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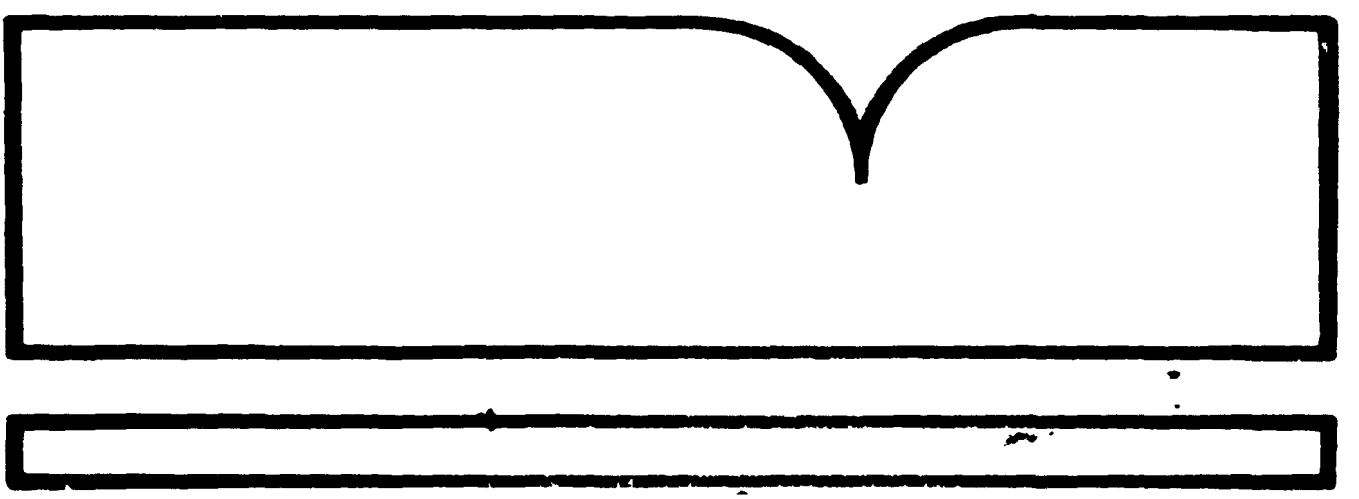
Benzyl Chloride Survey Report at the Monsanto Industrial Chemicals Company Bridgeport, New Jersey

Stanford Research Inst.
Menlo Park, CA

Prepared for

National Inst. for Occupational Safety and Health, Cincinnati, OH

5 Nov 76



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An industrial hygiene survey was conducted at Monsanto Industrial Chemical Company (SIC-2869) in Bridgeport, New Jersey on October 6, 1976 to determine if a more detailed survey were needed to quantify worker exposure to benzyl-chloride (100447). The facility had extensive medical and safety programs and provided all necessary personal protective equipment for its 170 employees. A total of 20 employees worked directly with benzyl-chloride. These workers were not fully evaluated to determine job function dose. Atmospheric samples contained benzyl-chloride concentrations of less than detectable to 1.25 parts per million. The author concludes that there are background concentrations of benzyl-chloride at this facility, but that short term high exposure may be possible during certain processes.

17. Document Analysis a. Descriptors

Field-study, Organic-solventw, Chemical-processing-workers, Health-surveys, Air-quality-measurement, Industrial-health, Chemical-exposures, Industrial-processes

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STANFORD RESEARCH INSTITUTE
MENLO PARK, CALIFORNIA 94025
(415) 326-6200

MONSANTO INDUSTRIAL CHEMICALS COMPANY

BRIDGEPORT, NEW JERSEY

BENZYL CHLORIDE SURVEY REPORT

of the plant contact

October 6, 1976

Prepared by: Joel M. Cohen
Industrial Hygienist

Approved by: Henry M. Taylor, Jr.
Senior Industrial Hygienist
Project Leader

November 5, 1976

Center for Occupational and Environmental Safety and Health

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MONSANTO INDUSTRIAL CHEMICALS COMPANY

DELAWARE RIVER PLANT

Table of Contents

I. INTRODUCTION AND RECOMMENDATION

The purpose of this evaluation is to determine if a more detailed industrial hygiene survey to quantify worker exposure to benzyl chloride is justified, and if it would be meaningful to characterize functional job exposures to the chemical. The focus of this survey report is upon work practices which relate to benzyl chloride and probable background levels of this chemical during production.

A chemical plant located in Bridgeport, New Jersey was visited during October 6, 1976 to conduct a preliminary industrial hygiene and epidemiologic evaluation. This plant has a continuously operating manufacturing facility for benzyl chloride, and two operations which use benzyl chloride to produce a plasticizer and a specialized solvent. These two use areas operate continuously and on an intermittent batch basis.

Preliminary determination of background airborne benzyl chloride levels in the three areas with a TLV Sniffer, Century Analyzer, and Miran Analyzer indicate lower concentrations of benzyl chloride. These levels are shown in the Appendix along with the charcoal detector tube sampling results.

It was reported that approximately twenty employees may be exposed to benzyl chloride from a total plant population of 170 persons. Those employees who take samples of benzyl chloride for the various "quality control" sampling points may have the opportunity to be exposed to appreciable levels of benzyl chloride for short durations of time. The additive affect of this exposure upon the workers' total dose was not evaluated. Furthermore, other operations, such as drumming, tank car loading, and various mechanic and laboratory job functions were not fully evaluated to the extent that job function dose could be determined.

In light of the initial (background level) sampling results and number of employees that may be exposed to higher levels (intermittently) of benzyl chloride, it is recommended that a more detailed industrial hygiene survey will be necessary to properly characterize job function exposures to benzyl chloride. This evaluation should include personnel monitoring.

II. EVALUATION

A. Walk Through

A survey of benzyl chloride manufacturing and two separate benzyl chloride use areas was conducted at the Monsanto Industrial Chemicals Company plant located in Bridgeport, New Jersey. The site is a multi-chemical production plant that occupies 450 acres of land. Approximately 100 acres of the 450 acres of land are devoted to production with the balance of land having been left undisturbed. Surrounding the facility are agricultural and industrial properties.

Prevailing winds are from the southwest. A water reuse facility, including a cooling tower, is located on the plant property. Water is available from wells.

The plant has extensive medical and safety programs. Pre-employment and annual physicals are required of all workers, regardless of age. Three physicians working out of their private offices administer the physicals. Biological testing, including blood and urine analysis, is performed, under contract with a special medical service. The medical service administers all the required tests from a mobile van brought to the plant property. There are also two men working per shift trained in first aid. Cigarette smoking is not permitted anywhere in the production area. Specially designated areas are provided for smoking.

Monsanto requires that each employee wear Monsanto supplied work clothing, safety shoes, safety glasses, and hardhats. When the specific job demands, additional personal protective equipment such as goggles, rubber gloves and aprons, and respirators are supplied. Respirators are available for higher risk exposures which might occur such as during system breakdowns. Depending on the risk, respirators used will vary in type from a cannister type to Scott Air Packs.

The total plant employs 170 workers of which 100 are hourly employees. The plant is in operation seven days a week. Employees

rotate work through three shifts in two week cycles working an average of 46 hours per week. There is no labor union at this plant.

On the average, there are 10 to 12 contract workers on the plant site on any given day. These contract workers do not have jobs that are fixed in one work area of the plant and may work in several different production areas throughout the workweek.

A continuously operating manufacturing facility for benzyl chloride, and two use areas are located on this plant site. The two use areas operate on a continuous and intermittent batch basis producing a plasticizer and a specialized solvent, respectively. The facilities that produce benzyl chloride and the plasticizer were constructed in 1961 and the solvent facility was built in 1972. This second use area is somewhat removed from the other benzyl chloride areas which are adjacent to each other.

Benzyl chloride is used in the first use area in the production of the plasticizer, benzyl phthalate. This facility is adjacent to the benzyl chloride manufacturing facility. Both of these facilities are in a single, relatively open structure. The second use area produces a specialized solvent intermittently on a batch basis. This production facility is located on the second floor of a partially enclosed structure. On the average, this operation uses benzyl chloride about four months per year. Also, each product run takes about two weeks to complete. The published total capacity of the benzyl chloride production plant is 75 million pounds a year. It was estimated that normal operation is somewhat less than published capacity.

It was reported that a total of twenty employees (three operators and two chief operators per shift) work within the three benzyl chloride areas. Of the three operators; one is required to work in the manufacturing area, one in the first use area, and one in the second use area per shift. The usual exposure duration reported for these employees to benzyl chloride within the operating area is four hours per shift.

The chief operators have a potential exposure to benzyl chloride of about one-half hour per shift within the operating area. First level supervisors (one in the manufacturing and first use area, and one in the second use area) also have a limited exposure to benzyl chloride comparable to the exposures received by the chief operator. There are also 30 mechanics who each average 3.7 hours per week in the benzyl chloride departments. In addition to the mechanics and operators, there are also three material handlers (called utility operators) which have a limited exposure to benzyl chloride of about six hours per week. Contract labor is periodically used in the benzyl chloride use and production areas.

Monsanto produces benzyl chloride by the photo-chlorination of toluene. Toluene and chlorine are pumped to the manufacturing area from a storage tank and rail car, respectively. The two chemicals (toluene and chlorine vapor) are then reacted in the chlorinators to produce crude benzyl chloride. The chlorinators also contain a quantity of unreacted toluene and benzal chloride. The effluent gas is cooled and removed while the condensate is recycled back to the chlorinators. Concurrently, benzyl chloride and unreacted toluene are piped to the stipper which separates the crude benzyl chloride from the toluene. Toluene is then cooled and also recycled back to the chlorinators while the crude benzyl chloride is sent to the two refining columns. After the refinement process the end product is cooled and piped to one of the two storage tanks. Some benzyl chloride residue exists in the refining columns which is pumped out to the disposal area (see Appendix).

Benzyl chloride is piped to the first use area from one of the two storage tanks beside the facility. It is then charged with other chemicals in one of the reactors to produce benzyl phthalate. The final product is sampled at the reactor mass point two times per shift. It was reported that at this sampling point, an insignificant quantity of benzyl chloride is present in the stream.

The second use area combines benzyl chloride with other raw materials in a single glass-lined reactor to produce a specialized

solvent. It takes about one hour to add all the needed raw materials for this process. Benzyl chloride is piped to the area from a storage tank near the first use area. This operation is intermittent and operates on a batch production basis. New batches can be started through the system every few hours. In general, this facility uses benzyl chloride about four months a year. A quality control sample is taken by plant personnel at the end of each batch, i.e., about five samples per day. During the walk-through survey, this area was not operating due to a system malfunction.

A benzyl chloride drumming operation was also surveyed briefly. In this operation, one worker fills as a daily peak average about 50 drums with benzyl chloride. Drumming is conducted only on the day shift. Working near the center of a one floor enclosed structure, with full width doors on each side of the complex (during the visit these doors were open), the employee places a skid load of empty drums upon a scale and inserts the benzyl chloride feed hose into one of the drum bung openings. The worker then places a four inch diameter flexible exhaust hose next to the drum filling point. This point of source exhaust system draws about 1200 cubic feet of air per minute to an eight foot, four inch diameter stack atop of the building. The worker releases the benzyl chloride fluid flow until the drum reaches full weight. The feed hose is then turned off, the hose is removed from the drum opening and is topped off with an inhibitor. The inhibitor extends the shelf life of the benzyl chloride which is unstable if contaminated with iron from the bung opening in the heresite drum. The iron and benzyl chloride can cause a Friedel-Crafts type condensation. The evolving hydrogen chloride from the reaction increase the pressure within the drum.

The potential for benzyl chloride exposure exists whenever a quality control sample is taken from the "closed-loop" process. Essentially, taking a sample entails an operator placing a sample container under a valve/spout and releasing its flow. Once a sufficient quantity of sample has been obtained, the valve is turned off. A list of the

number of quality control samples taken by the operators during each shift, and the location of the sampling points in the manufacturing facility is shown in the Appendix.

B. Discussion

The three operations described above manufactures and uses benzyl chloride in the production of benzyl phthalate and a specialized solvent. The manufacturing facility operates continuously and the two use areas operate continuously and intermittently on a batch basis. Both use areas are fed benzyl chloride from two storage tanks near the benzyl chloride manufacturing area.

Approximately twenty persons, not including maintenance, laboratory personnel, material handlers, and first level supervisors may be exposed to benzyl chloride. These workers were not fully evaluated to the extent of determining job function dose.

A Miran IA Infrared Spectrophotometer, Century System Total Organic Vapor Analyzer, and TLV Sniffer (combustion meter) were used as primary sampling instruments along with employing Bendix monitoring pumps with charcoal detector tubes to characterize environmental levels of benzyl chloride. The charcoal tube/pumps were placed in strategic locations as determined by initial walk-through readings from the TLV and Century meters. The pump locations were as follows:

- Ten feet downwind from two second floor finished goods sampling points
- On the first floor near the toluene stripper and refinery column (this location will be discussed later)
- On the center control room table in the main control room for the manufacturing and use one areas.

Both benzyl chloride use areas were checked with the TLV meter and Century Analyzer. Those locations where there seemed to be a chance for benzyl chloride exposure were investigated closely. For example, quality control sampling points and the control room were checked for the presence of concentrations of benzyl chloride. The Miran IA Infrared Gas

Analyzer was placed on the first floor of the relatively open manufacturing structure, between the gateside entrance, the toluene stripper, and refining columns. The Miran sampled from this point continuously. The Miran was adjusted to sample at the benzyl chloride specific wavelength. Data obtained from this sampling show environmental levels of benzyl chloride varied from less than detectable levels to 1.25 ppm.

The first use area was checked for the presence of benzyl chloride between the reactors, at one of the quality control sampling points. The second use area was also checked for benzyl chloride in the area around the reactor, however, this unit was not in production at the time of the survey. In both of the use areas, the TLV meter and the Century Analyzer were the only instruments used to characterize background levels of benzyl chloride.

The initial sampling results of the three areas suggest low (background) levels of airborne benzyl chloride. However, short-term high exposure levels of benzyl chloride may be possible, for example, when the operators collect a quality control sample.

APPENDIX

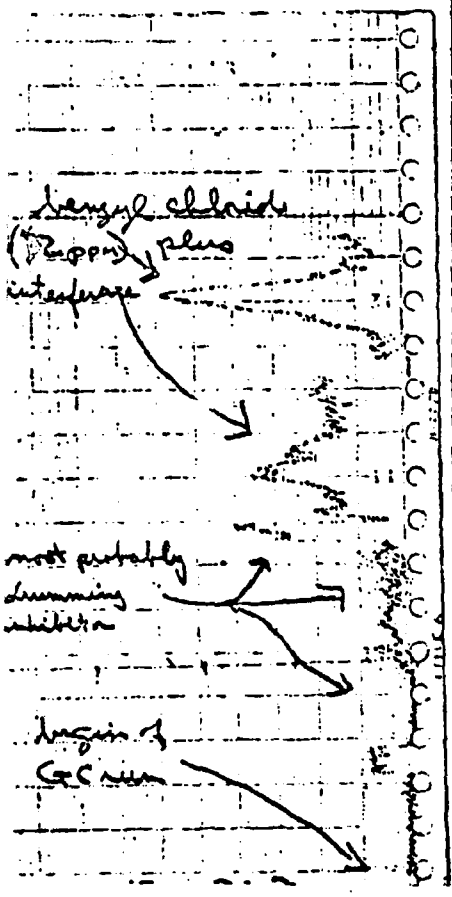
QUALITY CONTROL SAMPLING POINTS
IN THE BENZYL CHLORIDE MANUFACTURING FACILITY

Sampling Point	Number of Samples (per shift)
Toluene Feed	1
Chlorinator Mass	1
Column Feed	1
Toluene Recycle	1 (per day)
Column Bottoms (2 columns)	1 (per column)
Benzyl Chloride to Storage Tank (2 tanks)	6 (per day)
Benzyl Chloride Storage Tank	1 (per day)

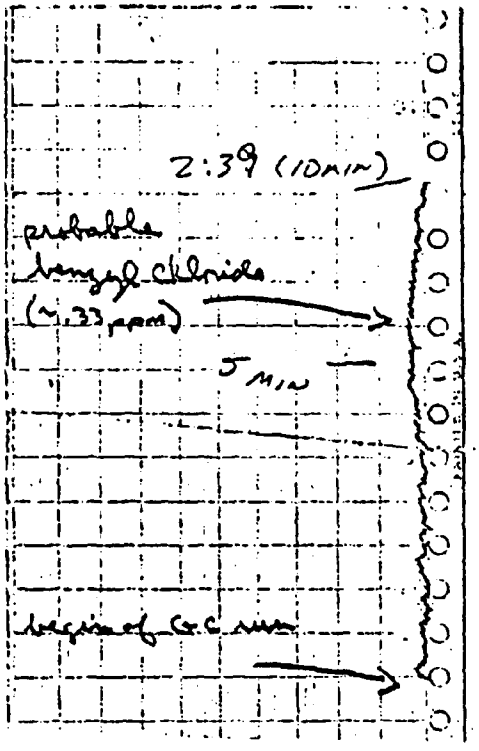
Monsanto, Bridgeport, New Jersey

Century Systems Gas Chromatographic Analyses
for Walk Through Survey Conducted October 6, 1976

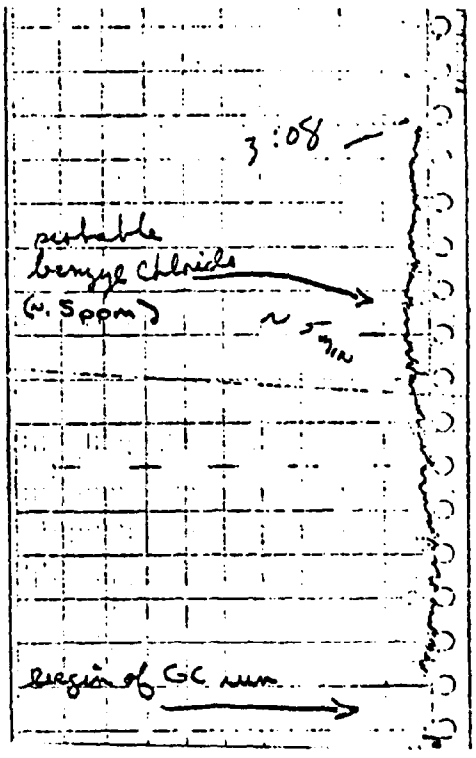
Sampling and Analysis by J. Cohen



Drumming operation
10/6/76 1150
Total Scan = 12 min.

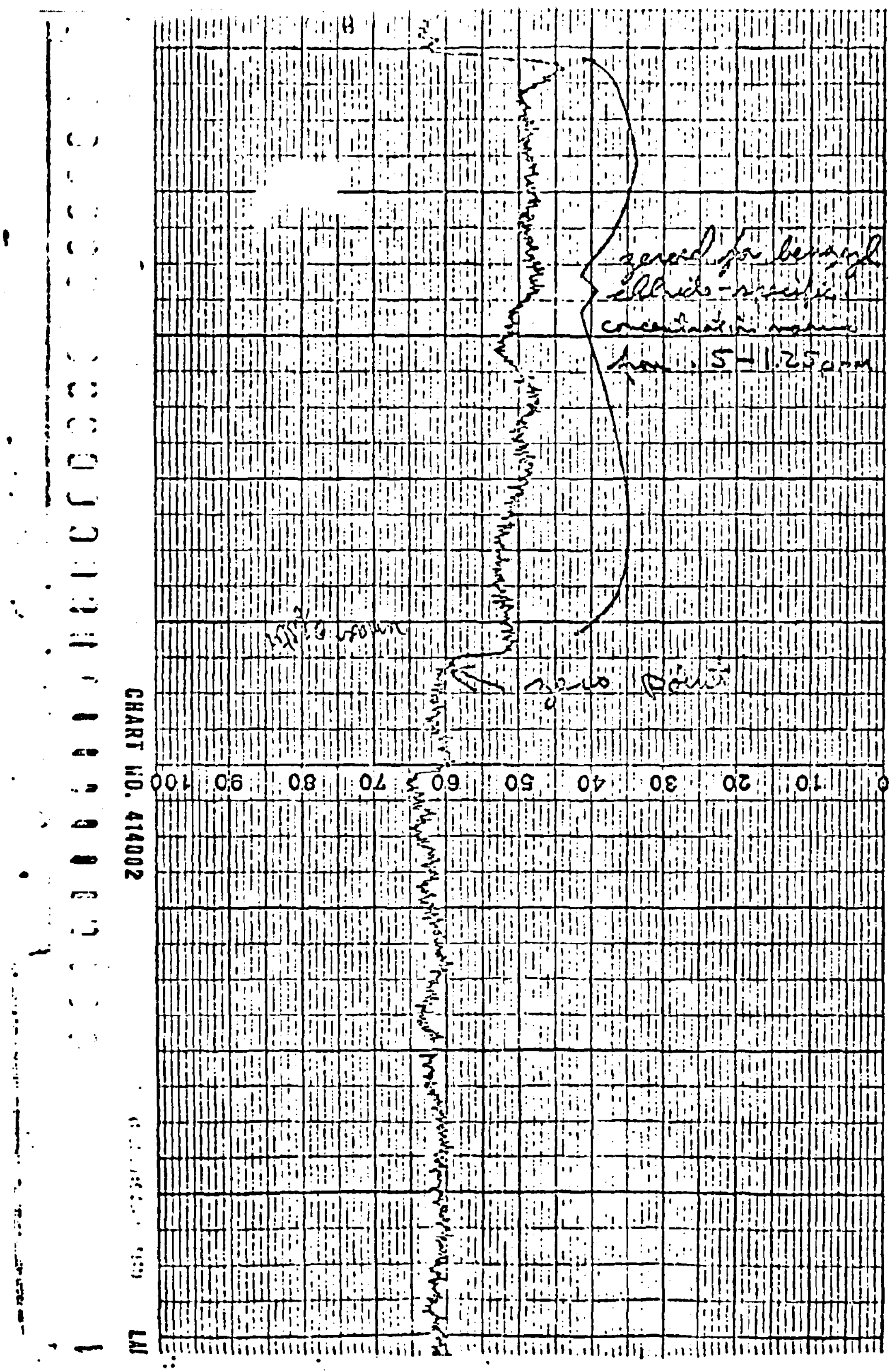


Second floor near walkway of benzyl chloride quality control sampling points
10/16/76 1430
Total Scan = 11 minutes



First floor near breathing zone of toluene stripper bottoms, quality control sampling point
10/16/76 1500
Total Scan = 11 minutes.

Note: It is incorrect to assess the exact concentration of benzyl chloride present in the working atmosphere because most levels measured were at the Century Analyzer's lower limit of detectability. However, it is possible to state with confidence that benzyl chloride was present in the working environment.



Monsanto, Bridgeport, New Jersey

Miran IA Sampling Conducted on October 6, 1976

Miran located on the first floor near the gateway entrance to the manufacturing area

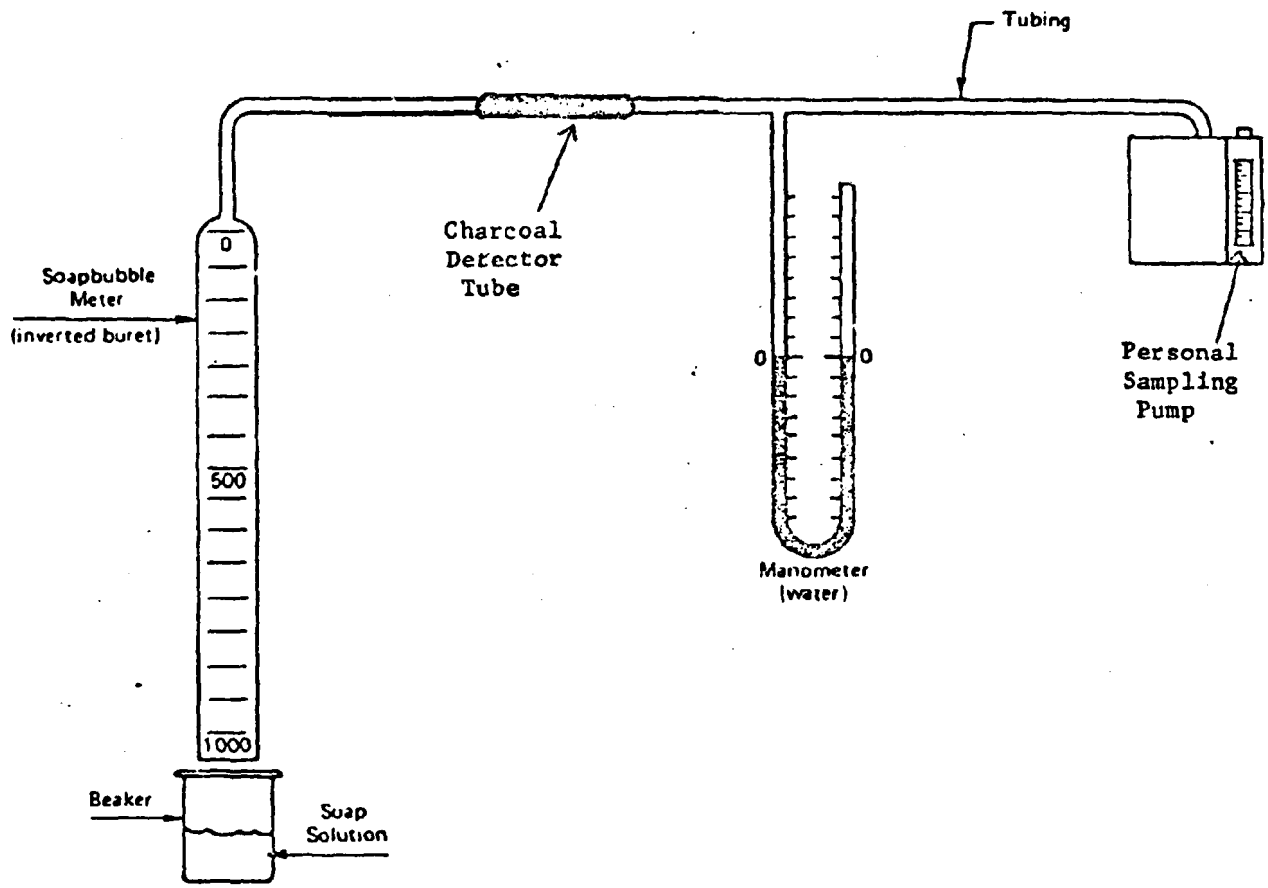
BENDIX PORTABLE SAMPLING PUMP

Principle of Operation

The Bendix BDX-44 pump provides a portable sampling source for the measurement of all dusts, gases, and vapors. The pump houses a double diaphragm pump assembly, operated by a push-button switch. Power is supplied to the pump by a nickel-cadmium battery pack. Since the normal operating flow rate for the Bendix pump is 0.5 to 3.0 liters per minute, a low flow assembly was used to reduce the flow rate such that sampling could be performed at 100-200 milliliters per minute. The low flow configuration includes an adaptor flowmeter, adaptor orifice, flow regulator/pulsation dampener assembly, and low flow flowmeter. All pumps used in the preliminary environmental sampling contained this low flow assembly.

Calibration of Bendix Pump

The calibration of the Bendix BDX-44 pump was performed with the use of a bubblemeter (buret set in an inverted position) with a charcoal tube assembly in line. Bubbles were run through the bubblemeter to thoroughly wet the walls. Special care was taken to assure that the bubble would be flat when crossing the top mark. An average of three readings were taken at each flow rate and adjusted to $\pm$ 1.5 seconds. The pumps were calibrated for 100 cc/min. and 200 cc/min. by checking the time which elapsed from 0-100 ml and 0-200 ml respectively. After returning from the field, each pump was recalibrated using the same techniques as described above and a flow rate chart was prepared to establish an average flow rate.



Taken from a NIOSH Criteria for a Recommended Standard to Chromium (VI)

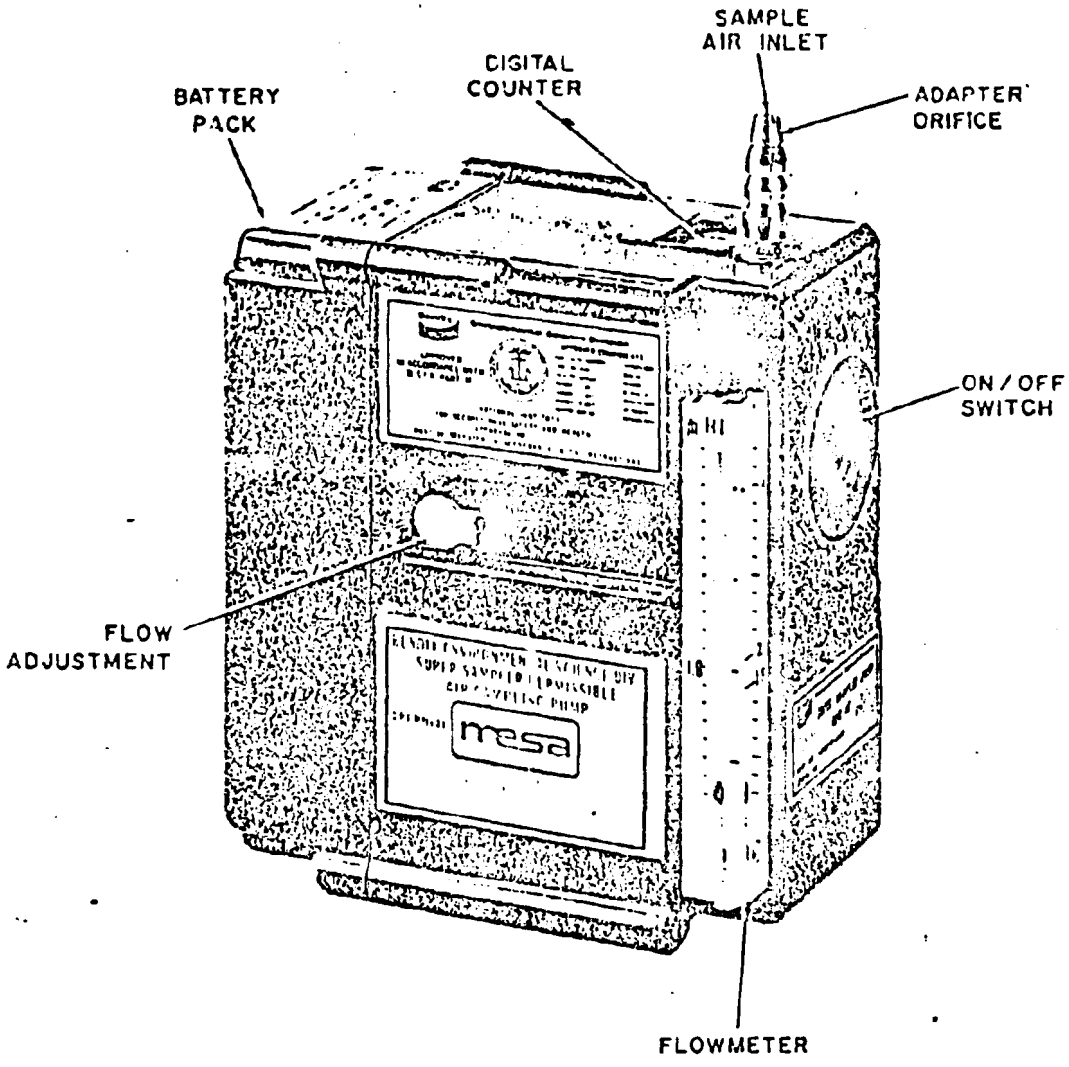


Figure 1. BDX 44 Pump

Taken from Bendix BDX-44 Operating Manual

ORGANIC SOLVENTS IN AIR

Physical and Chemical Analysis Branch

Analytical Method

Analyte:	Organic Solvents (See Table 1)	Method No:	P&CAM 127
Matrix:	Air	Range:	For the specific compound, refer to Tables I&II
Procedure:	Adsorption on charcoal desorption with carbon disulfide, GC		
Date Issued:	9/15/72	Precision:	10.5% RSD
Date Revised:	7/15/74	Classification:	See Table 1

1. Principle of the Method

   1.1 A known volume of air is drawn through a charcoal tube to trap the organic vapors present.

   1.2 The charcoal in the tube is transferred to a small, graduated test tube and desorbed with carbon disulfide.

   1.3 An aliquot of the desorbed sample is injected into a gas chromatograph.

   1.4 The area of the resulting peak is determined and compared with areas obtained from the injection of standards.

2. Range and Sensitivity

   The lower limit in mg/sample for the specific compound at 16 x 1 attenuation on a gas chromatograph fitted with a 10:1 splitter is shown in Table 1. This value can be lowered by reducing the attenuation or by eliminating the 10:1 splitter.

3. Interferences

   3.1 When the amount of water in the air is so great that condensation actually occurs in the tube, organic vapors will not be trapped. Preliminary experiments indicate that high humidity severely decreases the breakthrough volume.

   3.2 When two or more solvents are known or suspected to be present in the air, such information including their suspected identities, should be transmitted with the sample; since with differences in polarity, one may displace another from the charcoal.

A remaining description of the analytical method used by Kettering for the determination of benzyl chloride from charcoal tube samples will be provided in the final Task III report.

THE MIRAN IA GAS ANALYZER

Principle of Operation

The Miran IA Portable Gas Analyzer is a single beam, variable filter, spectrophotometer, scanning the infrared spectral range of 2.5 to 14.5 microns, in conjunction with a 5.6 liter capacity cell whose pathlength is variable from 0.75 to 20.25 meters. The device is adaptable for ambient air analysis through the use of a pump and a ten-foot sampling hose for drawing in air samples. A strip chart recorder is added to the Miran.

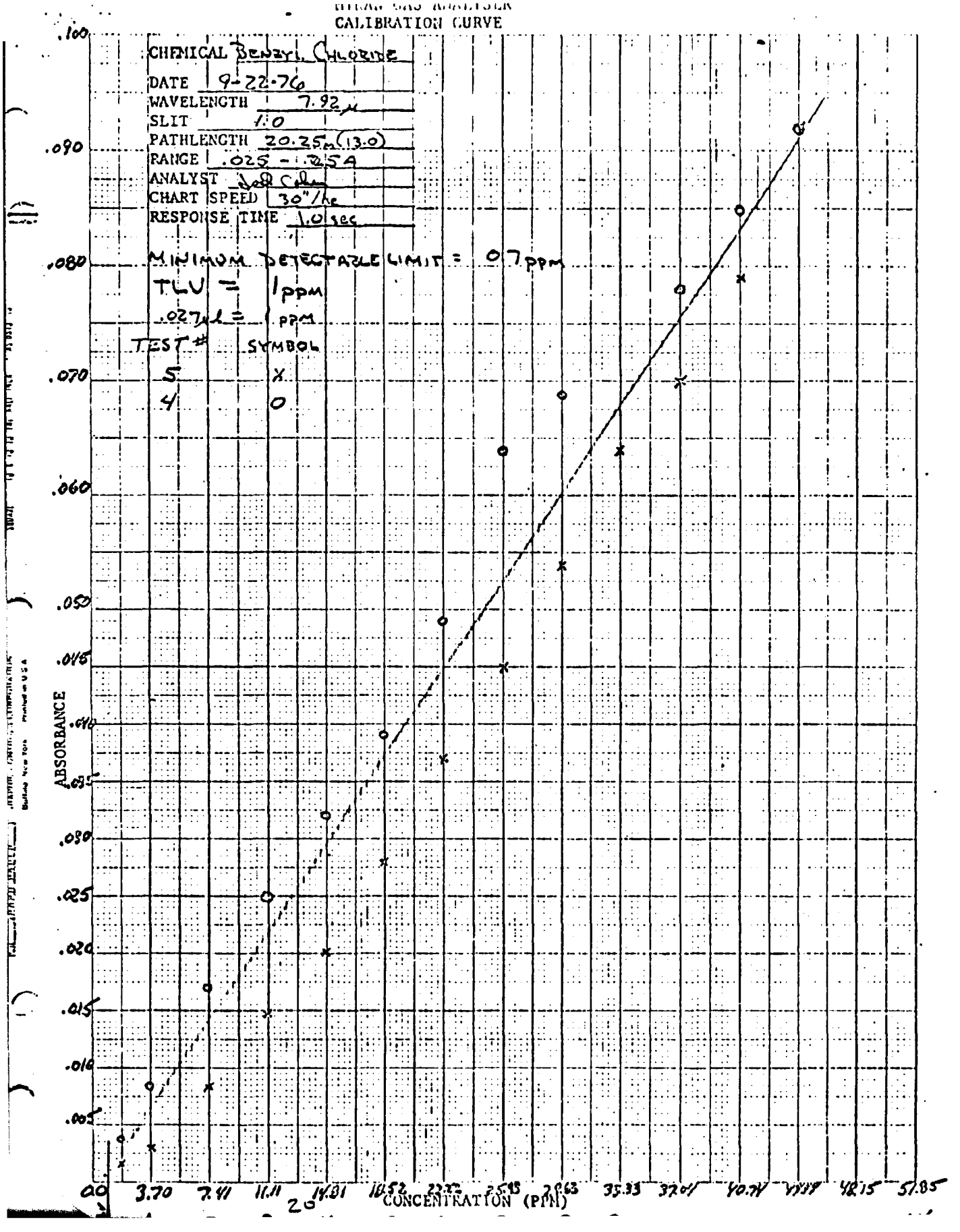
The analyzer consists of a radiation source; mirror system, mechanical chopper, circular filter, variable in three segments from 2.5 to 14.5 microns; a scanning motor; pyroelectric detector; a signal preamplifer; logarithmic range compensating circuitry; regulated power supplies; and a meter providing absorbance and percent-transmission scales; and a 0-1 volt output for use with a strip chart recorder or the Wilks digital display.

Calibration

Before actual calibration of the Miran is begun, the instrument should be purged of all contaminants by flushing the cell with filtered air. This is especially important if the Miran is used in a dirty or particulate ladden environment. An OSHA chart provides absorbance wavelength and pathlength information near the Threshold Limit Value Limits. A slit width of 1 mm is recommended for the calibration of benzyl chloride. Liquid samples were injected by syringe into the septum of a closed-loop pump. The samples were injected slowly to ensure complete vaporization. The spectrum was scanned from 2.5 to 14.5 microns. The strongest absorption wavelengths were determined by carefully rocking the wavelength dial to determine maximum absorbance. If the cell contains ambient air, carbon dioxide and water will also be present and must be taken into account by comparing the scan for benzyl chloride to a scan of air.

The cell is again flushed out of the closed-loop system with filtered air or "zero gas", through use of the Wilke "Zero Gas" filter. The slit is then closed and the analyzer function is set for percent transmittance. The instrument is again zeroed. Incremental amounts of benzyl chloride are then injected by syringe into the closed loop pumps. The step-ladder effect is observed and the absorbance noted for each increment. The meter is read according to which absorbance range is being used. At this point, it should be mentioned that the pathlength, wavelength, chart speed, slit, range and response time have been preset according to the sample.

After obtaining the complete step-ladder increments for the sample, the absorbance is converted into concentrations. A graph or Beer-Lambert plot between absorbance and concentration in ppm is constructed. From this point, the calibration procedure is considered complete. In the field it becomes possible to simply note the absorbance reading and go to the Beer-Lambert plot and determine the concentration present.


CALIBRATION CURVE
CHEMICAL Benzyl Chloride
DATE 9-22-76
WAVELENGTH 7.92 μ
SLIT 1.0
PATHLENGTH 20.25m (13.0)
RANGE .025 - .25A
ANALYST Jeff Colin
CHART SPEED 30"/hr
RESPONSE TIME 1.0 sec
MINIMUM DETECTABLE LIMIT = .07 ppm
TLV = 1 ppm
.027 A = 1 ppm
TEST # SYMBOL
5 X
4 O
ABSORBANCE
.100
.090
.080
.070
.060
.050
.040
.030
.025
.020
.015
.010
.005
.00
3.70
7.41
11.11
14.81
18.52
22.22
25.93
29.63
33.33
37.04
40.74
44.44
48.15
51.85
CONCENTRATION (PPM)

DETERMINATION OF ANALYTICAL WAVELENGTH FOR

BENZYL CHLORIDE

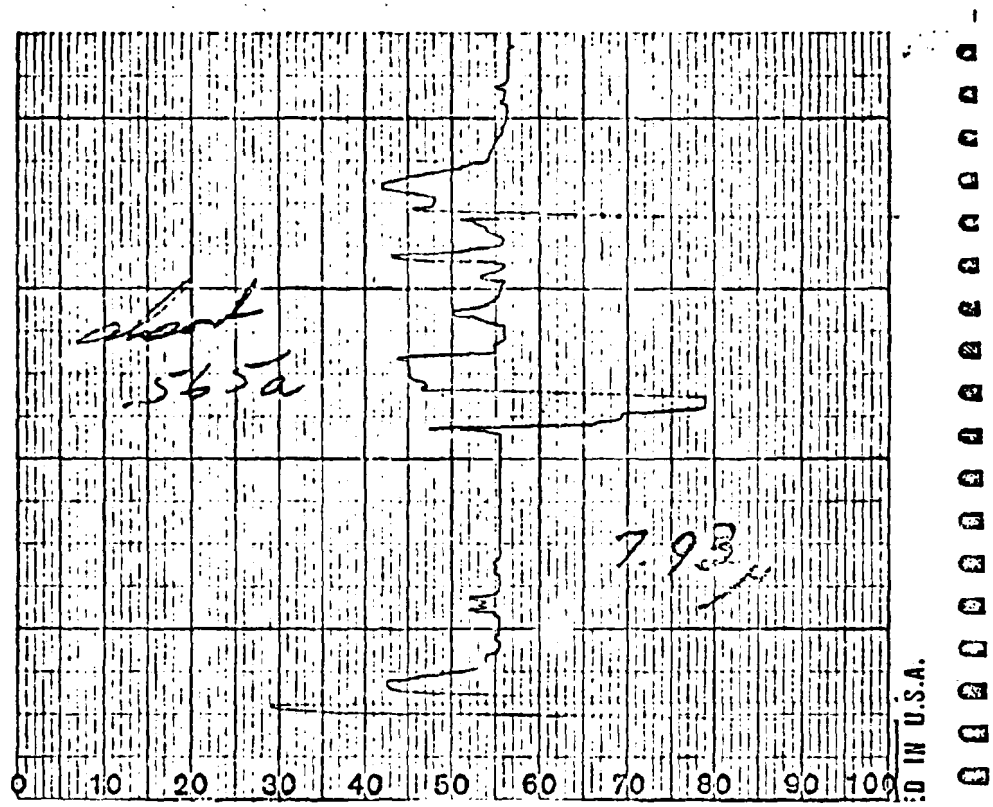
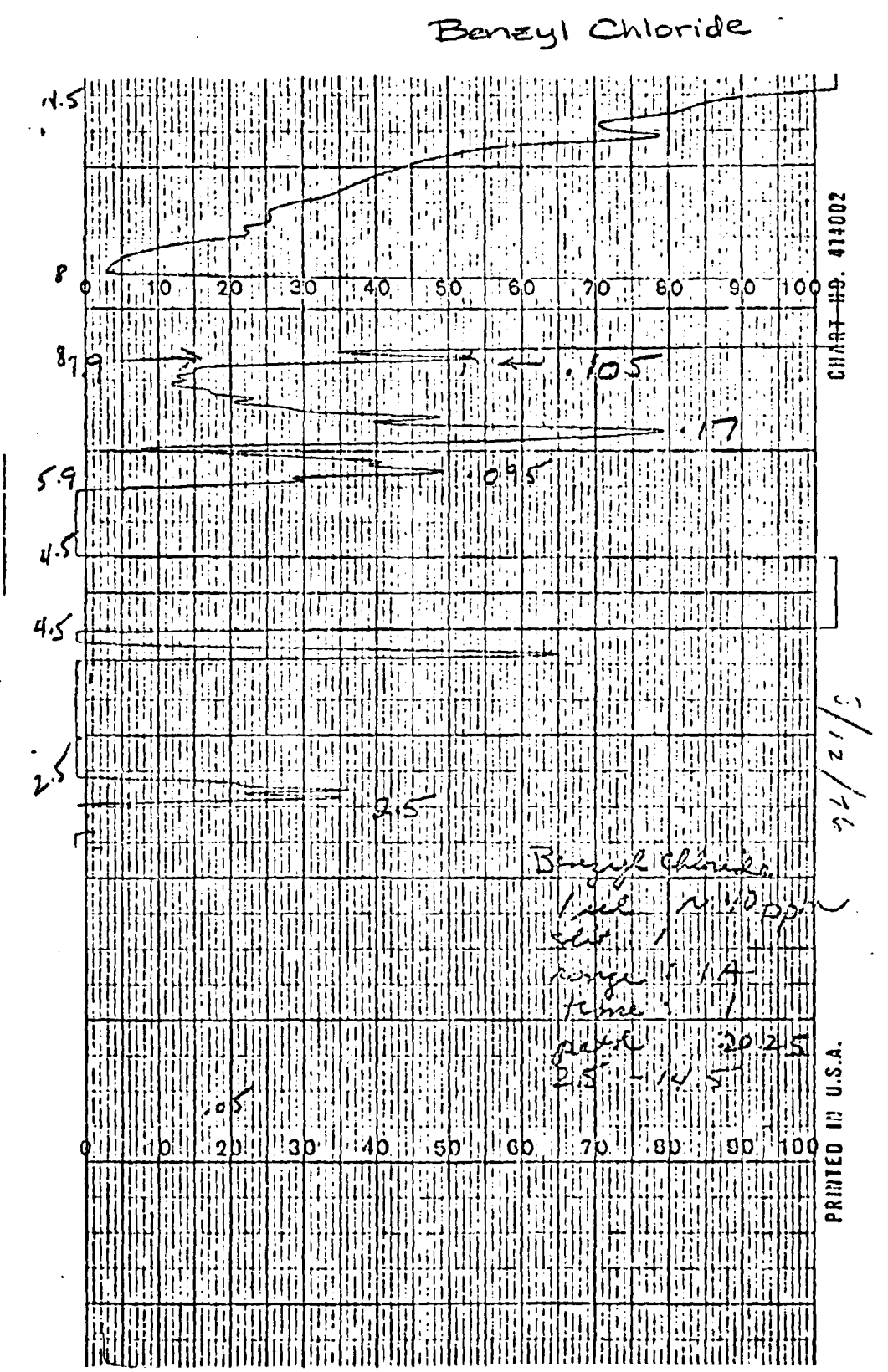


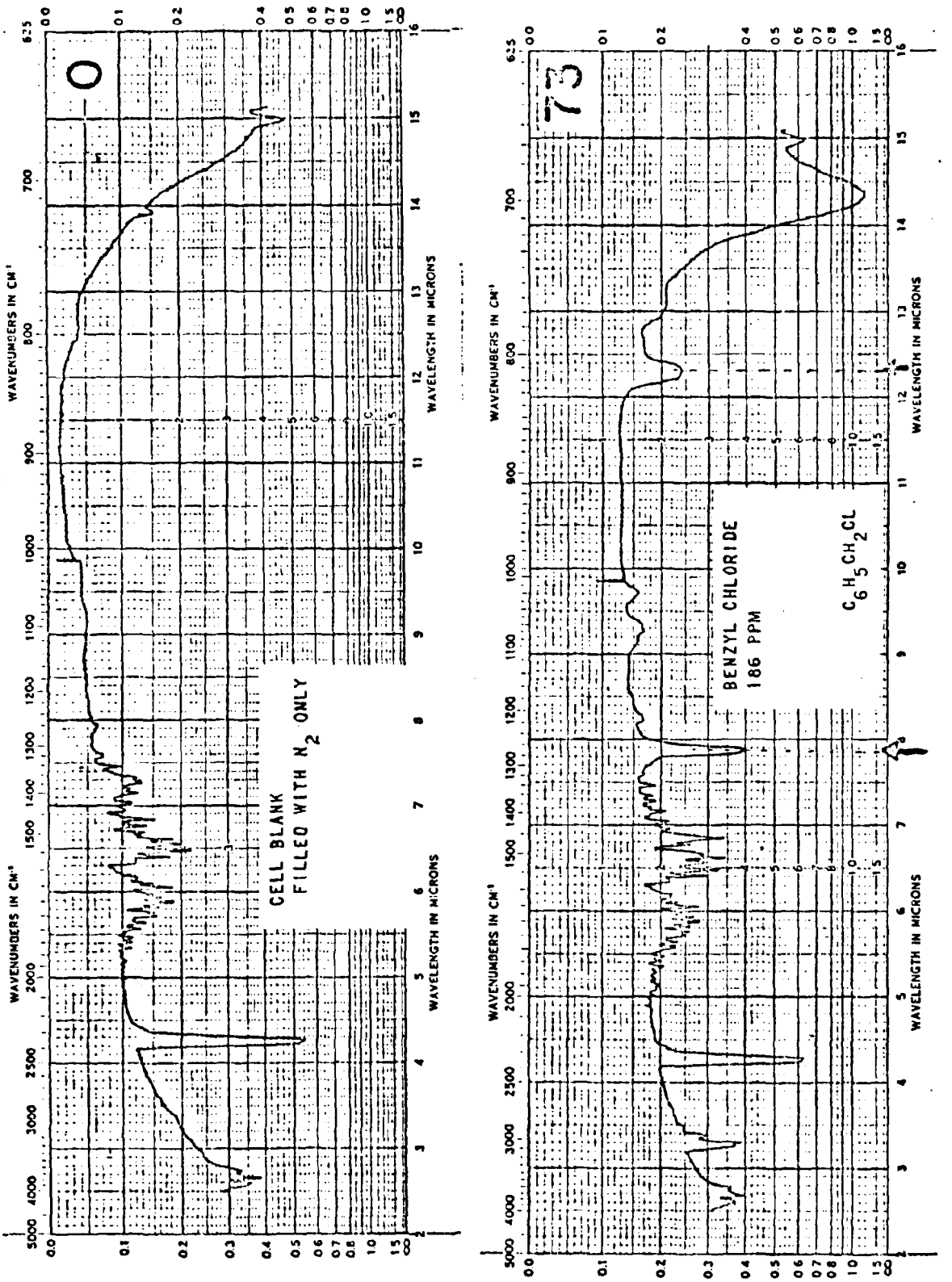
Chart Speed (in./min.)	2.0
Injection (microliters)	2.0
Pathlength (meter)	20.25
Response Time (sec.)	1.0
Absorbance Range	0.1
Slit Width (mm)	1.0
Zeroed Wavelength (microns)	4.7

CALIBRATION OF MIRAN IA FOR BENZYL CHLORIDE

INSTRUMENT SPECTRUM



SPECTRUM OF BLANK CELL AND OF BENZYL CHLORIDE



Taken from: Erley, D.S., Blake, B.H., Infrared Spectra of Gases and Vapors, Volume I-Prism Spectra 10 meter cell. Dow Chemical Company, Midland, Michigan, 1964.

TLV SNIFFER

The TLV Sniffer is a portable instrument that can detect combustible gases and vapors with a sensitivity range of from 1 to 10,000 ppm. A ppm meter located on the front panel allows for instant determination of many kinds of gases and volatile flammable vapors.

Principle of Operation

To detect and measure concentrations of combustible gas in air, the TLV Sniffer catalytically oxidizes gas in a pumped-in sample of air by means of a catalyst-coated resistance element. The resistance of this element changes with changes in heat that are proportional to the amount of oxidized gas, thereby altering the electrical balance of the catalytic element as compared to the resistance of a reference element. Both catalyst-coated ("active") element and reference element are incorporated in a Wheatstone Bridge circuit in such a way as to produce an electrical output proportional to their differences in resistance. Since any changes in air sample temperature and humidity affect both active and reference elements equally, the electrical signal output is proportional to the concentrations of combustible gas or vapor in the sample of air (expressed in volumetric terms as ppm).

Operational Functions

The TLV Sniffer has a ppm meter and range knobs allowing readings of 0-100, 0-1000, and 0-10,000 ppm. After a 10-minute warm-up, the instrument is successively zeroed at each scale range and then may be used with its hand-held attached probe to index possible hazard as readings are compared to published standard Threshold Limit Values. The TLV Sniffer is especially useful for locating hard-to-find gas leaks, with the probe moved in the direction indicated by rising meter readings to point out quickly the source of escaping gas. (Taken from Instrument Manual, TLV Sniffer, Bacharach Instrument Co.)

Bacharach J-W TLV Sniffer

The TLV Sniffer is factory-calibrated for hexane. This calibration was checked for accuracy at SRI by applying 500 ppm of commercially-bottled hexane calibration gas to the instrument's air sample intake; the appropriate gain potentiometer adjustment screw on the circuit board within the instrument was then adjusted to insure the exact reading of 500 ppm on the meter scale.

The instrument was further calibrated for benzyl chloride. This was accomplished by creating test atmospheres containing known concentrations of benzyl chloride and recording the instrument meter deflections. It has been determined that a conversion factor of 1.47 has been assigned to instrument readings of benzyl chloride. That is, the TLV meter will indicate 1 ppm for every 1.47 ppm of benzyl chloride present in the sampled air. Shown below are conversion factors for other gases and vapors.

Table 3-1. Multiplying Factors for Converting ppm Meter Readings of Hexane-calibrated Instruments to ppm Concentrations of Other Gases

Gas Detected	Factor	Gas Detected	Factor
Acetone	1.50	Methane	1.58
Acetylene	1.78	Methanol	3.71
Benzene	1.02	Methyl Acrylate	3.37
1,3. Butadiene	1.52	Methyl Chloride	3.81
Butyl Acetate	2.08	Methyl Chloroform	4.44
Carbon Disulfide	5.92	Pentane	1.04
Cyclo Hexane	1.02	Perchloroethylene	13.66
Ethyl Acetate	1.84	Propane	1.14
Ethylene Oxide	2.05	Styrene	2.25
Heptane	1.05	Toluene	1.03
Hexane	1.00	Trichloroethylene	6.40
Hydrogen	1.45	Vinyl Chloride	2.24
M.E.K.	1.60	Xylene (O)	1.64

Converting ppm Readings to Percent Level of Lower Explosive Limit (% L.E.L.)

(Taken from TLV Sniffer Operation Manual)

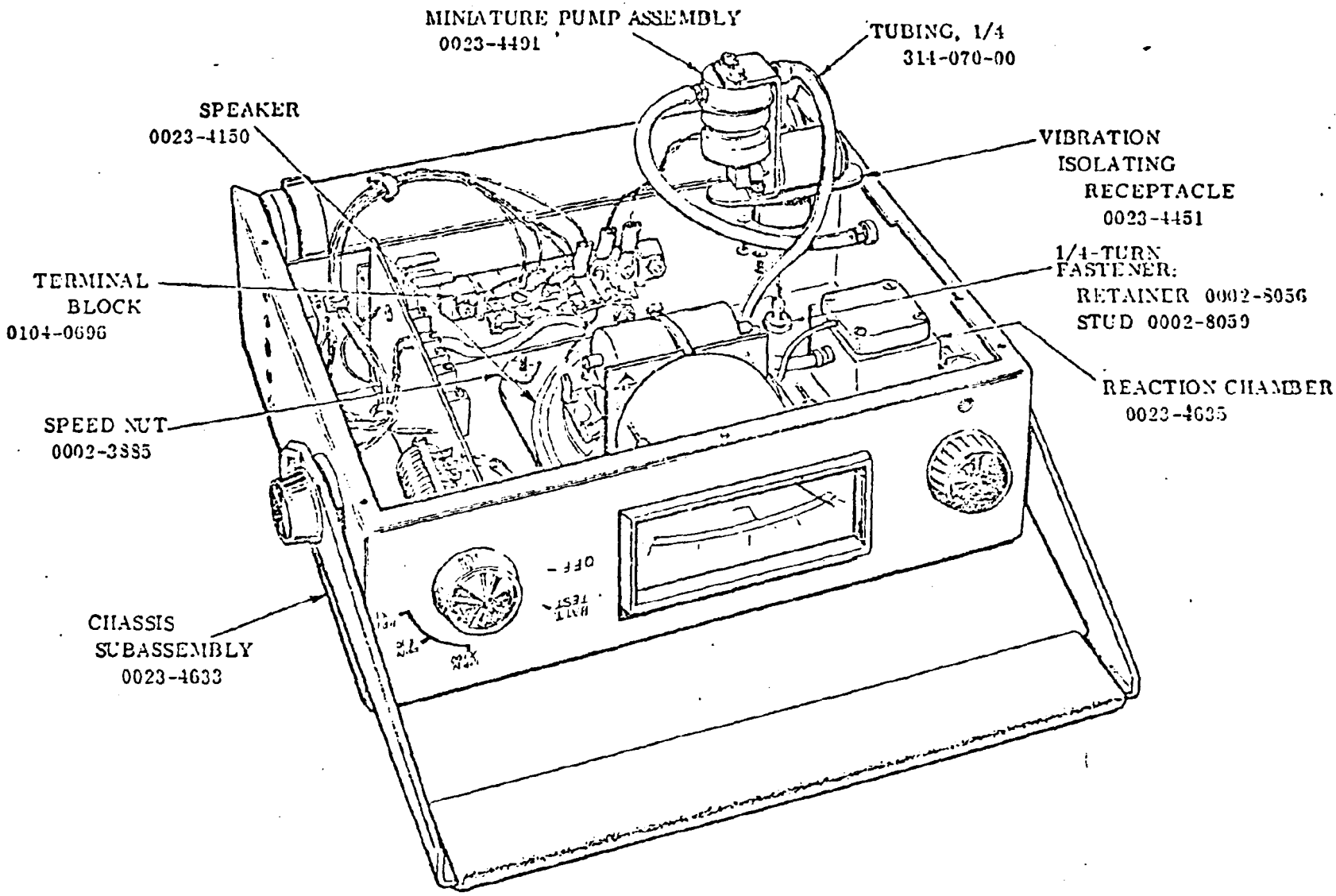


Figure 4-1. TLV Sniffer Chassis Subassembly Showing Miniature Pump Assembly in Disassembled Position

(Taken from TLV Sniffer Operation Manual)

CENTURY ORGANIC VAPOR ANALYZER

Principle of Operation

The Century Organic Vapor Analyzer is a portable instrument designed to detect organic gases and vapors with a sensitivity range of 0-1,000 ppm. The instrument utilizes the principle of hydrogen flame ionization for detection and measurement or organic vapors. The sample is drawn into the flame area by the instrument's pump. When organic compounds enter the flame, positive carbon ions are formed causing an increase in electrical conductivity of the flame. This change is detected and the output is directly proportional to the concentration of organic matter in the flame. The rate of ion generation is a function of the quantities and structure of the compounds in the sample.

Calibration of the Century Organic Vapor Analyzer

Calibration of the Century OVA-128 was performed following instructions in the manufacturer's Operating and Service Manual (pp 24-29, B12-B15). Known concentration of gases were prepared according to the method of Saltzman, "Preparation of Known Concentrations of Air Contaminants" in The Industrial Environment - It's Evaluation and Control, NIOSH, 1973 and also specified in the operating manual.

Organic Vapor Analyzer

After the required 10 minutes warm-up period, and meter zeroing has been accomplished, a sample of known concentration was drawn through the hand-held probe. The meter response was recorded. This procedure was repeated for several known concentrations appropriate to develop a calibration curve. A conversion factor was calculated using the recorded relative meter response and the known time concentration. It has been determined using the above described method that benzyl chloride has a 1.66 conversion factor.

Gas Chromatographic Mode

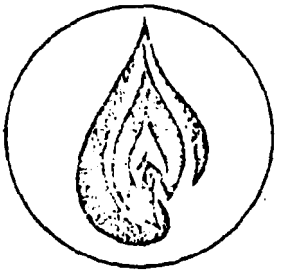
As above, a sample of known concentration is drawn into the warmed and zeroed instrument. When the meter indicates a stable reading the sample was injected into the column. Analysis of retention time and peak height was made from the strip chart recording. This procedure was replicated for several concentrations. In addition, mixtures of two gases were sampled to determine if any interference was observable. The qualitative (determined by retention time) and quantitative (peak height) vapor analysis was used to prepare charts of conversion factors and identification times.

INTRODUCTION

Century Organic Vapor Analyzers (OVA's) are highly sensitive instruments allowing detection and analysis of trace quantities of organic vapors in air. Totally portable, yet having the capability to measure concentrations to less than 0.5 PPM, the Century OVA has found wide acceptance in manufacturing, chemical, and other industries. Agencies such as OSHA and NIOSH use them. Insurance people and arson investigators find OVA's ideally suited to their needs.

The OVA takes the flame ionization detector (FID) used in the most sophisticated laboratory gas chromatographs and packages it in a 12 pound, go-anywhere instrument. A man can survey continuously for at least eight hours before refueling and battery recharging is needed.

This unique instrument is now available, fully certified by Factory Mutual, for use in Class I, Division I, and Groups A, B, C and D environments! Other domestic and foreign certifications are pending.

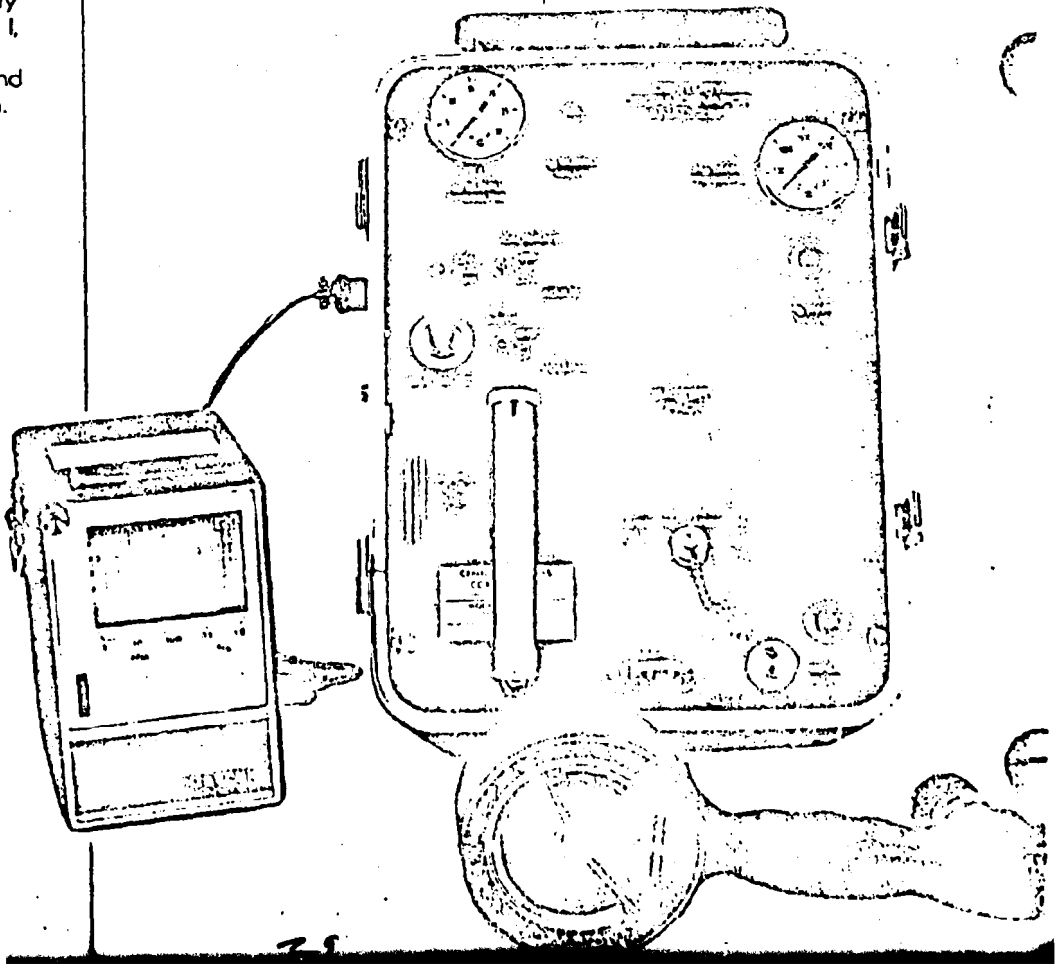


PRINCIPLE OF OPERATION

Flame ionization detectors are a precise means to detect organic vapors such as benzene, methane, styrene and vinyl chloride.

A small hydrogen flame is burned in a chamber and the sample being measured is circulated in close proximity to the flame. Carbon-containing ions are formed whenever traces of organics are present in the sample. These ions are forced to migrate to an electrode by an electrical field in the detector chamber. This results in a small current which is amplified, conditioned and then displayed on a hand-held meter or on a strip chart recorder.

The characteristics of flame ionization allow organics to be measured without interference in the presence of water vapor, NO_x, carbon monoxide, carbon dioxide and other in-organics.



CHARCOAL TUBE

AIR SAMPLING DATA - MONSANTO

Walk Through Survey Conducted October 6, 1976

Location	Sample No.	Time (min.)	Concentration (mg/m^3)
10' downwind from 2nd floor finished goods benzyl chloride quality control sampling point	BC-5	220	.14
Center of 2nd floor control room	BC-4	180	.11
1st floor near gateway entrance - at Miran probe head	BC-7	190	.05
Blank	BC-2		<1 microgram

(Front and back sections of the charcoal detector tube were analyzed for benzyl chloride)

Note that a concommitant study is now underway which is testing the validity of the system which analyzes and tests the methodology used for sample characterization of benzyl chloride in a mixed chemical environment. Slight changes in the above concentrations may be made once the study has been completed.

*Note: These meter readings cannot be directly translated into benzyl chloride concentrations since other organic vapors (e.g., toluene) were present in the in-plant atmosphere that also effect meter deflection. This becomes evident after an evaluation of the Century gas chromatographic analyses. From the foregoing, it becomes possible to conclude that the presence of other vapors along with benzyl chloride exists in the in-plant atmosphere. However, the high instrument readings most probably indicate the base level benzyl chloride concentrations at that point because they occurred in benzyl chloride dominated areas. The TLV meter reading of 70 for sample 1(a) most probably represents a 100 ppm of benzyl chloride at that point.