total organic vapor analyzer.

Block C of Figure 7-1-2 illustrates the flow paths after the Sample Inject Valve is moved to the "in" position to initiate the GC Mode. It can be observed that the hydrogen flow path is now through the sample loop which enables the hydrogen to sweep the air sample from the loop and carry it through the GC column. It can also be observed that the sample air going to the FID chamber is now routed through the activated charcoal filter where essentially all organic vapor contamination is removed from the air. The activated charcoal filter will effectively adsorb most organic vapors with the exception of methane and ethane. The functions of the Sample Inject Valve are, therefore, to transfer a fixed volume sample of the air being monitored into the hydrogen stream and to reroute the sample air supply through a filter (scrubber).

The Backflush Valve has no prepositioning requirement to function. It can be in either the "in" or "out" position at the time a sample is injected into the GC system for analysis. The Backflush Valve simply reverses the direction of the hydrogen flow through the GC column. If the Backflush Valve is in the "out" position during sample injection and analysis, it is simply moved to the "in" position when backflushing is desired or vice versa. See blocks A and B of *Figure 7-1-2*.

It should be noted in *Figure 7-1-2* that hydrogen is always flowing through the column and onto the FID detector and that the sample air supply is always flowing to the FID detector to provide oxygen for the hydrogen flame regardless of the operating mode.

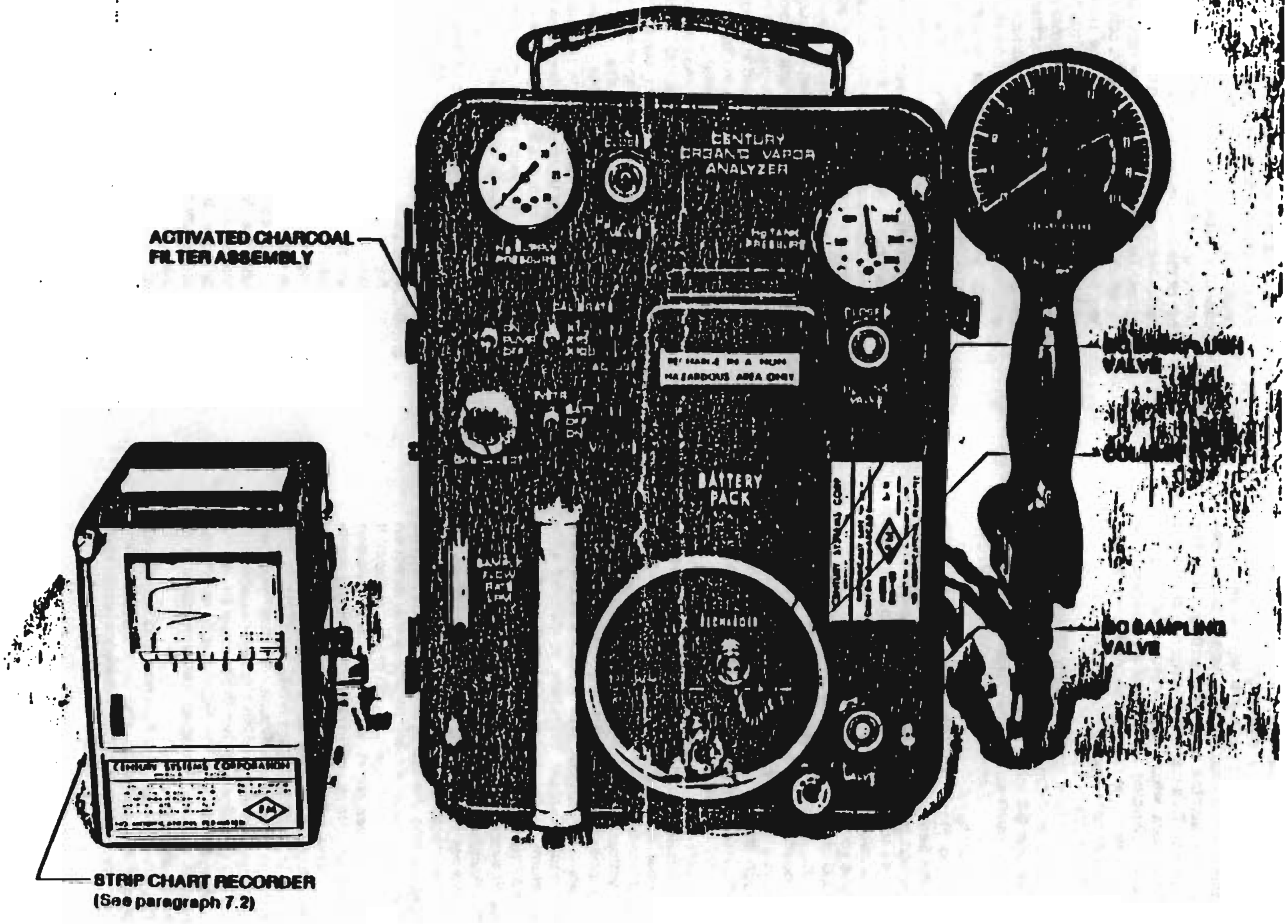
The recommended H2 flow rate is 12 cc/min. for proper FID operation and as a standard flow rate for generating GC reference/calibration data. This H2 flow rate is adjusted by varying the H2-Supply Pressure, which is the hydrogen pressure at the input of the flow contro capillary tube of the OVA. The pressure is changed by adjusting the set screw in the bonnet of the low pressure regulator, accessible by removing the battery pack from the instrumen panel. To monitor the H2 flow rate, connect a bubble meter to an end of the GC column which has been disconnected from the panel fitting and move the Backflush Valve so that hydrogen is flowing out of the column. Primary H2 flow control is accomplished by the capillary tube o the OVA. However, the flow restriction of a GC column will also affect the H2 flow rate and the effect will vary with column length, type o packing and packing methods. The nominal H2 Supply Pressure is around 10 PSIG and the pressure drop across a typical 24 inch long column packed with 60/80 mesh material is approximately 1 to 1.5 PSIG. Normally, whenthe H2 flow rate is set at 12 cc/min. with a Centur standard 24 inch long column, no adjustmen needs to be made when using columns from three (3) inches to four (4) feet long. Longer columns may require H2 flow adjustment for proper operation. Adjustment would be required and when precisely controlled analysis was being conducted or when the hydrogen flow was too low to keep the flame burning.

The sample air flow in the OVA is not adjustable and is nominally 1.0 liter/minute. This flow rate should remain relatively constant. A Sample Flow Gauge is provided on the OVA panel t monitor the sample flow rate. (NOTE: Pane gauge is not calibrated in LPM.) When the Sample Inject Valve is in the "in" position, there may be a slight increase or decrease in sampl air flow rate (0 to 15%). This change will normally not affect operation of the instrument as long as the flow rate is consistent from analysis t analysis. Basically, if the sample air flow rate i consistent between calibration and end usage there will be suitable precision in th measurements.

c) GC ANALYSIS

1) Sample Injection

When the Sample Inject Valve is depressed, the small volume of the input air sampl which is in the sample loop is injected int the hydrogen stream which transports th sample through the column for separatio of its components and on to the flame chamber for analysis. This small volume c injected sample is, therefore, qualitative analyzed based on the retention time of the individual components of that sample while passing through the column. Quantitativ analysis can then be accomplished by pea height or peak area analysis methods.


ACTIVATED CHARCOAL FILTER ASSEMBLY
CENTURY ORGANIC VAPOR ANALYZER
BATTERY PACK
[illegible] VALVE
COLUMN
GC SAMPLING VALVE
STRIP CHART RECORDER (See paragraph 7.2)

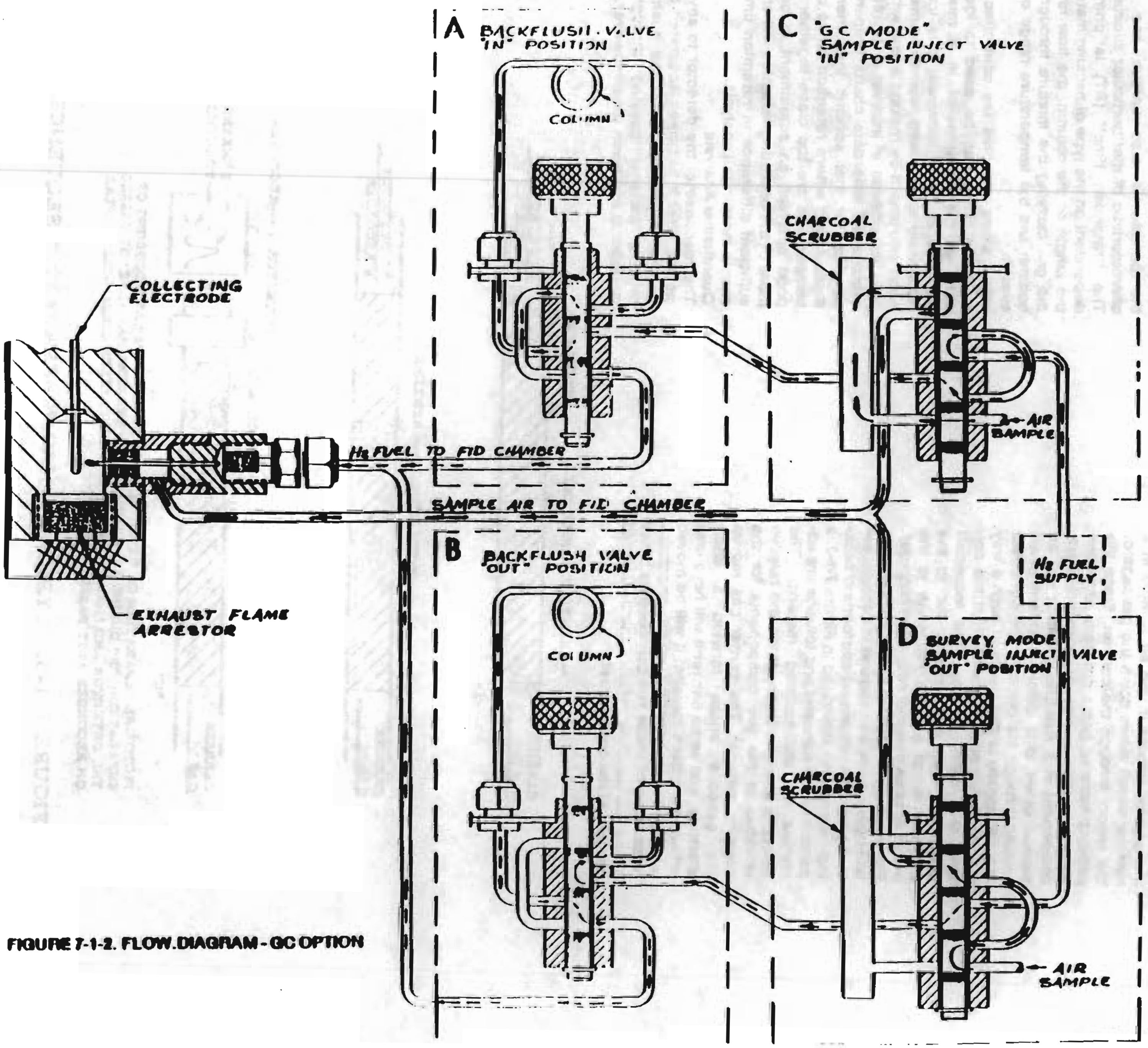


FIGURE 7-1-2. FLOW DIAGRAM - GC OPTION

2) The Column

The column consists of tubing packed with a material which physically interacts with the organic vapors in the air sample in a manner which slows down the passage of the vapors through the column. Since the packing material has a different attraction for each individual organic substance, each component in a mixture of gases will be slowed down to a different extent when passed through the column. The net effect is a separation of the gases in such a way that each component elutes from the column at a different time. The individual gases are then automatically fed to the detector which gives a response to the meter or to an external strip chart recorder.

For example: Suppose that a sample containing benzene and toluene is injected onto the column containing appropriate packing material. As illustrated in Figure 7-1-3, a portion of the benzene and toluene are adsorbed on the packing material. The amounts involved depends on the relative affinities of the two components for the packing material. The carrier gas moves the gaseous phase forward a short distance, and since benzene will have less affinity than does toluene, it will be moved through the column more readily, and thus a separation of these two components takes place and benzene reaches the detector at the exit of the column first.

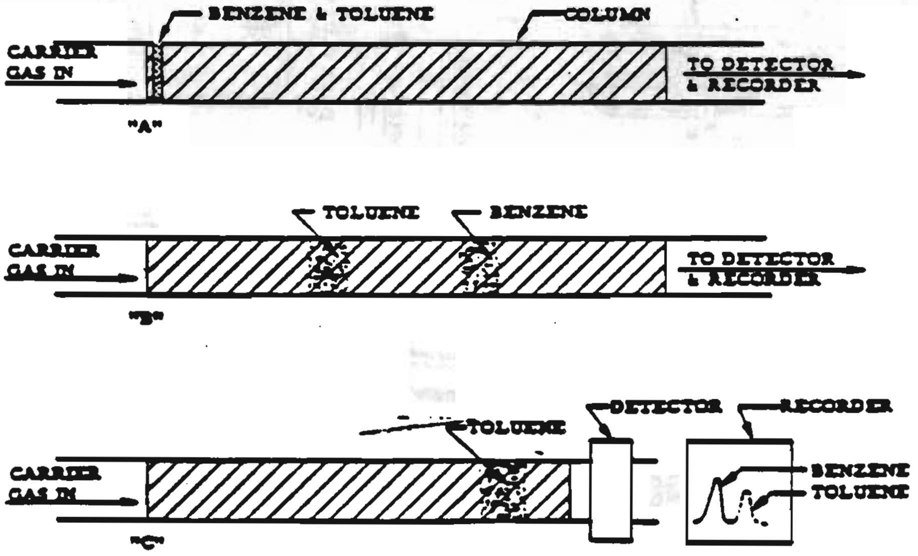
3) Qualitative Analysis

As each organic substance has a unique teraction with the column packing mater the time that the substance is retained the column is also unique and tl characteristic of that particular substan The "retention time" (RT) is prima dependent on the type of packing mater the length of the column, the flow rate the gas carrying the mixture through column and the temperature range of system.

When these variables are controlled, retention times can be used to iden each of the components in a mixtu Because of these variables, it is usu necessary to establish retention times each instrument by making a test with pure substances of interest or to refer established time data charts preparec advance for that specific instrument. those cases where retention times of components are too close together fc good analysis, an adjustment in one more of the operating variables will effe sufficient difference in retention times enable meaningful analysis.

4) Quantitative Analysis

The response of the detector to any c ponent after it has been separated by column is proportional to the quantity organic material passing through detector at any given time. However, si



PICTORIAL SEPARATION OF BENZENE AND TOLUENE - "A" AT BEGINNING OF SEPARATION; "B" DURING SEPARATION; "C" BENZENE HAS ALREADY PASSED THE DETECTOR AND IS RECORDED. TOLUENE (DOTTED LINES) WILL APPEAR ON RECORDER AS IT PASSES THE DETECTOR.

FIGURE 7-1-3. TYPICAL COLUMN SEPARATION SEQUENCE not all of the separated components elute from the column at the same instant, but varies from low to a maximum and then falls to ambient again, it is necessary to have a means to measure the total amount of the individual component vapors. When using a strip chart recorder, the curve drawn on the paper is triangularly shaped and the area under the peak is related to the amount of substance being analyzed. For the OVA systems which have logarithmic outputs, direct measurement of areas under the peak is extremely difficult. The methods of peak height analysis described herein provide a convenient means for quantitatively interpreting peaks when operating either the logarithmic or linear readout OVA's.

5) Backflush

The column Backflush Valve is provided to reverse the flow of the carrier gas (hydrogen) through the column. It is necessary that the column be backflushed after each individual analysis except under certain special conditions. The primary purpose of the backflush function is to clear the column of heavy compounds (with long retention times) which would contaminate the column and cause interference to the total organic reading and future GC analysis. The Backflush Valve has no "sense" (prepositioning requirement). It is simply reversed from either position it was in during GC analysis. The Backflush Valve should be actuated immediately after the peak of the last compound of interest elutes. Figure 7-1-2 illustrates the functions of the Backflush Valve.

In the Century GC system, the backflush is "to the detector". This is possible due to the fact that the carrier gas and detector fuel are one in the same, i.e., hydrogen. The backflush function, therefore, provides a convenient means of quantifying the total compounds in the backflush by simply recording the peak that elutes during the backflush operation. For field type instruments, this quantitative backflush information is very valuable. The backflush to detector also provides a direct means of observing the condition of the column and seeing when the column is clean and the detector response has returned to baseline. The time required for the backflush is usually 1.2 to 1.5 times the GC analysis time.

6) Survey to GC Mode Interface

There is an inherent advantage to integrating the GC system to the basic total Organic Vapor Analyzer (OVA). The OVA provides a direct reading of total organic vapors present in the air being sampled, which provides the operator with intelligence of what he is injecting into the GC system. He can then use this information to predict and verify the peaks that result during the GC analysis, including the backflush peak.

This feature completely eliminates expending valuable GC analysis time where there is no contamination concentrations of concern (comparable to taking noise measurements in quiet corners). This "front end" intelligence also enables the operator to select the most appropriate location to conduct an analysis, which is normally the area of highest concentration.

7.1.3 OPERATING PROCEDURES

7.1.3.1 GENERAL

The Gas Chromatograph (GC) Option is a supplementary system which is built into the OVA instrument during manufacture. This system provides an additional gas chromatographic analysis (GC Mode) of operation which can be initiated at any time during a survey by simply depressing the Sample Inject Valve. After completion of the analysis and backflush operations, the Sample Inject Valve is pulled out and the survey continued or another sample injected. Note that when the Sample Inject Valve is in the out (Survey Mode) position the OVA operates in . the same manner as a standard OVA which does not incorporate the GC Option.

7.1.3.2 GC SYSTEM CONTROLS AND COMPONENTS

Refer to Figure 7-1-1 for a view of the four (4) basic controls and system components provided in the GC Option. Table 7-1-1 below describes their functions.

TABLE 7-1-1
GC OPTION-COMPONENTS

Controls/Indicators — Function

1) Sample Inject Valve - This 2 position valve (shown schematically in Figure 7-1-2) is used to select either Survey Mode (valve out) or GC Mode (valve in).
2) Backflush Valve - This 2 position valve (shown schematically in Figure 7-1-2) is used to reverse the flow of H_2 through the column to:
   a) Backflush the column for clearing
   b) Quantitatively measure total compounds after a selected point. Example: Separation of methane from non-methane hydrocarbons to read total non-methane hydrocarbon level.
3) Column - Separates components of a gas mixture so that each component of the mixture elutes from the column at a different time.
4) Activated Charcoal Filter Assembly - This assembly functions only in the GC Mode (Sample Inject Valve "In") as shown schematically in Figure 7-1-2. It removes organic compounds (except simple C_1 and C_2 hydrocarbons) by adsorption from the sample air supply.

7.1.3.3 SERVICING AND TURN ON

Place the Sample Inject Valve in the "out" position and put the OVA instrument in operation per Section 2 of this manual. NOTE: Leave the hydrogen fuel and pump "on" for three (3) to four (4) minutes before attempting ignition to enable hydrogen purging of the column.

7.1.3.4 SURVEY MODE OPERATION

When using the OVA in the Survey Mode, ensure that the Sample Inject Valve remains in the full "out" position and that the Backflush Valve is either full "in" or full "out". Note that when changing from the GC Mode to the Survey Mode the OVA output readings will continue to change as long as any compounds are still eluting from the GC column. Therefore, under normal field conditions, the GC column should be backflushed for clearing, which takes approximately 1.2 to 1.5 times the already elapsed forward analysis time. The backflush peak may be observed returning to baseline, after which the Sample Inject Valve may be moved to the Survey Mode (out) position.

When the compound(s) being analyzed are known to be the only compound(s) present in the air sample, backflushing may be omitted.

7.1.3.5 GC MODE OPERATION

In normal GC analysis, a strip chart recorder is used to record the output concentration from the OVA as a function of time. This record, called a chromatogram, is utilized for interpretation of the GC data. The Century portable strip chart recorder is further described in paragraph 7.2.

a) OPERATION

1) Turn on recorder and push Sample Inject Valve "in" with a fast, positive motion. This starts the GC analysis which is automatic up to the point of backflushing. NOTE: Rapid and positive motion should be used when moving either the Sample Inject or Backflush Valves. On occasion, the flame in the FID detector may go out, which would be indicated by a sharp and continued drop of the concentration level. If this occurs, simply reignite the flame in the normal manner and continue the analysis. NOTE: A negative "air" peak typically occurs shortly after sample injection and should not be confused as flame-out.

2) The negative air peak and various positive compound peaks will be indicated on the OVA readout meter and the strip chart recorder and represent the chromatogram of the analysis.

3) After the predetermined time for the analysis has elapsed (normally immediately after the peak of the last compound of concern), rapidly move the Backflush Valve to it's alternate position (in or out). Leave the instrument in this condition until the backflush peak printed on the recorder returns to baseline, then pull the Sample
Inject Valve to the "out" position. If r
backflush peak appears, pull the Samp
Inject Valve out after being in the backflu:
condition for a period at least as long as tr
analysis time. The OVA is now back in tr
Survey Mode and ready for survey use
injection of another sample into the G
system.

b) INTERPRETATION OF RESULTS

Interpretation of the recorded chromatogram
always based on predetermined calibratic
data. A discussion of calibration methods ar
chromatogram interpretation is presented
paragraph 7.1.4.

7.1.4 CALIBRATION

7.1.4.1 GENERAL

The Century OVA with GC Option is a field instrume
intended for applications where there are a limite
number of compounds of interest and the compounc
are normally known. Under these field conditions, tr
operator must simply know the retention time and pea
height characteristics of the compounds of interest a
normally presented on his OVA instrument under h
specific operating conditions. Therefore, to calibrat
the OVA in the GC Mode, simply determine by test tr
retention time and peak area (using peak heigr
analysis) characteristics for the compounds of concerr
These tests should be conducted on the column to b
utilized and over the concentration and temperatur
range of concern. When representative characterist
data is available, such as in the Century Applica
tion/Technical Notes, a spot calibration check is no
mally all that is required.

It should be noted that under normal field condition:
the vapor concentrations vary continually as a functio
of time, location and conditions. Field measurement
for industrial hygiene work are normally associated wit
a threshold level around a preestablished concentra
tion. Surveys for locating fugative emission source
present a continually varying situation. Under thes
typical field conditions, it is desirable to have a fast an
simple method of interpreting the GC data for on-the
spot analysis and decision making. High precision
normally not a requirement for these type analysi
since the environment is continually changing. Th
methods presented in this section are designed to pro
vide a means for typical field analysis. When the OVA i
used under laboratory conditions, standard laborator
methodology may be used for greater precision.

7.1.4.2 TECHNICAL DISCUSSION

The chromatogram is a strip chart recorder printout o
the instantaneous organic vapor concentration from the
Century Organic Vapor Analyzer (OVA) as a function o
time. A typical chromatogram is illustrated in Figure 7-1-
4 and is seen to be a series of triangular shape peaks
originating and returning to a fixed baseline. Qualitative
interpretation of a chromatogram involves identifying
the compound causing a peak by analyzing the time it
took for the peak to appear after initial injection (referred to as retention time (RT)) and comparing this RT tc

reference data. Quantitative interpretation of a peak involves analyzing the area under the peak and relating this area to calibration data of peak area versus concentration for that specific compound under the conditions present during the GC analysis.

It can therefore be seen that interpretation of a chromatogram requires the use of calibration reference data. GC reference data is always generated empirically, i.e., through tests. Century publishes Application/Technical Notes which may be used as a reference for selecting columns and interpreting chromatograms. However, in most cases, certain relatively simple tests must be conducted to obtain the required reference data. A method for obtaining this type data and applying it to a calibration chart is presented along with a typical example of the exercise.

a) QUALITATIVE ANALYSIS

Under a given set of operating conditions, the retention time is characteristic of that particular substance, and can be used to identify specific compounds. It will be necessary to calibrate retention times by making tests with the pure compounds of interest.

The retention time (RT) is defined as that period of time from injection of the sample into the GC system until the point of maximum detector response for each substance. Retention time is measured from the point of sample injection to the apex of the triangle shaped curve obtained on the strip chart recorder. (See *Figure 7-1-4.*)

The strip chart recorder operates on a clock mechanism such that the distance along the baseline is proportional to time. While retention times are characteristic for each compound, it is possible that two materials could have the same retention times. Thus, if there is any question as to the identity of the vapor, it may be necessary to verify identification by retention times on two different columns.

Use of a longer column will increase the retention times of those components it is capable of separating. The time between peaks will therefore also be increased. This is especially useful to know if a component to be studied comes through too fast after injecting a sample or if certain desired peaks are so close that they overlap on the strip chart.

b) COLUMN SELECTION

Two columns are normally supplied with the instrument. These are general purpose columns and are useful in a wide variety of applications. If they do not perform the separations for your particular application, it may be necessary to select other packing materials or lengths of columns to meet your needs. Century Systems will guide you in this selection or prepare a custom column to meet your needs.

If columns are made by the customer or purchased from other sources, care must be exercised to ensure that their packing density does not create too large a pressure drop as compared to columns furnished by Century. Century's method of coding it's GC columns is presented on most Century published Application/Technical Notes. Several application notes have been inserted as an appendix to this manual to illustrate typical GC separations.

c) TEMPERATURE EFFECT ON RETENTION TIME

An increase in temperature will decrease column retention time (RT) and vice versa. Normally, retention time (RT) as a function of temperature changes linearly over the range of 0 to 40°C. For complex qualitative analysis, a calibration plot of RT versus temperature will be required. In typical ambient field usage such as inside a factory, the effect of temperature can be compensated for by the operator during chromatogram interpretation. A single component tracer compound can be sampled at any time to provide a "key" for other compound identification.

d) CARRIER GAS FLOW RATE EFFECT ON RETENTION TIME

An increase in carrier gas flow rate will decrease retention time. For reproducible data, the carrier gas (hydrogen) flow rate must be recorded in association with a chromatogram. Primary control of the H2 flow rate is accomplished in the OVA by regulating the hydrogen pressure across a capillary tube. The hydrogen flow rate is also affected by the restriction of the GC column but most columns have a limited effect. The hydrogen flow rate is factory set at 12 cc/minute with a typical 24 inch column.

e) QUANTITATIVE ANALYSIS

The area under a specific peak is a function of the concentration of the compound which created the peak. This area can be calibrated by injecting known concentrations of the compound. When the base of a symmetrical GC peak remains constant, the height of the peak may be used to measure the area. Typically, as the retention time of a peak increases on the same column, the base broadens and the peak height decreases for a given sample concentration. If the hydrogen flow rate is considered to be constant, the retention time of the peak will change as a function of temperature.

In general, the more triangularly symmetrical the peak, the better the peak height analysis capability. However, many GC peaks have "tailing" as illustrated in *Figure 7-1-4.* Peak height calibration is still an acceptable method for quantitative analysis as long as the area under the tail is small compared with the total peak area. If severe tailing occurs, empirical calibration data generated through tests may be required to plot the peak height versus the concentration curve. If the GC Option is used on a Century "logarithmic" OVA, there will be a major apparent increase in peak tailing. This apparent tailing is the result of the logarithmic

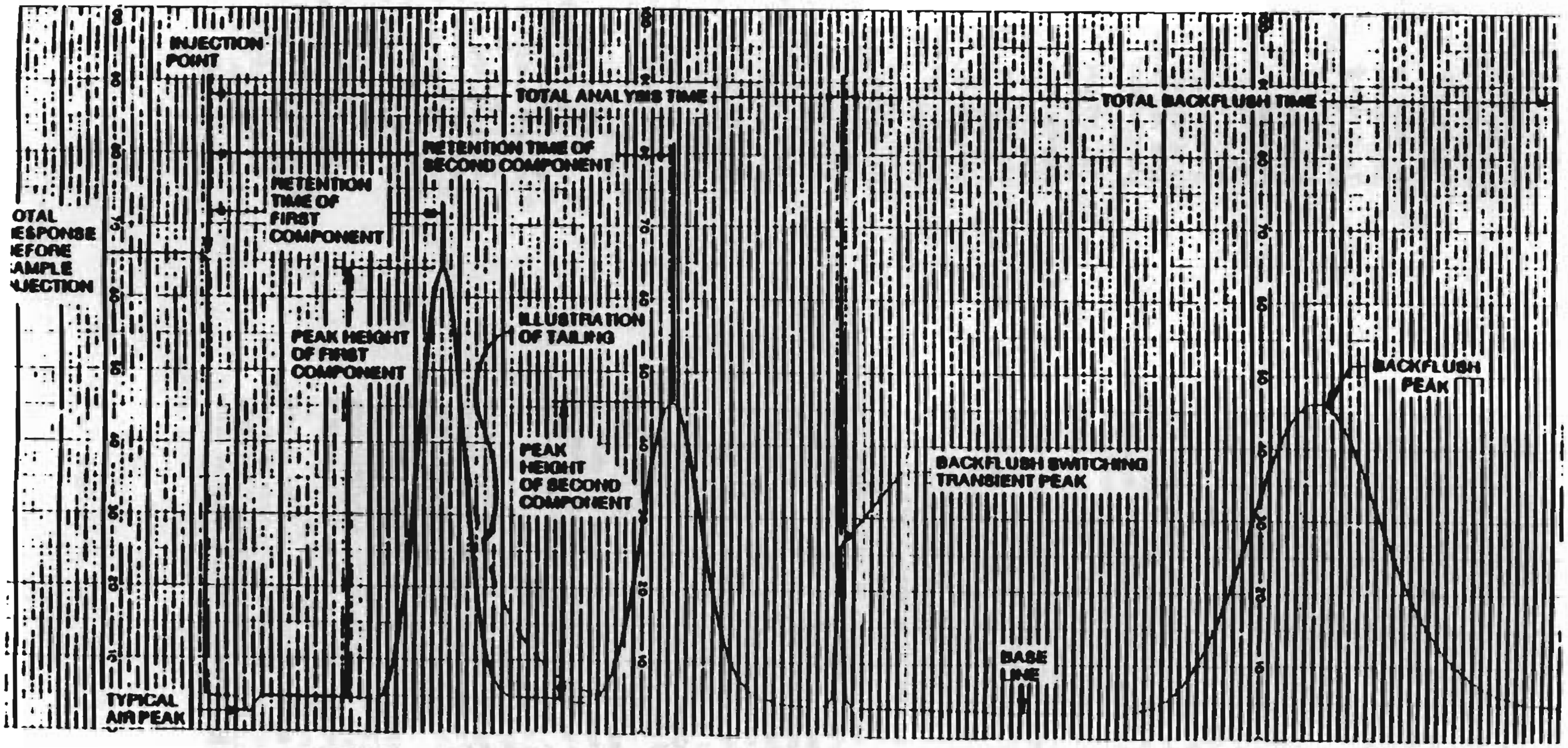


FIG. 7-1-4

TYPICAL CHROMATOGRAM (ILLUSTRATION)

scaling, which amplifies the low level signals. This apparent tailing does not appear on the "linear" OVA's, even though the same actual tailing is present.

Only peak height analysis will be discussed in this manual. The method presented is simply to inject a known concentration of the compound being tested and record the height of the peak under the test conditions. The peak height characteristics can be established for various columns and at various temperatures. Normally, both retention time and peak height characteristics will be measured simultaneously during the same test.

When peak area measurements are desired, the areas may be measured using an integrator on the OVA output signal. Other manual methods may also be used, such as counting squares, weighing curves or simple triangulation. When the GC peaks have good symmetry, triangulation (area equals 1/2 base x height) is a convenient method.

7.1.4.3 PREPARATION OF CALIBRATION SAMPLES

Samples for calibration of the GC system may be prepared with the procedures discussed in paragraph 4.3.3 of this manual. Sample mixtures are made by repeating the procedures presented for the compounds desired in the sample.

7.1.4.4 CALIBRATION DATA

When conducting tests to obtain GC calibration data, the following information should be recorded to qualify the data:

- a) Column - description and serial number as applicable
- b) Temperature - column temperature, normally room ambient
- c) Chart speed - distance/unit time
- d) Carrier flow rate - hydrogen flow rate through the column (cc/min.). (Reference paragraph 7.1.2.2 b)
- e) Sample concentration - ppm for each compound
- f) Sample volume - OVA by serial number or typically 0.25 cc for standard valve
- g) Recorder scaling - ppm per unit deflection
- h) Range - range of OVA being used, i.e., X1, X10, X100
- i) OVA type and serial number

To obtain a calibration point, inject a known concentration sample into the GC system and record the resulting chromatogram peak. The retention time for the peak may be scaled from the record or timed with a stop watch. The peak height may be scaled from the record or the OVA readout meter may be observed during the elution of the peak. Figure 7-1-5 presents the format of a chart which may be used to record calibration data. Experience has indicated that the peak height response of a compound is linear up to concentrations of greater than 1,000 ppm. Therefore, a single calibration point, preferably around the concentration of mos concern, is normally all that is required to plot a pea height response in ppm as a function of compound concentration. Data for other compounds on the same column may also be plotted along with their associated retention times, percent relative response in the tota organic Survey Mode, TLV, etc. Note that to keep the calibration curves readable on the chart a multiplier (X column is included. It is recommended that copies o the actual chromatograms be kept with the charts for observing the peak shapes, peak interferences, etc. It should be noted that a chromatogram can be utilized like a fingerprint for compound identification or peak height and shape comparison. Transparent overlays are sometimes an aid in chromatogram analysis.

When temperature variations are anticipated, data should be taken at several points and recorded on the chart as a new curve or as a relative change as a function of temperature as illustrated in Figure 7-1-5.

Preparing and using the calibration chart is very straightforward. As an example, once the elution sequence of a group of compounds is determined, a mixture of 100 ppm of each can be prepared and run on the GC for chart data. The retention time of each compound and the peak height of each can be read directly from the chromatogram and the data put on the chart. If temperature data is to be taken, additional chromatograms may be run with the same sample and the RT and peak height plotted as a function of temperature.

When complex mixtures such as gasoline are analyzed, it may be desirable to keep the record of the backflush peak for future reference and peak area com- comparison. It is also recommended that the total organic vapor concentration reading on the OVA be recorded for each calibration sample used. This reading should be put on the chromatogram and is used for arriving at relative response numbers and as a check on sample preparation precision.

Samples of forms for use in recording individual chromatogram data and also a sample form for the calibration chart are included in Appendix "A" and may be used as a guide or copied and used as is.

7.1.5 MAINTENANCE

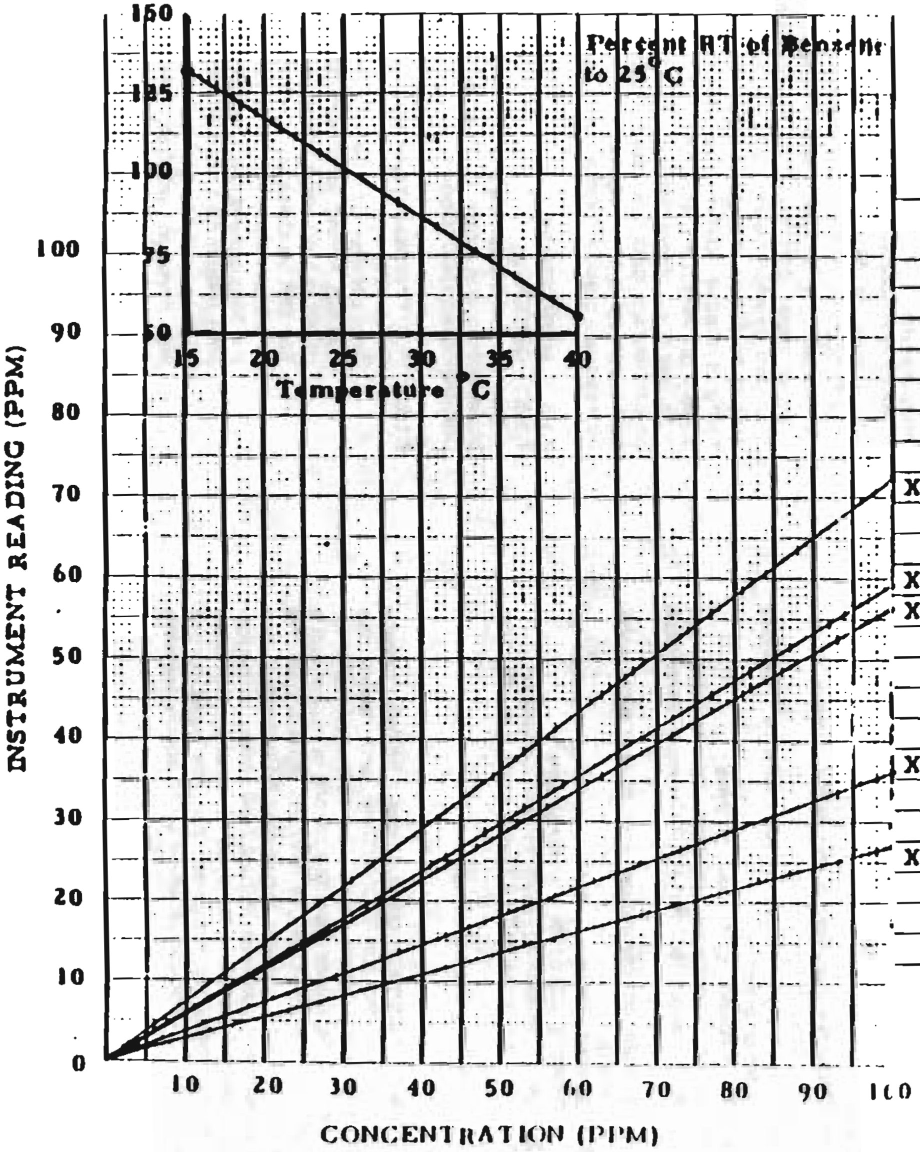
7.1.5.1 GENERAL

This section describes the routine maintenance, trouble shooting and spare parts peculiar only to the Gas Chromatograph (GC) Option.

7.1.5.2 ROUTINE MAINTENANCE

a) COLUMN

Any column can be contaminated with compounds having long retention times. This will result in high background readings. This condition can be checked by installing a new column or a blank column (tubing only). If this reduces the background reading, the contaminated column should be baked at 100°C (212°F) for three (3) to four (4) hours in a drying oven while passing nitrogen through the column. Higher

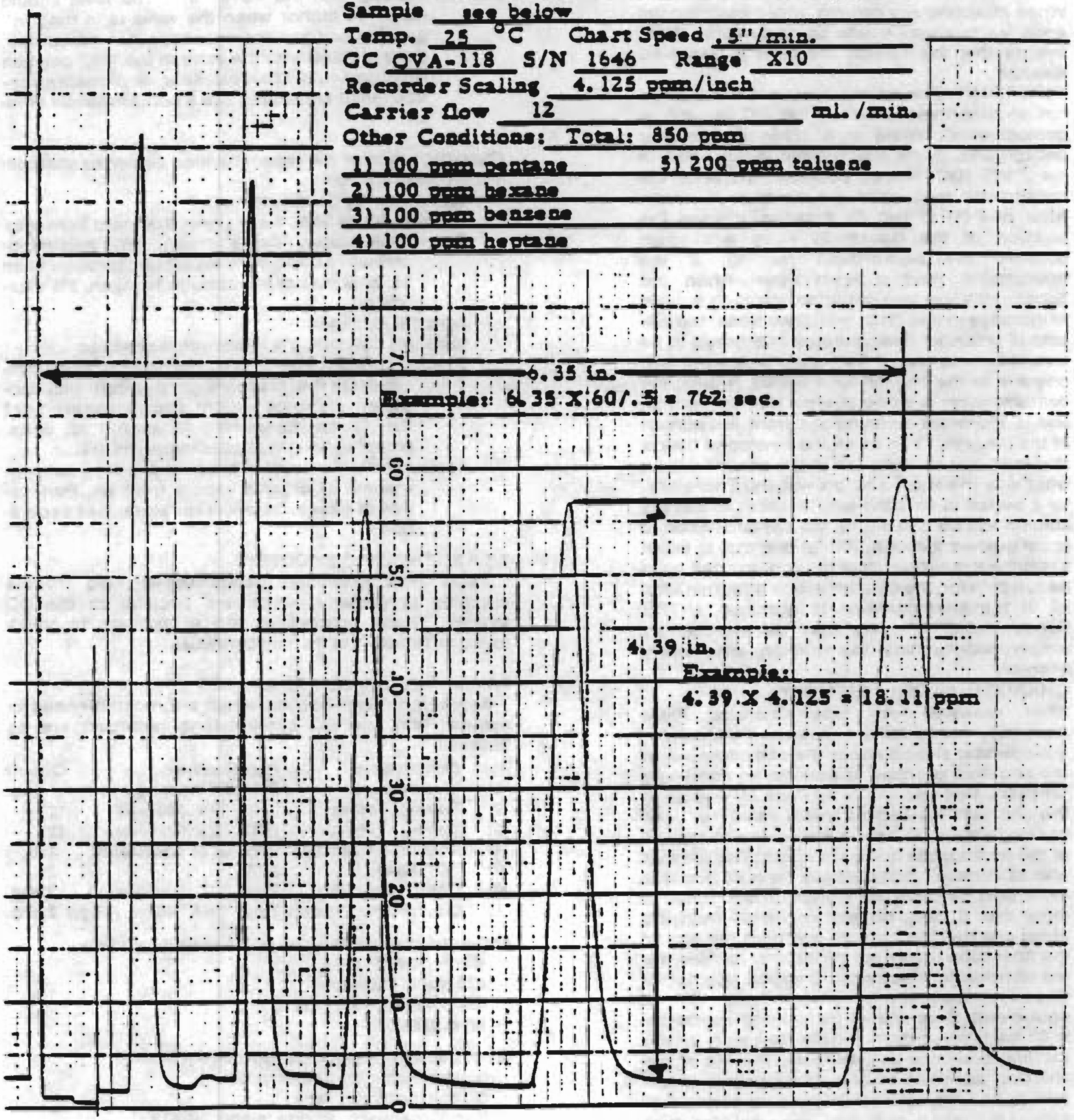


Column G-48 Chromatograph OVA-118
Temperature 25 °C Carrier Flow 12 ml/sec.
Injection: Volume 2.5 ml Type valve

X	Compound	R.R. (%)	RT (sec)	Date	TLV (ppm)
X4	Heptane	80	471	1-31-78	400
X2	Pentane	100	90	1-31-78	1000
X2	Hexane	90	198	1-31-78	100
X2	Benzene	150	291	1-31-78	1
X3	Toluene	120	762	1-31-78	200

NOTE: Concentration used for test is 100 ppm or as indicated by marked data points.

COMMENTS:



Date 1/31/78 Type Injection 2.5 ml valve

Column 510454-G-48

Sample see below

Temp. 25 °C Chart Speed .5"/min.

GC OVA-118 S/N 1646 Range X10

Recorder Scaling 4.125 ppm/inch

Carrier flow 12 ml./min.

Other Conditions: Total: 850 ppm

1) 100 ppm pentane 5) 200 ppm toluene

2) 100 ppm hexane

3) 100 ppm benzene

4) 100 ppm heptane

6.35 in.

Example: 6.35 X 60/.5 = 762 sec.

4.39 in.

Example:

4.39 X 4.125 = 18.11 ppm

temperatures may permanently damage the column packing. Columns may be cleaned while installed on the OVA by heating the column with hot, wet towels.

When installing any column, avoid touching the ends, as this may cause contamination. Also, ensure that the fittings are tight to avoid H2 leakage.

IMPORTANT: The following simple test may be run to determine whether the GC column is contaminated. While in a clean ambient air background, place the Sample Inject Valve in the "in" (GC Mode) position. Observe the background reading on the meter or recorder. After one (1) to two (2) minutes, change the position of the Backflush Valve and again observe the background reading. If the background reading went down when the Backflush Valve was actuated and then started to increase in one (1) to two (2) minutes, the column is probably contaminated and needs to be cleaned. Note that if hydrogen is flowing into one end of the column for a period of time, the contamination is being pushed into the column and is therefore cleaning the front endportion of the column. Then when the hydrogen flow is reversed, the exhaust end of the column will be what was the input end previously. Therefore, for a period of time the now exhaust end of the column will be clean until the contamination is again pushed through. Remember that to clean a column the hydrogen or other purge gas must be run through the column in one direction until all of the contamination is removed. NOTE: Contaminated columns can be avoided by simply backflushing the column after every analysis.

b) CHARCOAL FILTER ASSEMBLY

After repeated use, the Charcoal Filter Assembly will become saturated. Periodically, the operator should check the effectiveness of the activated charcoal to perform its screening function. This can easily be done by operating the unit with the Sample Inject Valve "in" and passing the probe near a concentrated sample of the compounds being analyzed. The readout should remain nearly steady (should not rise more than 0-2 parts per million (ppm)). If rise is more than 2 ppm, remove assembly from the panel and pull the knurled cap from the end of the filter tube (pull—not twist), and replace the old charcoal with activated charcoal (Barnebey Cheney, Columbus, Ohio, Type GI or equivalent). Care should be taken to completely fill the tube so there will not be a path for the sample to bypass the charcoal. The life of the charcoal depends on the time (length) of exposure and the concentration level during that exposure. When changing charcoal, be sure that any fine particle charcoal dust is removed from the assembly.

Another simple test of the charcoal filter is to note the background reading with the Sample Inject Valve "out" and then note the baseline reading with the valve "in". The level should never be higher when the valve is in the "in" position and the charcoal filter is in the air line. If the reading with the valve in the "in" position is higher, the charcoal filter is probably contaminated and acting like a contamination emitter.

Characteristics of the recommended activated charcoal are provided below:

Raw Material: Coconut Shell
Nominal Mesh Size: 8 x 14 (Tyler Standard Screens)
Size Distribution: On 8 mesh, 5% maximum; through 8 on 10, 60% maximum; through 10 on 14, 80% maximum; through 14 mesh, 5% maximum
Ash: 8% maximum
Moisture Content: 3% maximum, as packed
Standard Packages: 50 lbs. net weight fiber container; 58 lbs. gross weight (typical). 1 lb. container, shipping weight approximately 1-1/2 lbs. Carton containing 12 each 1 lb. units, shipping weight approximately 16 lbs.
Applications: Removal of medium and high concentrations of organic vapors from air. Purification of gases. Safety respirators. Gas separation.

7.1.5.3 TROUBLE SHOOTING

Table 7-1-2 presents recommended field trouble shooting procedures which are peculiar to the GC system. These procedures are in addition to those found in Table 6-1 of the basic manual.

7.1.5.4 RECOMMENDED SPARES

Spare parts and supplies which are recommended to support only the GC system (and recorder) are as follows:

Item	Description	Part Number	Quanth
1)	Quad Rings	510496-1 (10/pkg.)	1 pkg.
2)	Tubing, Teflon	.148" ID x .020 wall	12"
3)	Tubing, Teflon	.120" ID x .030 wall	12"
4)	Activated Charcoal	Type GI or equivalent	1 lb.
5)	"O" Ring	2-15	2
6)	Chart Paper (log)	Type "J" (6 rls./pkg.)	2 pkg.
7)	Chart Paper (linear)	Type "WA" (6 rls./pkg.)	2 pkg.

Activated charcoal may be purchased direct from:

Barnebey Cheney
835 North Cassady
Columbus, Ohio 43219
(614) 258-9501

Chart paper may be purchased direct from:

Gulton Recorder Systems Div.
Gulton Industrial Park
East Greenwich, Rhode Island 02818
(401) 884-6800

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TABLE 7-1-2

UBLE	TROUBLE SHOOTING PROCEDURE	REMEDY
1) Low sample flow rate on flow indicator	a) Check teflon tubing on valve assembly for kinks, etc.	Straighten or replace teflon tubing
	b) Check flow rate with valve in down position.	Check for over restriction of charcoal filter
2) H_2 flame will not light	a) Check column connections on top of unit to make sure they are tight.	Tighten fittings
	b) Check column for sharp bends or kinks. (Hydrogen flows through this column at all times and a sharp bend will compact packing too tightly for proper hydrogen flow.)	Replace column
	c) Check charcoal filter fittings to make sure they are tight.	Tighten fittings
	d) Check H_2 flow rate from the column.	Adjust hydrogen pressure to obtain 12 cc/min. flow r
	e) Check that the Inject and Backflush Valves are both completely in or out. A partially activated valve will block the H_2 and air flow paths.	Ensure both valves are either completely in or out.
	f) If a new column was installed prior to problem identification, check for proper hydrogen flow rate through the column (should be approximately 12 cc/minute). Reference paragraph 7.1.4.2 d.	Increase hydrogen pressure to obtain proper hydro flow rate or if column is excessively restrictive, repl or repack the column.
3) Ambient background reading in clean environment is too high	a) Check for contamination in charcoal filter assembly. This can be detected if ambient reading increases when going in to the chromatographic mode. Reference paragraph 7.1.5.2 b.	Replace activated charcoal in charcoal filter assembl
	b) Check for contamination in column. Reference paragraph 7.1.5.2 a	Replace or clean column.
	c) Check for contamination in column valve assembly.	Remove valve stems and wipe with clean lint-free clo Heat valve assembly during operation to vaporize remove contaminants.
4) Flame-out when operating either valve	a) Ensure valves are being operated with a quick, positive motion.	Operate valve with a positive motion.
	b) Either H_2 or air may be leaking around one or more of the valve quad rings. Assess by tests and "O" ring inspection.	Remove stems and lightly coat with silicone grease, ly on contact surface of the "O" ring. Wipe off exce (do not remove quad rings).
	c) Damaged or worn quad rings causing leak.	Replace quad rings and grease as above.
5) Excessive peak tailing	a) Change or clean GC column and see if problem disappears.	Ensure columns are clean prior to use. Refer paragraph 7.1.5.2 a for cleaning instructions. If one o same type of column tails worse than others, repack t column or discard.
	b) Inspect GC valves for excessive silicone grease or contamination.	Excessive lubricant or foreign matter in the val assembly can cause excessive tailing. Clean val assemblies and lightly relubricate as required. Lub

7.2 RECORDER OPTION

7.2.1 GENERAL

A Portable Strip Chart Recorder is available from Century for use with the OVA instruments (reference Figure 7-2-1). The recorder is powered from the OVA battery pack and the output can be scaled to match the OVA readout meter, thereby providing a permanent record for subsequent analysis or reference. The recorder is available in two models. P/N 510445-1 is used with standard Models OVA-88, OVA-98 and OVA-118. P/N 510445-2 is certified intrinsically safe and is used with the certified Models OVA-108, OVA-128 and OVA-138.

7.2.2 APPLICATIONS

The recorder can be used with the OVA to provide a record of the long term monitoring profile of an area in total organic vapor concentrations, or can be used with the Gas Chromatograph Option to provide a chromatogram of the GC analysis.

7.2.3 FEATURES

The recorder prints dry (no ink) on pressure sensitive chart paper. Housed in rugged die-cast aluminum, it weighs approximately four (4) pounds and is 5-5/8" high, 3-5/8" wide and 4-1/8" deep.

The recorder is available for use with either the Century logarithmic or linear scaled OVA's by simply changing the scale and paper style. The recorder is equipped with two gain ranges and an electronic zero adjustment control. The HIGH gain position is normally used only with the logarithmic OVA to provide a means of scale expansion.

7.2.4 CONTROLS AND CONNECTIONS

Described below are the functions of the various controls and connectors. Reference Figure 7-2-1.

Controls and Connections—Function

1) HIGH-LOW Switch - This switch, located on the right hand side of the recorder, provides 2 ranges. The LOW range is set for the same full scale reading as the OVA readout meter. The HIGH range can be set to give an increased sensitivity to the recorder without effecting the OVA calibration.
2) ZERO ADJUST Knob - This potentiometer, also located on the right hand side of the recorder, permits "nulling" of the background reading on the recorder only (without affecting the calibration of the OVA as displayed on the OVA readout meter). In the full clockwise position of the knob, the recorder will display the same reading as the OVA meter. Counterclockwise rotation will reduce the reading on the recorder only.
3) Power Connector - This 126 series, 5 pin Amphenol connector provides power and signal to the recorder, as follows:

Standard 510445-1	FM 510445-2	Function
A	B	Input signal
E	E	pos. 12VDC input
H	H	Ground

7.2.5 OPERATING PROCEDURES

Connect cable between recorder and OVA. Tu recorder on by selecting either the HIGH or LOW po tion of the switch. (Normal is "LOW".)

When using the HIGH gain position (typically only logarithmic OVA's), it may be desirable to "null" out th background on the recorder. To accomplish this, pr vide clean air to the OVA or place a charcoal filter in lin with the OVA input to establish a "zero" reference an use the ZERO ADJUST Knob to set the recorder need to the zero line. Remove the filter and the instrume and recorder are ready for use. NOTE: During norm survey use, it is best to turn the recorder off to conser paper and battery power.

7.2.6 CALIBRATION

7.2.6.1 GENERAL

Electronic and mechanical adjustments, other tha the operational adjustments on the side panel, are pr vided to calibrate and align the recorder.

7.2.6.2 MECHANICAL ZERO ADJUSTMENT

a) Snap out the front panel nameplate (using small blade screwdriver in the left hand slot) fo access to mechanical zero adjust screw, plac HIGH-LOW Switch in OFF position.
b) Unscrew knurled fastener at top left of fron panel, open recorder. Pull down plastic chass latch on right side to release sticker bar tensio on paper and adjust mechanical zero as required. Replace nameplate, chassis latch an resecure front panel.

7.2.6.3 GAIN ADJUSTMENT

Separate adjustments are provided for the HIGH an LOW ranges on the recorder. (Refer to Figure 7-2-1 fo location.)

a) Connect recorder to OVA and adjust OVA fo full scale reading on readout (about 5 VDC).
b) Loosen knurled fastener on upper left of th front panel and pull front panel down.
c) Place HIGH-LOW Switch in LOW and adjust R until recorder prints full scale.
d) Place HIGH-LOW Switch in HIGH and adjus OVA to read the desired full scale with fron panel CALIBRATE ADJUST Knob, typically hal scale on the readout. Adjust R2 until recorde reads full scale. NOTE: Full scale adjustment o the recorder for 1/2 scale on the OVA gives a gain increase of two (2) in the height of the peak on the chromatograms. This is the factory set point for the HIGH gain range; however, other points can be set as desired with 30 ppm full scale on the logarithmic units and a gain of three (3) on the linear units being the maximum obtainable without amplifier loading.

7.2.7 SAFETY

Due to the low power requirements of the recorder, one model has been approved for use with Century's line of certified intrinsically safe instruments. The only difference between the two models is a heavy blue epoxy powder coat on the certified model and different power connector pin arrangement to prevent accidental interchange of the recorders.

7.2.8 MAINTENANCE AND ROUTINE OPERATIONS

Refer to the manufacturer's (Gulton) manual on the recorder which is enclosed with each recorder when shipped.

7.2.8.1 CHANGING CHART SPEEDS

The recorder is equipped with a 16 RPM motor which gives a writing speed of four (4) strikes per second. The chart advance speed is determined by the gear train assembly number used. The inches per hour for each gear train is given in the table on page 9 of the Gulton recorder manual. Refer to the bottom line of the chart adjacent to drive motor 16 and note for example that a number 1 gear train has a chart speed of 8"/hour.

a) To change the paper speed, open the recorder, remove gear box spring (on left side), move gear box in direction of arrow on its case and lift out from top. Do not force out from bottom. Insert new gear, bottom first, slide into position against arrow direction. Replace gear box spring.

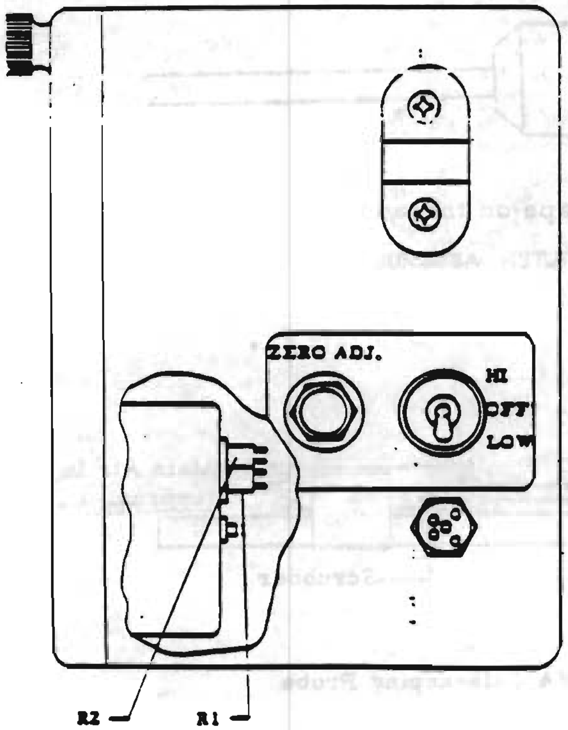


FIGURE 7-2-1. RECORDER CONTROLS AND ADJUSTMENTS

7.3 ACTIVATED CHARCOAL FILTER ASSEMBLY

The Activated Charcoal Filter Assembly, P/N 510095-1 is an optional accessory that can be used with any of the Century portable OVA's. The filter can be installed o the OVA Readout Assembly or attached at the end o the telescoping probe. The filter assembly is typically filled with activated charcoal which acts as an adsorben and effectively filters out most non-methane or non ethane organic vapors. A screw cap on the probe end is removed for refilling the filter with activated charcoal o any other filtering media desired.

Applications of the filter include:

1) Obtaining a clean air sample for zero baseline check and adjustment on linear OVA's or for background check on logarithmic OVA's.
2) Running "blank" chromatograms to assess instrument contamination.
3) Rapid screening of methane and non-methane organic vapors.
4) Selective screening for natural gas surveys.
5) As a moisture filter when filled with a desiccant such as silica gel.

A press fit, large adapter on the back of the filter assembly is removed when installing the unit on the telescoping probe. When replacing the cap end after refilling, one wrap of 1/4 inch teflon tape should be used to seal the threads. The recommended activated charcoal for use in the filter is Barnebey-Cheney, Type GI-8679.

The life of the filter will depend on the time in use and the concentrations of the compounds being filtered. Under typical industrial air monitoring conditions, the filter will last for many days of continuous sampling.

7.4 OVA SAMPLE DILUTOR

An adjustable Sample Dilutor Assembly, P/N 510825-1, is available as an optional accessory for use on al Century portable Organic Vapor Analyzers. The dilutor may be adjusted over the range of 5:1 to 50:1 in OVA response. In operation, the dilutor is attached to the end of the telescoping probe or may be connected by external tubing to the input fitting of the OVA side pack case. Dilution of the air being monitored is accomplished by stream splitting through the use of a needle valve on the sample input. An activated charcoal scrubber is inserted in the main air supply line to the OVA and scrubs the air clean of organic vapors and also creates a slight vacuum at its output side of the scrubber and the vacuum at this point draws the sample air through the needle valve where it mixes with the main air supply going to the OVA detector.

This dilution valve provides a means of sampling vapor levels above the lower explosive level (LEL) and in oxygen deficient atmospheres. These conditions can occur in normal leak or source survey as the operator gets close to the leak or vapor source or in monitoring various manufacturing or material handling processes Approximately 14% oxygen is required to sustain operation of the FID in the OVA.

7.4.1 SETTING DILUTION RATE

Prepare a sample in a bag at a high level, typically 1,000 to 5,000 ppm. Any suitable gas can be used, such as butane from a cigarette lighter; however, a compound similar to those to be measured provides greater accuracy. The actual concentration of the gas does not have to be known, since the dilution rate is simply a relative level.

Obtain an OVA reading on the vapor sample with the dilution valve removed. Then install the valve, loosen the jam nut and turn the needle valve until the meter reading corresponds to the original reading divided by the dilution factor desired. Retighten the jam nut.

It should be noted that when the dilution valve is used for natural gas leak survey and pinpointing that the charcoal filter will not remove the methane from the dilution air supply. Care should be taken so that natural gas is not allowed to enter the main air inlet.

7.5 OVA SEPTUM ADAPTER

A Septum Adapter, P/N 510645-1, is available for direct on-line sample injection to the GC column inlet. The Septum Adapter mounts directly on the OVA front panel and sample injections from .025 to 2.5 cc may be made using a gas tight syringe. This provides a range of se sitivity of approximately 10% to 1000% of the OVA sta dard valve, which has a sample loop volume of apprc imately 0.25 cc. Syringe injection can cause a flame-ot however, the OVA may be reignited after the injection made. The air in the sample must elute from the colum before reignition can be made. The time for the air pe to elute will be a function of the column length and tl volume of the sample injected. For example, a 1 cc sar ple into a 12" column will require waiting approximate 5 seconds; and, a 2.5 cc sample into a 48" column w require approximately 20 seconds.

The Septum Adapter also provides a means wherel samples can be taken from oxygen deficient a mospheres or process streams and injected directly i to the chromatograph. Headspace analysis may also t accomplished using the Septum Adapter and a syringe

When the Septum Adapter is installed on the OVA, tl normal GC sample valve may still be used alternate with the syringe injection. In addition to variable samp size and sensitivity, syringe injections will normally pr vide greater symmetry and reduced tailing chromatogram peaks as compared with the standar valve injection.

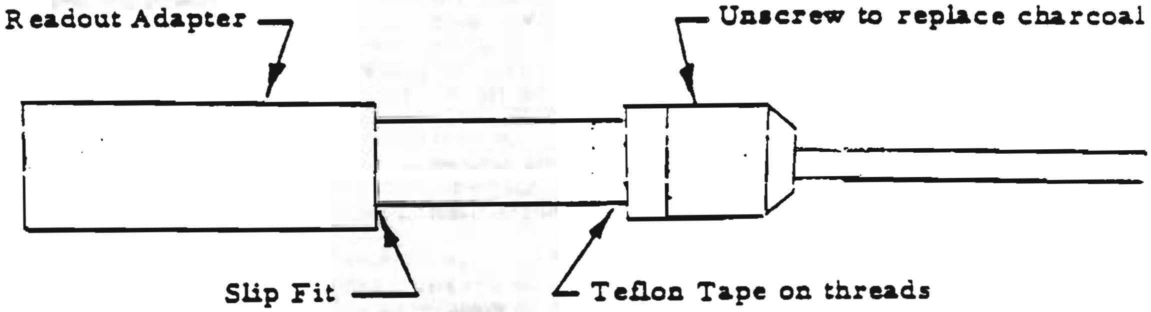


FIGURE 7-3-1. ACTIVATED CHARCOAL FILTER ASSEMBLY

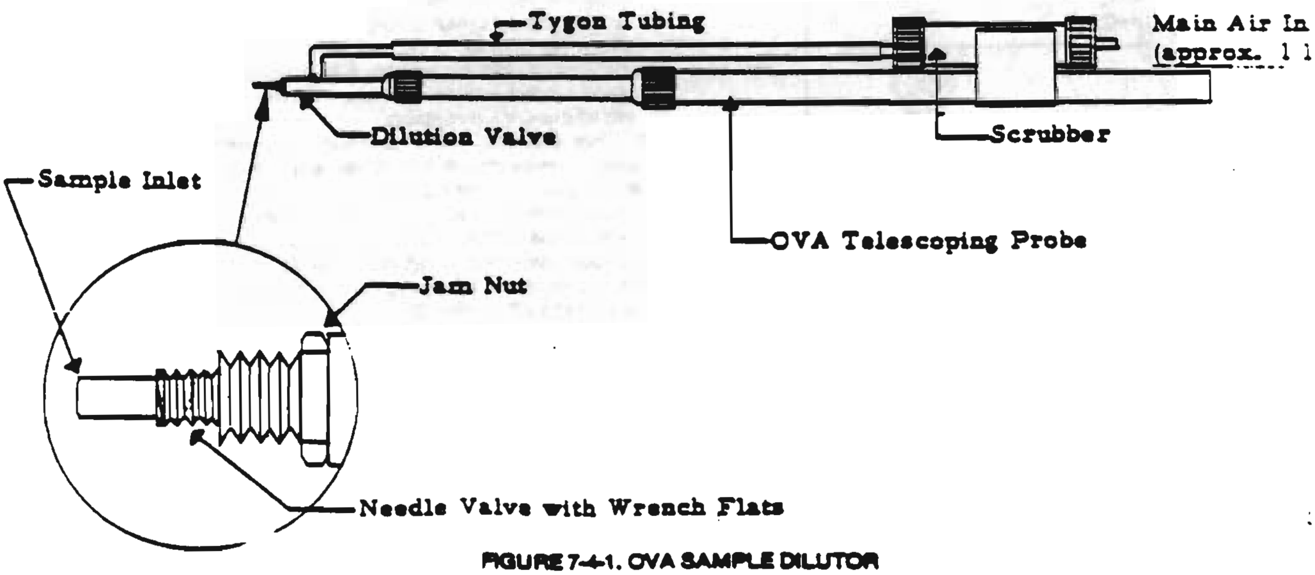
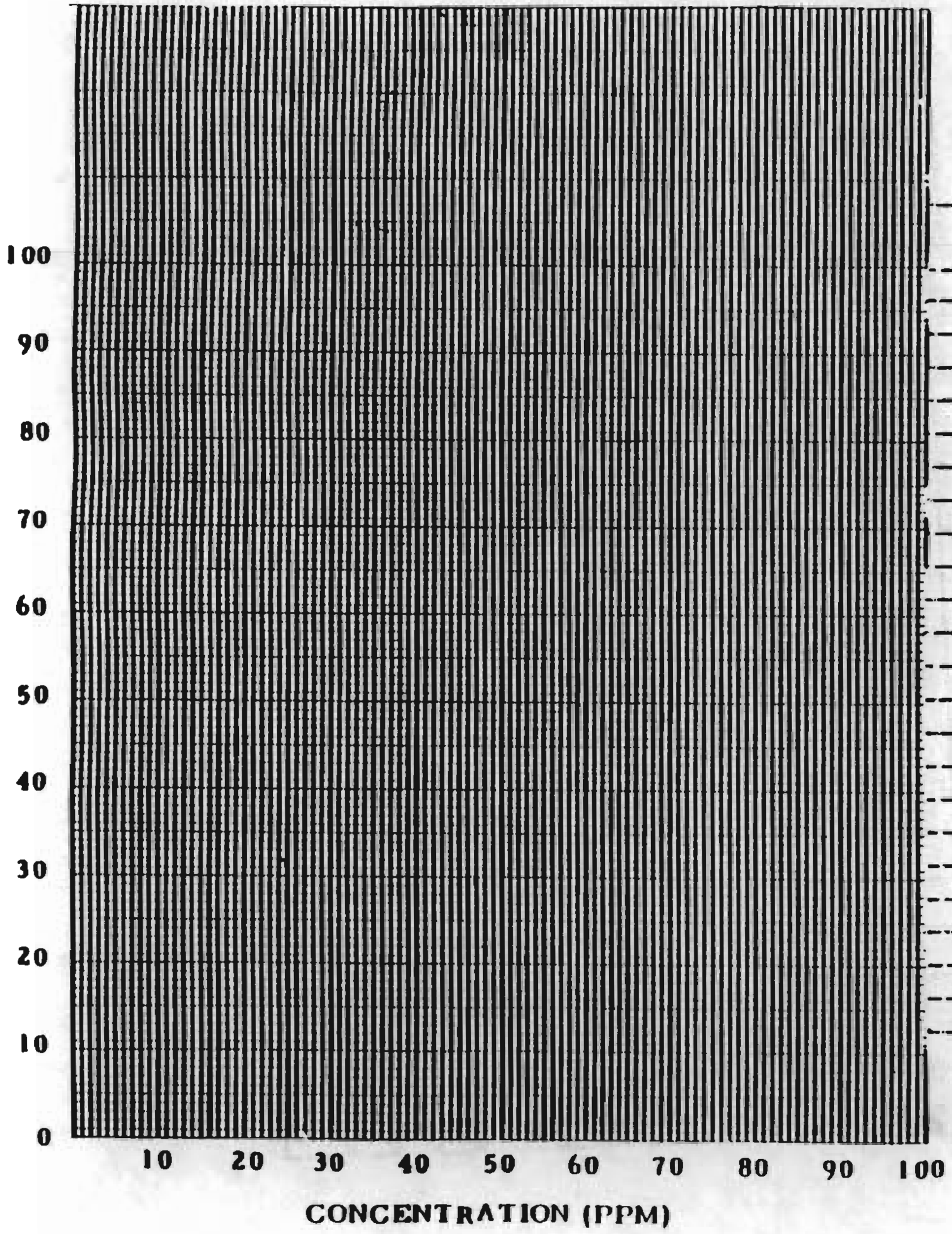


FIGURE 7-4-1. OVA SAMPLE DILUTOR



Column ______ Chromatograph ______

Temperature ____ °C Carrier Flow ___ ml/sec.

Injection: Volume ______ ml Type ______

X	Compound	R. R. (%)	RT (sec)	Date	TLV (ppm)

NOTE: Concentration used for test is 100 ppm or as indicated by marked data points.

COMMENTS:

ITEM NO.	QTY. REQ. PER DASH NO. -1	-2	-3	-4	-5	-6	PART OR IDENT. NO	DESCRIPTION
33	1	1					11752-1	Fitting
34	1	1					510193-2	Potentiometer Assy, 100K (R52)
35	1	1					RN55D5621F	Resistor, 5.62K, 1%, M.F. (R54)
36	2	2					MS35206-226	Screw, 6-32X1/4 Lg., Pan Hd Phillips
37	1	1					510540-3	Spacer
38	1	1					510499-1	Bracket
39	1	1					510539-1	Flow Gauge Assy.
40	1	1					510223-6 △1	Pump Assy.
41	1	1					7806UC	Regulator
42	1	1					PL11-213-8 △1	Motor, 12 VDC
43	4	4					12SI-11-1AA	Stud Assy.
44	4	4					5 S 3-1	Washer
45	1	1					NY334R	Capacitor, .33UF
46	A/R	A/R					Type 0113	Tubing, Teflon, .148 I.D. X .020 Wall (Blk. Oxide)
47	3	3					MS35190-221	Screw, 4-40X1/4 Lg. Ft. Hd. Phillips
48	A/R	A/R					35-31	Locktite, Retaining Compound
49	2	2					MS35337-6	Washer, Helical, No. 6
50	1	1					11-1-11	Dial, 10 Turn, 1" Dia.
51								
52	1	1					510537-1	Support, Preamp
53	1	1					510538-1	Clamp, Preamp
54	A/R	A/R					8505-10	Wire, Awg 26 Black, Stranded, Tinned
55							-1	Brown
56							-2	Red
57							-3	Orange
58							-4	Yellow
59							-5	Green
60							-6	Blue
61							-7	Violet
62							-9	White
63	A/R	A/R					8505-14	Wire, Awg 26 Wht/Blk, Stranded, Tinned

APPENDIX "A"

OVA-128

This Appendix includes the following:

Sample forms and typical Application/Tech Notes

Side Pack Assy Dwg. No. 510605
Side Pack Assy Parts List No. LM510605

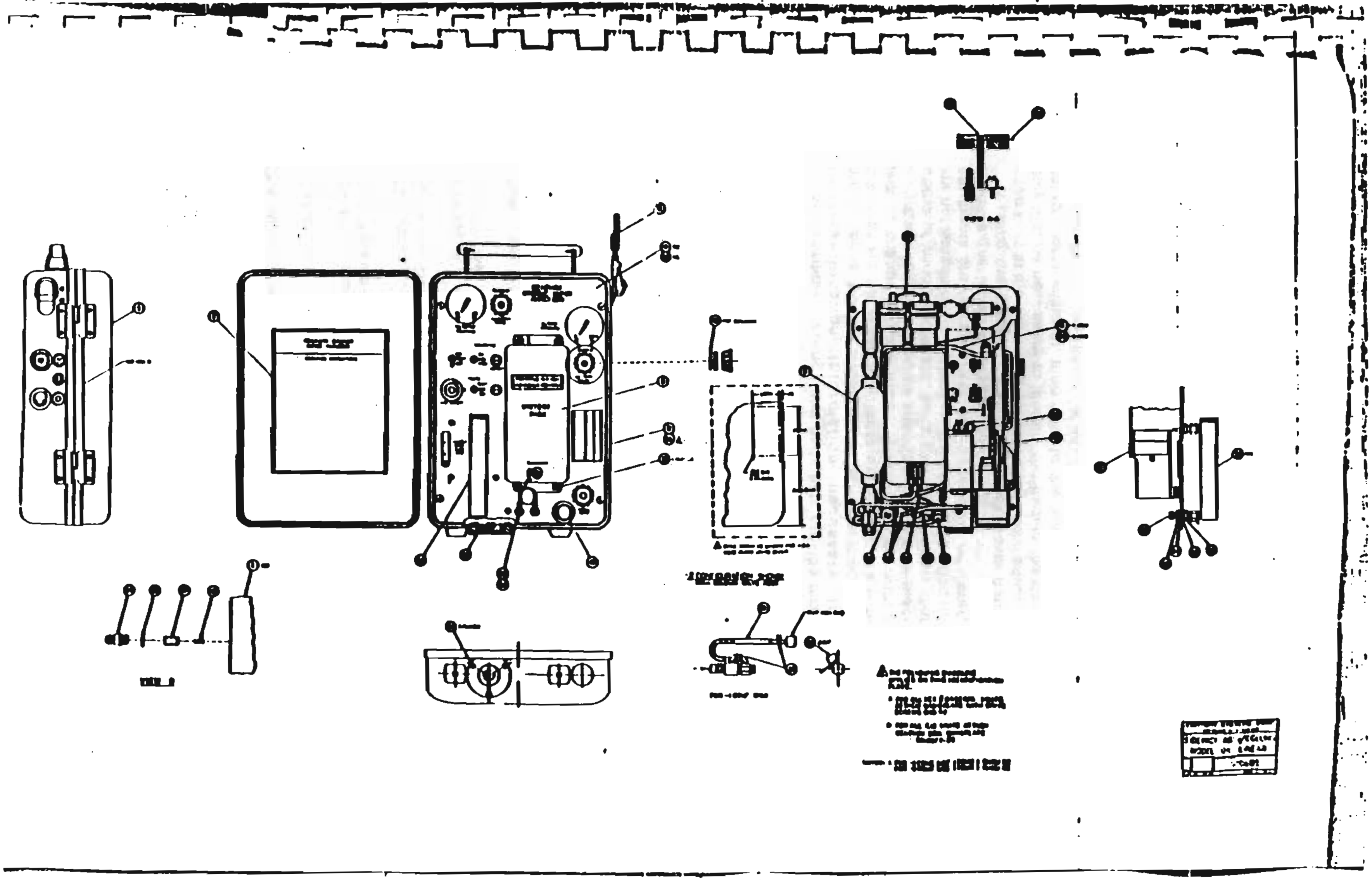
Electronic Component Assy Dwg. No. 510570
Electronic Component Assy Parts List No. LM510570

Cylinder Assy Dwg. No. 510055
Cylinder Assy Parts List No. LM510055

Schematic Wiring Diagram Dwg. No. 510555

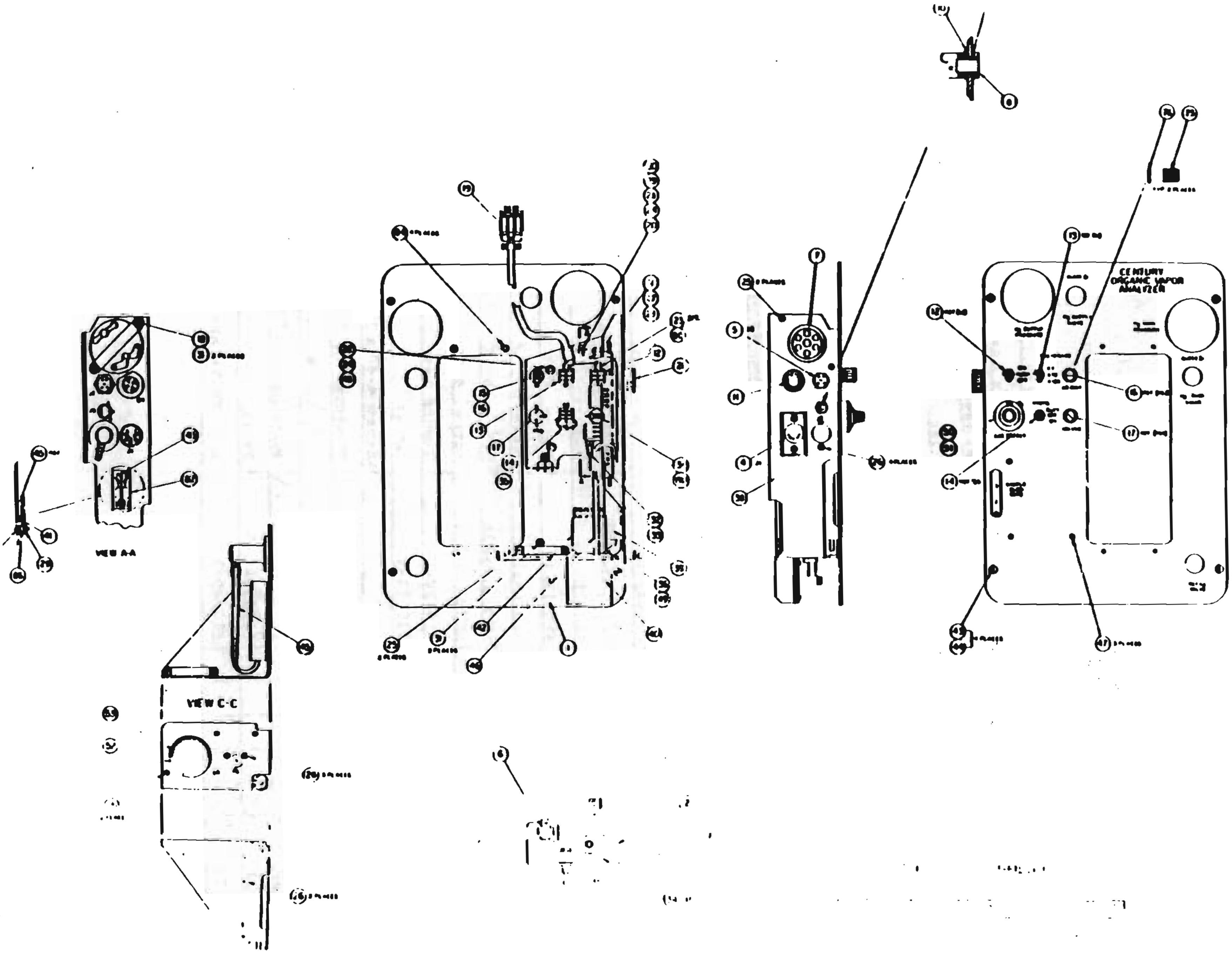
The assembly drawings and parts lists provide location/identification information necessary for maintenance, trouble shooting and parts ordering. The drawings are furnished only for reference and are subject to change without notice. The schematic wiring diagram is for use in trouble shooting for possible electronic or wiring problems. Note that components that are not accessible for safety reasons on the certified instruments are not shown on the schematic. However, typical signal levels at selected points are shown.

In using the drawings and parts list to locate items described in the Maintenance Section of this manual, it may first be necessary to identify the item in the parts list (by nomenclature), then refer to the corresponding item number on the drawing for location.



CENTURY SYSTEMS CORP.	TITLE SIDEPACK ASSY/COLUMN OVA-128
-1 Conf. OVA-128 -3 Conf. OVA-128 Tri-Column -2 Conf. OVA-128 w/column	LM 510605

1	1	1	1				510508-1	Case Assy.
2	1	1	1				510055-1	Cylinder Assy.
3	1	1	1				510542-1	Battery Pack Assy.
4	1	1	1				510570-1	Electronic Component Assy.
5	1	1	1				510073-1	Capillary Tube
6	1	1	1				510094-1	Carrying Strap Assy.
7	1	1	1				510295-1	Ident. Plate, Operating Instr
8	1	1	1				510137-1	Ident. Plate, Calib. Rate
9	1	1	1			△1	510577-2	Ident. Plate, OVA Assy.
~~[illegible]~~	/						~~[illegible]~~	~~[illegible]~~
11	1	1	1				510590-1	Printed Wiring Board Assy.
12	1	1	1				510600-1	Preamp Assy.
13	1	1	1				5105[illegible]-1	Mixer & Burner Assy.
14	1	1	1				510382-1	Fitting Assy.
15	1	1	1				LC-032C-4SS	Spring
16	1	1	1				568-013	O-Ring
17	1	1	1				510318-1	Filter, Cup
18	3	3	3				510164-1	Washer
19	4	4	4				MS35206-226	Screw, 6-32 x 1/4, Pan Hd Phillips (Blk C
20	2	2	2				MS35206-223	Screw, 4-40 x 1 1/2 Lg, Pan Hd Phillips
21	1	/	/				510420-1	Tubing Assy.
22	1	1	1				510622-1	Cover
23	3	3	3				.	Screw 4-40 x 1/2 Socket Head.
24	1	1	1				3305-11-46	Thermostat, 75°C
25	1	/	/				510440-1	G.C. Valve Assy (Dual)
26	A/R	A/R	A/R				△1	Identification Plate
27	2	/					510568-1	Spring
28	/	/	1				510440-2	G.C. Valve Assy (Tri)


CENTURY
ORGANIC VAPOR
ANALYZER
VIEW A-A
VIEW C-C

Date ______ **Type Injection** ______

Column ______

Sample ______

Temp. ______ **°C** **Chart Speed** ______

GC ______ **S/N** ______ **Range** ______

Recorder Scaling ______

Carrier flow ______ **ml. /min.**

Other Conditions: ______

______

______

______

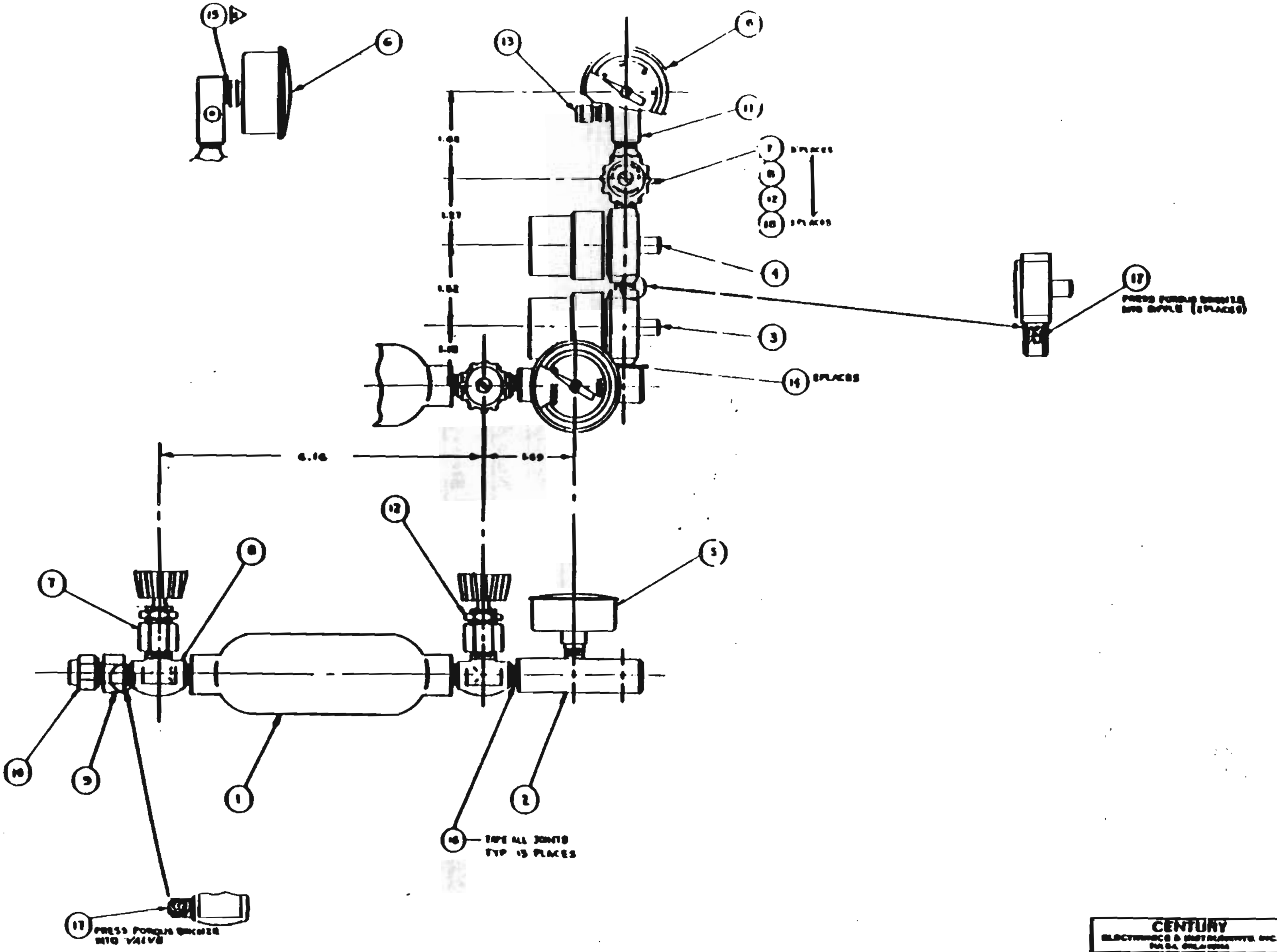
______

CENTURY SYSTEMS CORP.	TITLE ELECTRONIC COMPONENT ASSY
-1 Conf. OVA-128 -2 Conf. OVA-128 w/column	LM 510570

1	1	/				510386-4	Panel	
2	1	1				510379-1	Housing, Filter	
3	1	1				SAC-22D/1-2	Connector	
4	1	1				D5M	Connector	J1
5	1	1				126-011	Connector, 5 Pin, Female	J2
6	1	1				126-192	Connector, 7 Pin Female	
7	1	1				75547	Speaker	
8	1	1				42A	Tina - Jax	
9	1	1				510362-1	Washer, Nylon	
10	1	1				2154	Washer, Shoulder	
11	1	1				510567-1	Switch, Push Button	S4
12	1	1				BA2011	Switch, Toggle	S2
13	1	1				BA2101	Switch, Toggle	S1
14	1	1				BA2051	Switch, Toggle	S3
15	2	2				510540-3	Spacer	
16	1	1				510193-1	Potentiometer Assy, 50K	R53
17	1	1				5100 53-1	Potentiometer	R50
18	1	1				510389-1	Clamp	
19	1	1				510519-1	Cable Assy.	
20	1	1				3942	Clamp, 1/4"	
21	1	1				510052-2	Shield	
22	2	2				8327	Spacer	
23	1	1				1468-1/4	Terminal Lug	
24	3	3				MS35190-223	Screw, 4-40X3/8 Ft. Hd. Phillips	
25	6	6				MS35206-213	Screw, 4-40X1/4, Pan Hd. Phillips	
26	9	9				MS35190-221	Screw, 4-40X1/4, Ft. Hd. Phillips	
27	2	2				MS35206-214	Screw, 4-40X3/8, Pan Hd. Phillips	
28	5	5				MS15795-4	Washer, No. 4, Flat	
29	2	2				MS35649-4	Nut, Hex, 4-40	
30	1	1				MS35337-4	Washer, Split Lock, No. 4	
31	5	5				511-041800-00	Nut, Hex, 4-40	
32	1	1				11761-1	Washer	

ITEM NO.	QTY. REQ. PER DASH NO.						PART OR IDENT. NO	DESCRIPTION
	.1	.2	.3	.4	.5	.6		
64	A/R	A/R					8505-15	Wire, Awg 26 Wht/Red, Stranded, Tinned
65							-20	Wht/Orange
66							-17	Wht/Yellow
67							8505-18	Awg 26 Wht/Blue, Stranded, Tinned
68								Awg 22 Wht/Blk, Type 44A0311, 2500V
69								Wht/Brn.
70								Wht/Red.
71								Wht/Orng.
72								Wire, Awg 22 White, Type 44A0311, 2500V
73							299/1	Wire, Buss, Awg 26, Tinned
74	A/R	A/R					PVC-105-14	Sleeving, 3/32
75	2	2					KN-500-1/8(Blk)	Knob, Black, 1/8" Shaft
76	2	2					568-8	O-Ring
77	1	1					4976	Lug, Spade
78	1	1					CL-2	Clip
79	1	1					510581-1	Wire List
80	/	1					510386-5	Panel
81	A/R	A/R						Wire, Awg 20, White, Type 44A0311, 2500V
82	1	1					510574-1	P.W.B. Motor Regulator
83	1	1					MS35206-217	Screw, 4-40 x 1/2, pan hd. Phillips
84	4	4					CL-632-2	Nut, 6-32
85	A/R	A/R					FIT-105-1/8	Sleeving, Shrink, 1/8 PVC
86	1	1					8480	Spacer, .250 dia. x 1/8 thk.

△1 -6 to be used effective S/N 1400 and up with Escap Motor #PL-11-213-35.



CENTURY
ELECTRONICS & INSTRUMENTS INC.
TULSA, OKLAHOMA

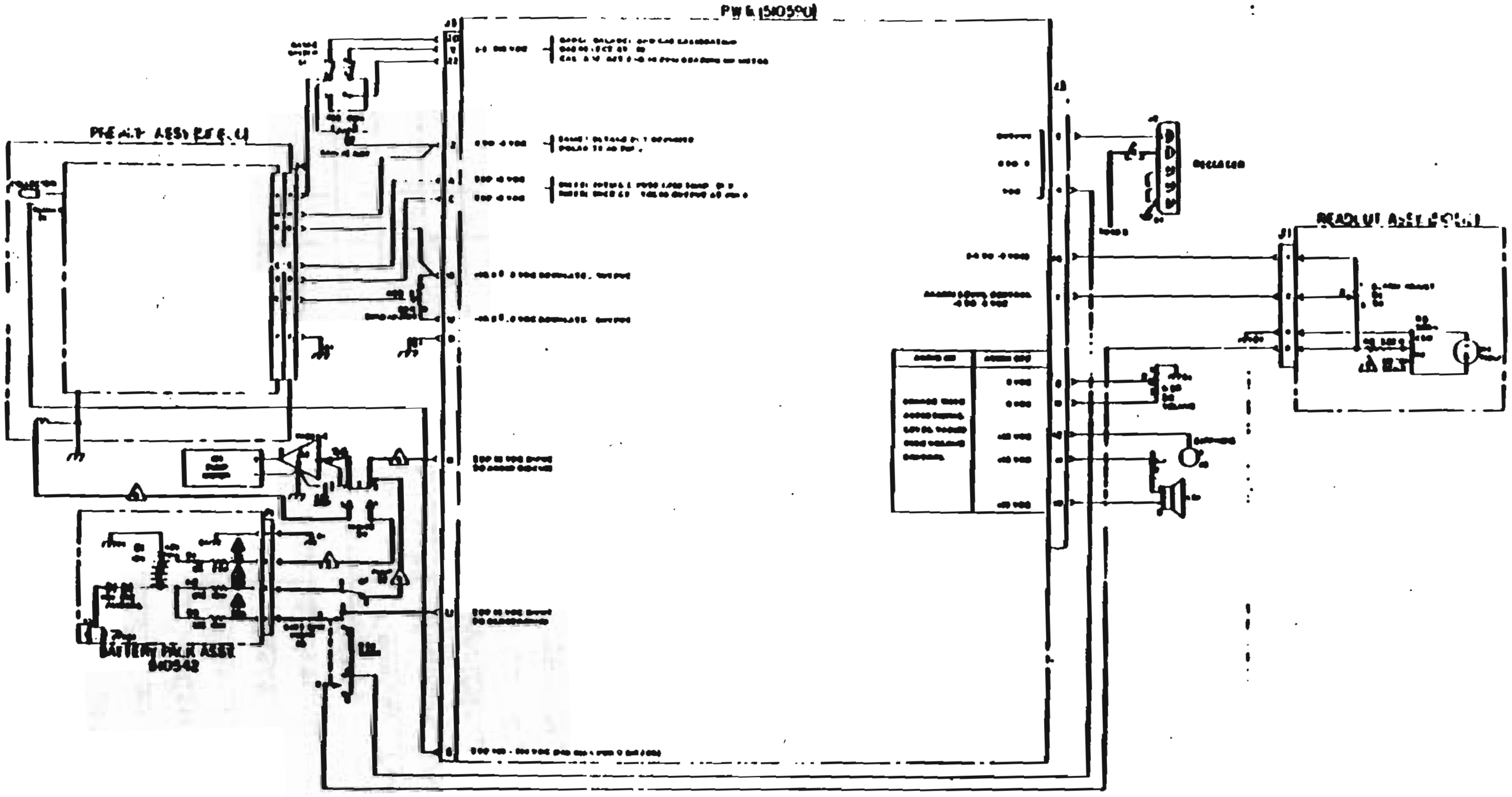
CYLINDER ASSY

D

510055

CENTURY SYSTEMS CORP.	TITLE CYLINDER ASSY
-1 Conf. OVA-88, 98, 118, 108, 128, 138	LM 510055

	1	1						510056-1	Cylinder
	2	1						510057-1	Manifold
	3	1						510100-1	Regulator Assy., High Pressure
	4	1						510100-2	Regulator Assy., Low Pressure
	5	1						510008-1	Gauge H. P.
	6	1						510007-1	Gauge L. P.
	7	3						510059-1	Adapter Panel
	8	3						510058-1	Valve
	9	1						646F 1/4	Coupling, Female 1/4 Tube x 45°
	10	1						640-FB-1/4	Nut, Cap, 1/4" x 45°, Brass
	11	1						510108-1	Manifold
	12	3							Nut, 5/8" - 24, Brass
	13	1						510283-1	Connector, Filter Assy
	14	2						112-B-1/8	Nipple, Close, 1/8" Brass
2	15	1						510109-1	Connector (MOD)
	16	A/R						A69007	Tape, Pipe Thread, 1/4" Teflon
	17	3							Filter, Porous Bronze, 1/4 dia.
									x 1/4 Lg., Grade 30
	*	A/R						510160-1	Wafer, (Teflon)
									* Use only if required
	18	3						510152-1	Ident. Plate Hydrogen Knob



CENTURY SYSTEMS CORP.

SCHEMATIC

ORGANIC VAPOR ANALYZER

OVA-128

D

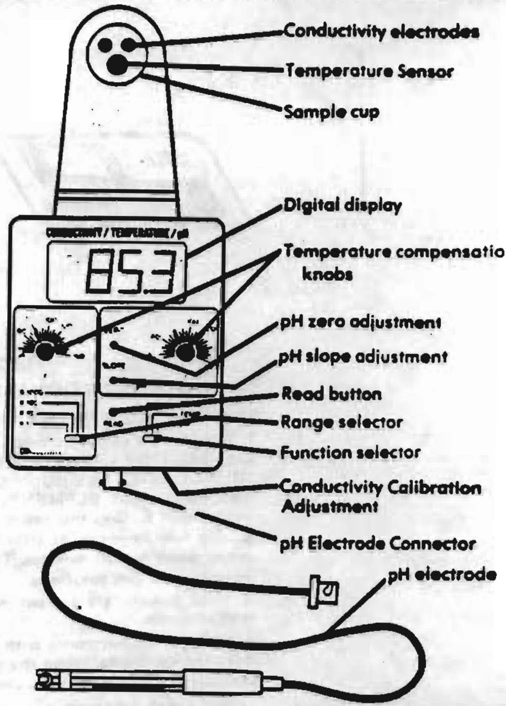
510555

4

HYDAC®

DIGITAL CONDUCTIVITY / TEMPERATURE / pH TEST

HB835-1-



FEATURES

- Digital display liquid-crystal type, 3-½ digit
- Visual warning when battery needs to be replaced
- 9 Volt Alkaline Battery
- Automatic battery strength compensation
- Rugged ABS (Acrylonitrile Butadine Styrene) instrument case plus handy carrying case

Conductance measurement

4 ranges, measured in micromhos
0 to 20
0 to 200
0 to 2,000
0 to 20,000

Integral sample cup

Accessible Calibration Adjustment

Temperature measurement

0 to 160° Fahrenheit range

Integral sample cup

pH measurement

0 to 14 range

Slope and zero adjustments on face of unit

External electrode

Buffer solutions available

ACCURACY

Conductivity ± 2% Full Scale

Temperature ± 2° Fahrenheit

pH ± .01 pH units of 77° Fahrenheit

COLE-PARMER
INSTRUMENT CO.
7425 N. OAK PARK AVE.
CHICAGO, ILLINOIS 60648
(800) 323-4340 (312) 647-7600

ELECTRODE INSTRUCTIONS

SEALED COMBINATION ELECTRODE WITH SILVER/SILVER CHLORIDE REFERENCE

PREPARATION FOR USE

1. Moisten the electrode body with tap water and carefully remove the lower (storage) plastic cap. CAUTION SHOULD BE USED IN REMOVING THIS CAP. PULL STRAIGHT DOWN. DO NOT BEND THE BODY OF THE ELECTRODE. THIS CAN RESULT IN DAMAGE TO THE INTERNAL ELEMENT. Rinse the exposed pH bulb and ceramic wick area with tap water. NOTE: Save this lower plastic cap for use in storage of the electrode.

2. For first time use, or after long term storage, immerse the lower end of the electrode in tap water for 30 minutes. This hydrates the pH bulb and prepares the ceramic wick for contact with test solutions.

3. If air bubbles are present in the pH bulb, shake the electrode downward to fill the bulb with solution.

4. NOTE: For electrodes with a removable guard, the guard is shipped in the box separate from the electrode. When the storage cap is removed, this guard is easily slipped on for bulb protection and off for bulb cleaning.

pH MEASUREMENTS

5. Rinse electrode tip with distilled water and immerse in a buffer solution whose pH is close to that of the solution to be tested. Stir solution with the electrode to assure contact with elements in the shrouded tip and to dislodge any air bubbles if present.

6. Adjust the standardize control on the pH meter to cause the meter to read the pH of the buffer. NOTE: Allow a few minutes for the electrode to reach full equilibrium.

7. Remove electrode from buffer, rinse vigorously with distilled water, shake off clinging water and immerse electrode in the solution to be tested. Read the pH value. NOTE: The electrode should always be rinsed with distilled water between solutions to prevent cross-contamination.

8. In high precision measurements it is good practice to repeat paragraphs 5 and 6 in this section as needed to assure full equilibration of the electrode.

STORAGE

9. SHORT TERM: Immerse the electrode tip in 2M KCl (dilute 4M KCl with an equal volume of distilled water).

10. LONG TERM: Fill lower plastic cap with 2M KCl and replace it on electrode tip. Replace electrode in shipping box.

RESTORING ELECTRODE WITH IMPAIRED RESPONSE

Used electrodes, which are mechanically intact, can often be restored to full response by one of the following procedures:

1. INORGANIC SCALE DEPOSITS: Dissolve the deposit by immersion of the electrode tip in dilute hydrochloric acid for a few minutes followed by a thorough rinse in tap water.

2. ORGANIC OIL OR GREASE FILMS: Wash electrode tip with detergent and water. If film is known to be soluble in a particular organic solvent, wash with this solvent. Rinse electrode tip with tap water.

3. PLUGGED OR DRY CERAMIC WICK: Remove the contaminate with one of the above procedures, then soak in 2M KCl solution.

Operating Instructions

Cole-Parmer's 148

Digital Conductivity Me

Cole Parmer

Cole-Parmer Instrument Company
7425 North Oak Park Avenue, Chicago, Illinois 60648
Phone 1-312-647-7600 or Toll-free 1-800-323-4340

1. General Information

The instrument comes with a remote PVC probe, with two stainless steel electrodes located just below the PVC cap. A probe sleeve protects the electrodes and is perforated to direct the flow of liquid during measurements. It is not possible to take readings without this protective sleeve. The electrode is kept dry in the air and will not give a reading in a dry state.

A soft vinyl carrying case, 9-volt battery and an instruction manual are also included with the meter. Model 1481-52, a pint of standard calibration solution (12,980 µmho) is available as an optional accessory; call Cole-Parmer, toll-free at 1-800-323-4340, for additional information or technical assistance. (In Illinois, call collect at 1-312-647-7600.)

2. Specifications

Ranges:	µmho: 0 - 199.9, 0 - 1999, 0 - 19,990 ppm CaCO$_3$: 0 - 19,990
Accuracy:	±1% full scale
Drift:	1 digit/10°C
Temperature compensation:	Manual, 0° to 30°C at 2% per °C
Cell constant:	Adjustable by potentiometer K ±15%
Display:	1/2" LCD; with low battery indicator
Battery:	One 9-volt (included)
Battery life:	100 hours continuous operation
Probe:	Contains 2 stainless steel electrodes; PVC body, 59" cord
Dimensions:	7"L x 3¼"W x 1½"D
Weight:	1½ lbs (0.9kg) with case and probe

3. Calibration

Procedure below is based on use of the 1481-52 conducitivity calibration solution. Follow these instructions carefully:

1. If the instrument is in the "Off" position, turn the switch to the "0 - 19.990 µmho" position.
2. Pour the calibration solution into a beaker and measure the temperature of the solution.
3. Immerse the electrode in the solution so that the liquid flows through the perforations. Stir gently to permit any trapped air in the electrode to escape.
4. Position the Temperature Adjustment dial (°C) on "25".
5. Check the µmho value of the solution in terms of the ambient temperature. If the solution temperature is other than ambient, refer to the Temperature/µmho table, page 4.
6. Adjust the Cell Constant dial (K%) until the display reads "12.88" (on this scale a final zero must be added).

NOTE: When the calibration is complete, the meter will maintain the proper value for at least a month.

4. Using the instrument

If the unit has been calibrated, just immerse the end of the electrode in the liquid to be measured.

If the reading is higher than the range selected, the display will read "1" in the far left digit position. If this happens, go to a higher range. For example:

> **The solution to be measured is 350 µmho. If the instrument is initially positioned at the "0 - 199.9" µmho range, only "1" will be displayed. Go to the "0 - 1999" µmho range to display the "350" µmho reading.**

5. Using the temperature compensation

Variations in temperature have an effect on the conductive characteristics of the sensor. For example, the value of a piece of metal taken at 200°C is different from the value it would have had at 25°C. To correct this kind of error, the temperature is understood to be at 25°C (ambient) unless indicated otherwise.

When conductivity is measured at temperatures other than 25°C, the manual temperature adjustment should be used to correct this error. Refer to the chart below for the µmho value of the standard solution (Model 1481-52) at various temperatures.

NOTE: The influence of the temperature is an average of 2% per °C. For example, if the solution at 10°C measures 1000 µmho, at 25°C it would have measured 1200 µmho.

Temperature/salinity value chart

Temperature (°C)	Salinity (in µmhos)
0	7150
5	8220
10	9330
15	10480
16	10720
17	10950
18	11190
19	11430
20	11670
21	11910
22	12150
23	12390
24	12640
25	12880
26	13130
27	13370
28	13620
29	13870
30	14120
31	14370

6. Use of the salinity scale

The salinity scale displays the ratio between µmho and ppm $CaCO_3$ (about 0.5) automatically. Other salts have different specific µmho/ppm $CaCO_3$ ratios. NaCl, for example, has 0.64 µmho.

The salinity scale is used specifically for determining this ratio, as in the case of "primary" waters, heating, evaporating towers. In fact, in almost all these cases the presence of $CaCO_3$ is predominent with respect to the other salts.

7. Calibration of the salinity scale

It is possible to use the salinity scale reading directly in µmhos. A very interesting use consists of expanding the scale up to 199.900 µmho. To make this modification, proceed as follows:

1. Unscrew the 3 screws on the back cover. Inside you will see a "multi-turn" trimmer located near the right-hand edge of the printed circuit.
2. With the switch in the "0 - 19.990 µmho" position, immerse the electrode in the calibrating solution.
3. Turn the Cell Constant dial (K%) to calibrate the instrument to the standard solution value, thereby decreasing the value to one tenth of the original value. For example: for a reading of "1164", adjust to "11.640."
4. Position the switch on the salinity scale and turn the trimmer on the circuit board until the display reads "116." In this way one gets a measurement that is 1/10 of the preceeding one. The range, in such a case, will therefore be 0 - 199.99.

NOTE: Two zeros are added to the reading on the salinity scale (ppm $CaCO_3$). However, the 0 - 19.990 range has been decreased.

8. Checking the electrode

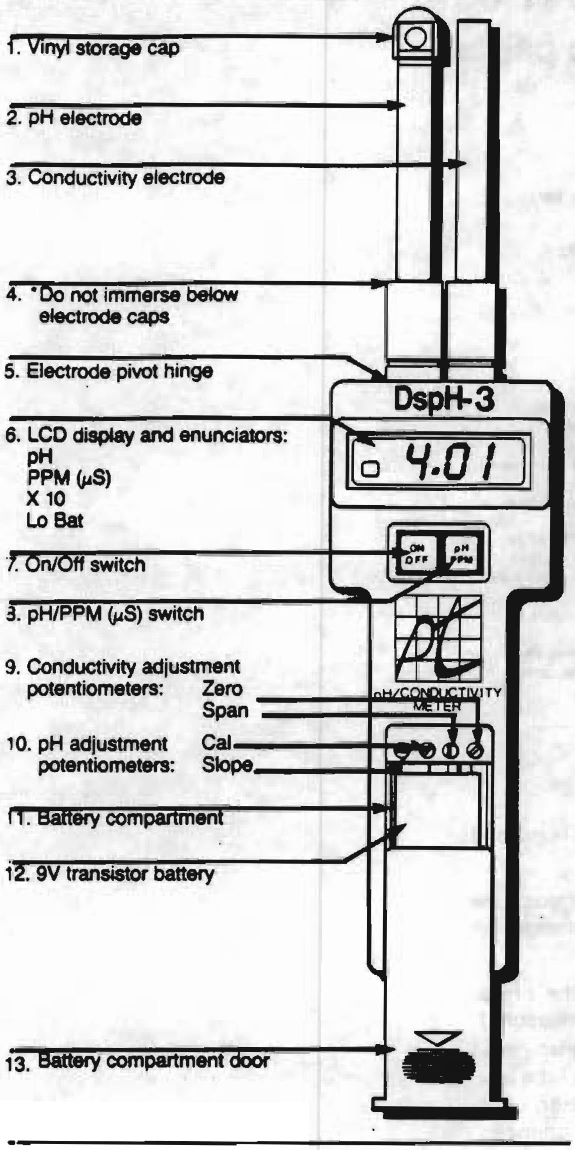
The electrode is made of PVC and therefore has limited resistance to temperature extremes. In particular it should be noted that the 4 steel rings (which combine to form the 2 electrodes) are embedded in the PVC. Prolonged exposure to high temperatures can open the joint, permitting fluid underneath the rings and breaking the electrical contact.

A damaged electrode is easily identifiable. To test for damage, unscrew the PVC sleeve and dry the rings. In air, with switch in the "0 - 199.9" position, the display should read "0.0". (Readings of "0.1" and "0.2" are still acceptable.) Higher readings, such as "10.0," are a clear symptom of a ruined electrode.

9. Cleaning the electrode

Periodically, and at least once a month, it is a good idea to unscrew the protective cover and carefully clean the rings and the PVC support. Use alcohol and a cotton wad. Then rinse the electrode throughly and dry with care.

DspH-3 pH/3 RGE. CONDUCTIVITY METER



OPERATING INSTRUCTIONS

1. Deploy electrodes in either the 90 or 180 degree measurement position.
2. Energize by depressing the On/Off switch once.
3. Immerse electrodes into solution to be measured. For proper operation, immerse electrodes ½ their length.
4. When energized, the LCD enunciator will indicate which parameter is being measured. E.G. pH, PPM (µS), or PPM (µS) X10. Only the 200K range utilizes the X10 enunciator. 20K and 2K are direct readings. Note selection sequence in #7. Overrange conductivity is indicated by a 1. Proceed to higher range for reading.
5. Agitate electrodes briefly and observe the reading.
6. For each range change desired, depress the pH/PPM (µS) switch once. This unit utilizes 3 ranges of conductivity. The range sequence is: pH-200K-20K-2K.
7. Rinse electrodes thoroughly and replace pH storage cap.

CALIBRATION INSTRUCTIONS

Your instrument has been pre-calibrated prior to shipment. Calibration should be performed periodically with fresh pH buffers and known conductivity solutions.

pH MODE

1. Rinse the pH probe in distilled water.
2. Insert in a fresh #7 buffer solution.
3. Slide back the battery compartment cover to the first stop exposing the adjustment pots.
4. Adjust the CAL pot until the display reads 7.00.
5. Remove probes, rinse and insert in a #4 or 10 buffer solution.
6. Adjust the SLOPE pot until the display reads the correct value.

CONDUCTIVITY MODE

1. Rinse probes thoroughly by agitating in pure water.
2. Wipe off conductivity probe and allow to dry.
3. Once dry, conductivity should read 0 in air.
4. Adjust ZERO pot if reading is incorrect.
5. Immerse sensor in known conductivity solution. Adjust SPAN pot to desired conductivity value.
6. Only a single point calibration in the 2K range is required to standardize. However, if unit is to be used primarily in higher ranges, it is recommended that the single point calibration be performed near point of use for best resolution.
7. Rinse probes.

HELPFUL HINTS

1. Electrodes should be rinsed thoroughly after each test.
2. Be sure to replace the protective pH cap after each use.
3. Fill the cap with a small amount of pH 4 buffer or tap water.
4. If the conductivity probe does not zero, it may indicate dried solids on the sensor. Clean with a mild detergent solution.
5. For best results, calibrate pH with a buffer that is within 3 pH units of the test sample.
6. Choose a conductivity calibration solution that is near the samples to be measured.
7. Remove the battery when the instrument will be stored for a long period.

Model
5941-00

pHep - pH electronic paper

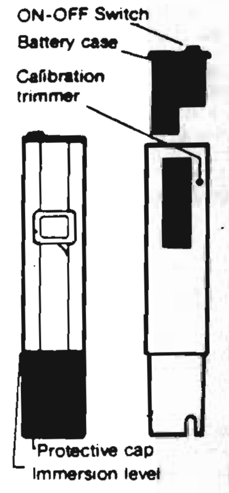


Fig. 1 Fig. 2

Specifications:

— Range:	0.0 to 14.0 pH
— Resolution:	0.1pH
— Accuracy:	± 0.2 pH
— Battery:	4 x 1.4 V (DURACELL MP 675H or equivalent)
— Battery life:	1,000 hours
— Operating temperature:	0 to 50° C (32°F to 122°F)
— Size (L x W x H)	6" x 1-1/4" x 3/4"
— Calibration:	By offset trimmer
— Weight:	2.3 oz

Operating Information:

- Remove protective cap (figure 1).
- Turn on pHep by ON-OFF switch located on top (figure 2).
- Dip pHep in solution up to immersion level (figure 1). Under no circumstances immerse above display level.
- Stir gently and wait a few seconds. If electrode is dry wait a bit longer.
- When not in use, switch off pHep and replace protective cap.
- Large differences in readings of pH (±0.5 pH) could be due to dry electrode or run-down batteries. To improve performance leave pHep up to immersion level in tap water for a few minutes at least once a week.
- To change batteries, pull out the battery case (figure 2) and replace batteries.
- To recalibrate the instrument, dip in pH 7 solution and adjust the reading if necessary by offset trimmer using a small screwdriver.

Made in Singapore

Before you begin — some tips on using the pHep

Do not be alarmed when white crystals form on the cap. This is normal with all pH electrodes.

Condition the pHep: Remove the cap and soak the sensor for at least one half hour in either a 4.0 pH or 7.0 pH buffer, or tap water. Immerse the sensor end up to the ridge (about 1 inch from the end).

Calibrate the pHep: After conditioning, you must calibrate the pHep, using a buffer solution with a value close to the solution to be measured. When measuring drinking water, for example, immerse the pHep in a 7.0 pH buffer, agitate in the buffer, and let the reading stabilize for a few seconds. Then turn the trimpot, located on the back of the meter, until the display reads 7.0 pH. Since electrode response normally changes with time, we recommend that you periodically recalibrate.

Simple maintenance: Take quick readings of aggressive solutions, heavy metals or proteins. Rinse immediately with de-ionized water to remove any residue from the electrode. In most other solutions, rinse with distilled water or even tap water if de-ionized water is not available. When storing the pHep, we recommend that you insert a small piece of white tissue or sponge in the base of the cap, wet it with the same liquid you used to condition (see above), and then replace the cap firmly. This retards leakage from the reference electrode and prolongs the useful life of the pHep. If you do not store it as recommended, repeat the conditioning soak procedure after storage of more than a week.

Applications: water conditioning, factory waste, effluent monitoring, plating rinse tanks, food processing, routine testing in schools and labs, swimming pools, aquariums and fish culture.

Cole-Parmer Instrument Company
7425 North Oak Park Avenue, Chicago, Illinois 60648
Phone 1-312-647-7600 or Toll-free 1-800-323-4340

5

6

Oxygen Meter, Model 51B, YSI, A low cost, high accuracy, battery-operated instrument ideal for field work in either fresh or salt water. It indicates dissolved oxygen directly over a 0-15 mg/l range within a temperature range of -5° to +45° C with an accuracy of ±0.2 mg/l or better at calibration temperature. Temperature measurement accuracy is to ± 0.6° C. The oxygen scale is readable to 0.1 mg/l; the temperature scale to 0.25° C. Response time typically for temperature and dissolved oxygen readings is 90% in ten seconds at 30° C constant temperature. Operation is very simple; just dial in the local altitude and water salinity, adjust for ambient temperature, and you're ready to measure. Uses four disposable "C" size zinc batteries which provide approximately 1000 hours of operation. Order probes, calibration chamber and probe service kit separately.

III. Calibration

The operator has a choice of three calibration methods — Winkler Titration, Saturated Water, and Air. Experience has shown that air calibration is quite reliable, yet far simpler than the other two methods. The three methods are described in the following paragraphs.

Winkler Titration

1. Draw a volume of water from a common source and carefully divide into four samples. Determine the oxygen in three samples using the Winkler Titration technique and average the three values. If one of the values differs from the other 2 by more than 0.5 mg/l, discard that value and average the remaining two.
2. Place the probe in the fourth sample and stir.
3. Read temperature of calibration sample and set solubility dial to sample temperature. Observe correct salinity. Allow the probe to remain in the sample at least two minutes before setting temperature.
4. With switch in READ O_2 position, set CALIB O_2 Knob to the average value determined in Step 1. Leave in the sample for an additional two minutes to verify stability.

Saturated Water

1. Air saturate a volume of water (300-500cc) by aerating or stirring for at least 15 minutes at a relatively constant temperature.
2. Place the probe in the sample and stir.
3. With the switch in the CALIB O_2 position, adjust the CALIB Knob to the mark for the local altitude. Leave probe in sample for 2 minutes to verify stability.

Air Calibration

1. Switch to CALIB O_2 position.
2. Place the probe in moist air. B.O.D. probes can be placed in partially filled B.O.D. bottles. Other probes can be placed in YSI 5075A Calibration Chamber (Refer to the following section describing CALIBRATION CHAMBER) or the small calibration bottle (the one with the hole in the bottom along with a few drops of water. The probe can also be wrapped loosely in a damp cloth taking care the cloth does not touch the membrane. Wait approximately 10 minutes for temperature stabilization. This may be done simultaneously while the probe is stabilizing.
3. With the CALIB Knob set the meter pointer to the mark for the local altitude. Be sure reading is steady. For calibration at altitudes higher than 7000 feet above sea level, see Table II. Recalibration is recommended when altitude is changed. A 1000 ft. altitude change can result in a 3% reading error — 0.3 mg/l at 10.0 mg/l.

The probe is now calibrated and should hold this calibration value for many measurements. Calibration can be disturbed by physical shock, touching the membrane, or drying out of the electrolyte. Check calibration after each series of measurements and in time you will develop a realistic schedule for recalibration. For best results when not in use, follow the storage procedures recommended for the various probes described under OXYGEN PROBES AND EQUIPMENT. This will reduce drying out and the need to change membranes.

Calibration Chamber

The YSI 5075A Calibration Chamber is an accessory that helps obtain calibrating conditions when air calibrating in the field and is also a useful tool when measuring in shallow water (less than 4 ft). As shown in Figure 9, it consists of a 4-1/2 ft. stainless steel tube (1) attached to the calibration chamber (5) and the measuring ring (7). For calibration insert the solid rubber stopper (6) into the bottom of the calibration chamber (5). Push the probe (4) through the hollow rubber stopper (3) as shown in Detail A. For maximum accuracy wet the inside of the calibration chamber (5) with fresh water. This creates a 100% relative humidity environment for calibration. Insert the probe-stopper assembly in the top of the calibration chamber.

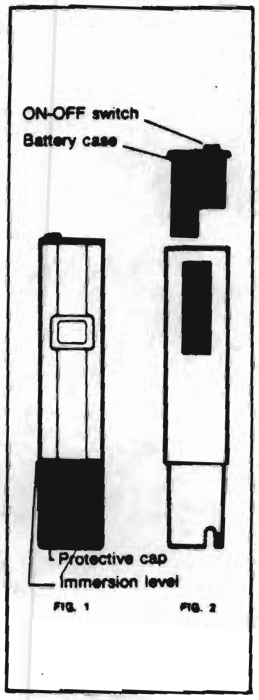
During calibration hold the calibration chamber under water and calibrate as described in the Air Calibration procedure. Keep the handle above the water at all times. After calibration the chamber can be used as a measuring aid by removing the probe-stopper assembly from the calibration chamber (5) and placing it in measuring ring (7) (See Detail C). Slowly stir the water with the wand when measuring.

7

Cole Parmer

Model 5942-00

ORP: Oxidation Reduction Potential Tester



Made in Singapore

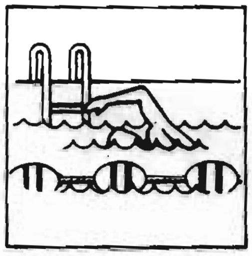
Specifications:

Range: −999 to +999 mV
Resolution: 1 mV
Battery: 4 x 1.4 (Duracell MP 675H or equivalent)
Battery life: 1000 hours (approx)
Operating temp: 0 to +50°C (32° to 122°F)
Size (LxWxH): 5.6" x 1.1" x 0.6"
Weight: 2.3 ounces

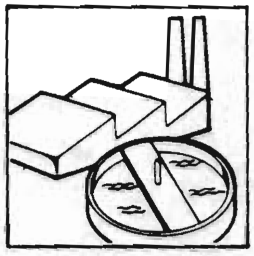
Operating Instructions:

1. Remove protective cap (figure 1). Note Salt crystal formation around cap is normal.
2. Turn on ORP by ON-OFF switch located on top (figure 2).
3. Dip ORP in solution up to but not beyond immersion level (figure 1).
4. Stir gently and wait several minutes until reading stabilizes, longer if the electrode bulb was dry.
5. When not in use, switch off ORP and replace protective cap.
6. Replace all batteries if the display becomes faint or disappears altogether, or if the accuracy deteriorates.
7. To change batteries, pull out battery case (figure 2) and replace batteries.
8. The ORP does not require calibration. If you suspect the readings, check batteries or call Cole-Parmer.

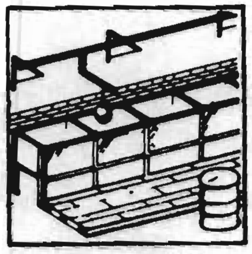
APPLICATIONS



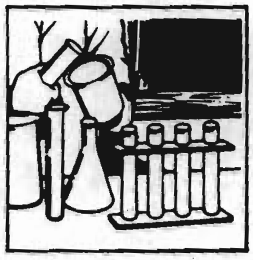
SWIMMING POOLS



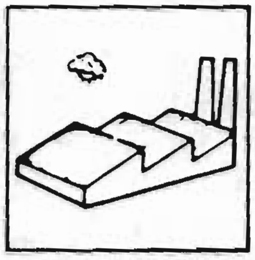
FACTORY WASTE



PLATING TANKS



SCHOOLS AND LABS



GENERAL INDUSTRY

Cole-Parmer Instrument Co.
7425 N. Oak Park Avenue
Chicago, Illinois 60648

8

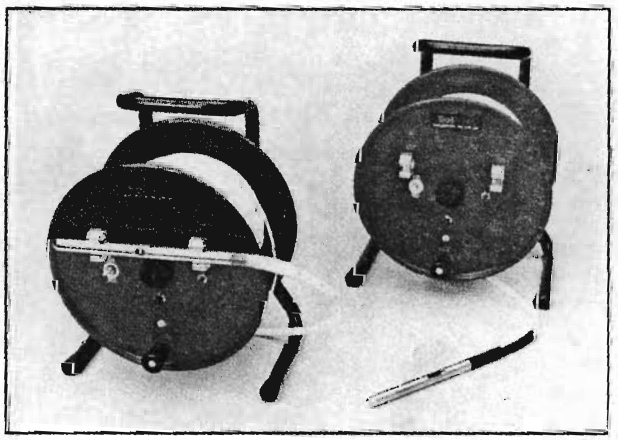
WATER LEVEL MEASUREMENTS — Solinst

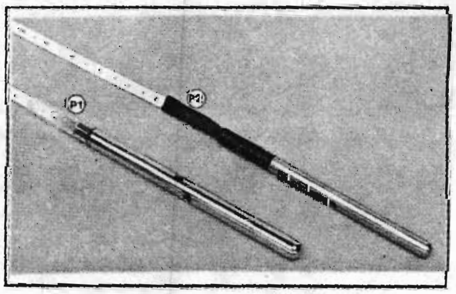
The preferred water level meter for durability, quality, and ease of operation for years has been SOLINST. The instrument most frequently used is the Model 101 with the M2 option to provide a scale in feet and 10ths of feet; with markings every 20th of a foot. The standard instrument is equipped with a nickel plated brass probe (P1 Probe), however a stainless steel probe (P2 Probe) is a popular option.

Model 101—Flat Tape Water Level Meter

For measuring the depth of water in boreholes, standpipes and wells, the Flat Tape Water Level Meter (dipmeter) is the most reliable and accurate of the Solinst Water Level Meters and is easy to operate and read.

Also available is the Model #102 Coaxial Cable Water Level Meter for use in applications with small size tubes.





P1 Regular nickel plated brass have 0.59" diam. (15mm) and are 8-1/4" long (210.0mm).

P2 316 Stainless Steel fitted with a neoprene strain relief have a 0.5" diam. (12.7mm) and are 7-1/2" long (190.5mm). It is ideal for environmentally sensitive applications.

Other Options

Indicator Signals An audible buzzer is standard equipment. However, a signal light can also be added, where background noise may be a problem.

Sensitivity Control

The standard equipment includes a sensitivity control mounted on the circuit board which can be set to suit water conductivity conditions. This control can be incorporated into the on/off switch, as a variable scale, for cases in which a variety of water conductivity conditions are encountered.

Appendix B

LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PLAN

(to be subsequently provided by selected laboratory)

Appendix C

DATA VALIDATOR SCOPE OF WORK

DATA VALIDATION SCOPE OF WORK - NYSDEC RI/FS PROGRAM

Data validation is the systematic process by which the data quality is determined with respect to data quality criteria that are defined in project and laboratory quality control programs and in the referenced analytical methods. The data validation process consists of an assessment of the acceptability or validity of project data with respect to stated project goals and requirements for data usability. Ideally, data validation establishes the data quality in terms of project data quality objectives. Data validation consists of data editing, screening, checking, auditing, certification, review, and interpretation. The purpose of data validation is to define and document analytical data quality and determine if the data quality is sufficient for the intended use(s) of the data. In accordance with DEC requirements, all project data must be of known and acceptable quality. Data validation is performed to establish the data quality for all data which are to be considered when making project decisions. Laboratories will be required to submit results which are supported by sufficient back-up data and QA/QC results to enable the reviewer to conclusively determine the quality of data.

DUTIES AND QUALIFICATIONS OF A DATA VALIDATOR

In order to ensure an acceptable level of performance, the following qualifications and requirements are established for all consultants/contractors functioning as data validators. These qualifications and requirements shall apply whether the consultant/contractor is: a) retained directly through contracts executed by this agency; b) retained as a subcontractor to a consultant functioning under contracts executed by this agency or c) retained by a responsible party functioning under the guidance and direction of an order on consent. Consultant/Contractor functioning as a data validator shall be independent of the laboratory generating the data.

The consultant/contractor functioning as a data validator shall provide evidence that all staff members involved in the data validation process have: a) a bachelors degree in chemistry or natural sciences with a minimum of 20 hours in chemistry; b) one (1) year experience in the implementation and application of the protocol(s) used in generating the data for which they are responsible. The successful completion of the EPA Data Validation Training Course may be substituted for the analytical experience requirement. In addition, these same staff members must have a minimum of one (1) year experience evaluating CLP data packages for contract and protocol compliance.

The consultant must provide the resume of the proposed third party data validator along with a recent data validation report prepared by that validator for review and approval by the Division of Hazardous Waste Remediation Quality Assurance Officer.

The independent data validator is also required to meet with a data validator of the Quality Assurance Section prior to reviewing the first data package.

Consistent with the Division's Quality Assurance Program Plan, all laboratory data generated in support of any investigation, remediation or monitoring activity carried out under the Division's program responsibility shall be developed under the administrative and operational control of a Quality Assurance Project Plan (QAPjP). To this end the QAPjP shall become an integral part of the Project Work Plan and those portions that pertain to the development and production of analytical data shall define the task of the laboratory charged with developing and producing this data. The QAPjP, as part of the Project Work Plan shall include the following information:

1. The number and types of samples that are to be analyzed.
2. The sample holding times that must be observed and the time from which these holding times shall be measured.
3. The list of analytes to be identified and quantified during the analytical process.
4. The site specific limits of concern for each of the analytes listed in each of the matrices to be sampled.
5. The matrix specific method detection limits that must be obtained for each of the analytes and matrices listed (this value should be in the neighborhood of 1/5 the site specific limit of concern).
6. The analytical protocols that shall be employed including any special handling or cleanup procedures that may be required.
7. The frequency and types of any required quality control samples e.g., trip blanks, rinse blanks, replicates, matrix spikes and matrix spike duplicates.
8. The identification of any critical samples and any special analytical treatment that they may require.
9. The required deliverables and supporting documentation where these differ from or are not a part of the required analytical protocols.

In order to facilitate the data validation process, copies of the project Work Plan, Quality Assurance Project Plan (addressing the above referenced nin points of information), together with the project required deliverables and supporting documentation, and laboratory subcontract shall be submitted to the firm contracted to carry out the data validation portion of the standby contract.

Task I: Completeness

The Validator shall review the data package to determine completeness. A complete data package will consist of the following eight (8) components:

1. All sample chain of custody forms.
2. The case narrative(s) including all sample/analysis summary forms*.
3. Quality Assurance/Quality Control summaries including all supporting documentation.
4. All relevant calibration data including all supporting documentation.
5. Instrument and method performance data.
6. Documentation showing the laboratory's ability to attain the contract specified method detection limits for all target analytes in all required matrices.
7. All data report forms including examples of the calculations used in determining final concentrations.
8. All raw data used in the identification and quantitation of the contract specified target compounds.

*These forms appear as an addendum to the NYSDEC CLP forms package and will be required for all data submissions regardless of the protocol requested.

All deficiencies in the requirement for completeness shall be reported to the consultant immediately. The laboratory shall be contacted by the consultants QAO and shall be given ten (10) calendar days to produce the documentation necessary to remove the deficiencies.

Task II: Compliance

The Validator shall review the submitted data package to determine compliance with those portions of the work plan that pertain to the production of laboratory data. Compliance is defined by the following criteria.

1. The data package is complete as defined in Task 1 above.
2. The data has been produced and reported in a manner consistent with the requirements of the QAPjP and the laboratory subcontract.
3. All protocol required QA/QC criteria have been met.

4. All instrument tune and calibration requirements have been met for the time frame during which the analyses were completed.

5. All protocol required initial and continuing calibration data is present and documented.

6. All data reporting forms are complete for all samples submitted. This will include all requisite flags, all sample dilution/concentration factors and all premeasurement sample cleanup procedures.

7. All problems encountered during the analytical process have been reported in the case narrative along with any and all actions taken by the laboratory to correct these problems.

The data validation task requires that the Validator conduct a detailed comparison of the reported data with the raw data submitted as part of the supporting documentation package. It is the responsibility of the Validator to determine that the reported data can be completely substantiated by applying protocol defined procedures for the identification and quantitation of the individual analytes. To assist the Validator in this determination the following documents are recommended; however, the EPA Functional Guidelines will be used for format only. The specific requirements noted in the Project Quality Assurance Project Plan are prerequisite, for example holding times or special analytical project needs, to those noted in the Functional Guidelines.

1. The particular protocol(s) under which the data was generated e.g., NYSDEC Contract Laboratory Protocol; EPA SW-846; EPA Series 500 Protocols.

2. Data validation guidance documents such as:

   a. "Functional Guidelines for Evaluation Inorganic Data" (published by EPA Region 2).

   b. "Functional Guidelines for Evaluation Organics Analyses" Technical Directive Document NO. HQ-8410-01 (published by EPA).

   c. "Functional Guidelines for Evaluating Pesticides/PCB's Analyses" Technical Directive Document NO. HQ-8410-01 (published by EPA).

   NOTE: These documents undergo periodic revision. It is assumed that the selected firm will have access to the most current applicable documents and guidelines.

The Validator shall submit a final report covering the results of the data review process. This report shall be submitted to the Project Manager or his designee and shall include the following:

1. A general assessment of the data package as determined by the accomplishment of Tasks I-II above.

2. Detailed descriptions of any and all deviations from the required protocols. (These descriptions must include references to the portions of the protocols involved in the alleged deviations).

3. Any and all failures in the Validator's attempt to reconcile the reported data with the raw data from which it was derived. (Again, specific references must be included). Telephone logs should be included in the validation report.

4. A detailed assessment by the Validator of the degree to which the data has been compromised by any deviations from protocol, QA/QC breakdowns, lack of analytical control, etc., that occurred during the analytical process.

5. The report shall include, as an attachment, a copy of the laboratory's case narrative including the DEC required sample and analysis summary sheets.

6. The report shall include an overall appraisal of the data package.

7. The validation report shall include a chart presented in a spread sheet format, consisting of site name, sample numbers, data submitted to laboratory, year of CLP or analytical protocol used, matrix, fractions analyzed, e.g., volatiles, semi-volatiles, Pest/PCB, Metals, CN. Space should be provided for a reference to the NYSDEC CLP when non compliancy is involved and a column for an explanation of such violation. (See attached form)

oup #	Date	CLP Year	Sample No.	Matrix	VOA Compliancy	BNA Compliancy	Pest/PCB Compliancy	Metals Compliancy	CN	Total Phenols	Page No. in the CLP	Non-Compliancy