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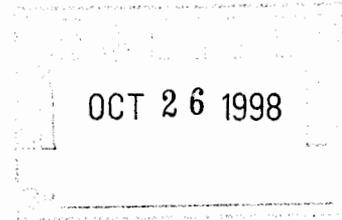
AUSTIN  
FORT WORTH  
HOUSTON  
MONTERREY, MEXICO

October 23, 1998

**CONFIDENTIAL SETTLEMENT COMMUNICATION  
NOT ADMISSIBLE FOR ANY PURPOSE**

**VIA HAND DELIVERY and FEDERAL EXPRESS**

Michael T. Donnellan, Esq.  
Environmental Enforcement Section  
Environment and Natural Resources Division  
United States Department of Justice  
P.O. Box 7611  
Washington, D.C. 20044-7611



Re: Sparton Technology, Inc.

Dear Michael:

Enclosed with this letter is a copy of an addition to the vadose zone investigation work plan, which has been prepared by Pierce Chandler. Your copy and that going to all of the other plaintiffs' contacts includes all of the attachments except for the laboratory QAPP. Mike Hebert's copy is being hand delivered to him with the laboratory QAPP. I have not included that attachment with the other copies because of its bulk. I would ask that Mike determine who else in your group needs or wants a copy and provide that to them.

The three other work plans, involving the off-site containment system, the on-site containment system, and aquifer restoration were prepared by Stavros Papadopoulos. Stavros is having copies of those work plans hand delivered to your office today, and sending copies to the other plaintiffs' contacts by Federal Express.

An original of this letter is being sent with the work plan Pierce has developed, as well as the three work plans Stavros has finalized.

Please give me a call next week so we can discuss setting up a conference call to review and, hopefully, finalize these four work plans, as well as the groundwater monitoring plan.

Yours very truly,

A handwritten signature in black ink, appearing to be "J. B. Harris", written over the typed name "James B. Harris".

James B. Harris

Enclosure

cc: R. Jan Appel -- via U.S. Mail  
Pierce L. Chandler -- via U.S. Mail  
Stavros Papadopoulos -- via U.S. Mail  
Gary L. Richardson -- via U.S. Mail  
Michael A. Hebert -- via/hand delivery  
Steven Amter -- via Federal Express  
Dennis McQuillan -- via Federal Express  
Gary A. O'Dea -- via Federal Express  
Ana Marie Ortiz -- via Federal Express  
Charles de Saillan -- via Federal Express  
John Stomp -- via Federal Express

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VADOSE ZONE INVESTIGATION WORKPLAN  
(ADDITIONAL SOIL GAS CHARACTERIZATION)

PURPOSE

The purpose of this workplan is to establish investigative procedures for confirming the limits of soil gas constituent concentrations above 10 ppm<sub>v</sub>. The resulting soil gas characterization will be used to confirm implementing a "robust" soil vapor extraction (SVE) system to augment the existing AcuVac SVE system.

This workplan revises the Additional Soil Gas Characterization section of the May 18, 1998 SVE Workplan submitted by Sparton. Since that submittal, the following activities have been conducted relative to the SVE Workplan:

- Technical conference call of June 18, 1998
- Submittal of soil gas characterization summary (all previous investigation) on July 8, 1998
- Technical meeting in Dallas on July 14, 1998
- Receipt of workplan comments dated July 20, 1998
- Technical conference call of July 28, 1998
- Settlement conference in Albuquerque on July 30, 1998
- Sparton's response to workplan comments on August 5, 1998
- Technical conference call on August 14, 1998
- Technical conference call on August 19, 1998
- Settlement conference in Albuquerque on August 26, 1998
- Receipt of additional workplan comments on September 4, 1998
- Sparton's response to additional workplan comments on September 24, 1998
- Settlement conference in Albuquerque on October 1, 1998

As a result of these activities, there is general agreement on the scope of the vadose zone investigation workplan and the revised design and operation of the SVE system.

## PREVIOUS CHARACTERIZATION

Soil gas characterization has been an ongoing activity at the Sparton site since Spring 1994. The previous investigations and reports are summarized in the following discussion:

- 1) In Spring of 1984, Tracer Research Corporation conducted a limited soil gas survey to a) assist in delineating the extent of off-site groundwater impacts and b) determine if there was a source upgradient from the Sparton property. Over 50 sampling points were utilized on-site and 9 sampling points were utilized along Irving Boulevard south of the property. Highest constituent concentrations were observed in the sampling transect nearest the pond/sump area (near current monitoring well MW-17). Soil gas TCE concentrations ranged from 720 ug/l (161 ppm<sub>v</sub>) to less than 0.25 ug/l. TCA concentrations ranged from 440 ug/l (97 ppm<sub>v</sub>) to less than 0.25 ug/l.  
The Tracer Study concluded a) that soil gas concentrations decreased radially in all directions from the pond/sump area and b) that concentration isopleths are skewed to the southwest in the direction of groundwater movement (RFI, Attachment 7, Appendix B). Results were also included in Appendix 2 of the CMS Report.
- 2) The use of soil gas as a "tracer" for groundwater contamination was an evolving technology. The 1984 Sparton soil gas/groundwater investigation was summarized in a paper by Eric Lappalla in 1984 and was included in the 1989 EPA Seminar Publication "Corrective Action: Technologies and Applications" (EPA/625/4-89/020).
- 3) In September 1985, a vadose zone investigation was conducted on site--primarily in the pond/sump area. At EPA's request, a report containing the results and discussion of this investigation was not included in the RFI; however, boring logs and analytical results were included in Attachment 6 of the RFI. A total of 13 borings (including groundwater monitoring well MW-18) were used. Soil samples were obtained at approximately 5-foot intervals. These samples were screened using a PID to select samples for laboratory testing. A total of 126 soil samples were subsequently analyzed for TOX. The 21 samples with positive TOX detection were further tested for target VOC previously identified in groundwater

samples. VOC was detected in only 6 of these samples (RFI, p.82-83).

The results of the field screening and analytical testing showed that highest concentrations occurred in the immediate pond/sump area and were associated with silt/clay and/or the water table. At the time of the investigation (9/85), it appeared that the bulk of any contaminant release had completed its migration to the water table leaving behind only scattered residual VOC sorbed onto fine-grained silts and clays. Consistent with the 1984 soil gas survey, concentration isopleths were centered on the pond/sump area.

- 4) In July 1987, an extensive soil gas survey of over 100 sampling points was made. The purpose of the soil gas survey was to determine the extent and magnitude of groundwater impacts--particularly off-site (At this point in time, 25 groundwater monitoring wells had been installed on-site). The soil gas investigation indicated that on-site concentrations had dropped well over an order of magnitude since the 1984 survey. The 1987 results were also consistent in pattern with the 1984 soil gas study and the 1985 vadose zone investigation--the isopleths were still centered on the pond/sump area. The 1987 study is included in Attachment 7 of the RFI and Appendix 2 of the CMS.
- 5) A third soil gas survey using 63 sampling points was conducted in June 1991. The 1991 investigation covered approximately the same area as the 1987 survey, so valid comparisons could be made. A report was included in Attachment 9 to the RFI Report and the results were included in Appendix 2 of the CMS Report.

In this third survey, both TCE and TCA were found over the same area as in the 1987 survey, but concentrations had dropped approximately an order of magnitude (RFI, p. 97 and CMS p. III-28 and III-29). The concentration pattern was consistent with previous work. At a single location on the southwest side of the building TCE concentration was a maximum 24 ug/l (5 ppm<sub>v</sub>) and TCA was a maximum 12 ug/l (3 ppm<sub>v</sub>). Moving away from the plant, concentrations dropped over 4 orders of magnitude.
- 6) In April 1996, soil gas data was obtained from 13 monitoring wells screened across the water table. Soil gas samples were obtained from the monitoring wells and analyzed for VOC. The

soil gas results were consistent with previous investigations. Highest soil gas concentration occurred on-site near the pond/sump area. Soil gas concentration decreased rapidly moving away from the source area and concentrations were negligible off-site. The obtained soil gas results were compared to predicted equilibrium soil gas concentrations calculated using Henry's Law and the groundwater concentration at each well location. The comparisons indicated that, with the possible exception of TCA at monitoring well MW-17, soil gas is not a source of constituents to the groundwater and, in fact, groundwater is probably the source of VOC detections in soil gas at locations distant from the pond/sump area (CMS, p.III-29 - p.III-30, Appendix 2).

- 7) In June 1996, a vapor probe cluster was installed in the immediate vicinity of the solvent sump area. This was the first intrusive investigation in the source area since the pond/sump area had been closed and capped with pavement in 1986. The vapor probe cluster consisted of six individual probes screened at approximately 10-foot intervals down to just above the water table. Subsurface materials ranged from clay and very fine sand to scattered cobble gravel. As expected because of the location beneath the sump area, soil gas constituent concentrations were very high, ranging from 24,000 to 27,000 ug/l TCE (5376 to 6048 ppm<sub>v</sub>) in a clayey zone at 30 feet bgs to approximately 9,000 ug/l (2016 ppm<sub>v</sub>) in fine sand to cobble gravel zone at 60 feet (Soil Gas Report, p.14 & Appendix 2). These results were consistent with previous data.
- 8) In February 1997, 5 vapor recovery wells were installed in and around the pond/sump area. Recovery well VR-1 was installed through the center of the original solvent sump and the remaining wells were installed at varying radial distances up to 100 feet. All wells were screened from 10 feet bgs to just above the water table (approximately 55-foot screen). During installation, headspace soil gas readings were obtained from soil samples at 5-foot intervals. Well VR-1 had the highest headspace readings of 280 ppm with the higher readings corresponding to silt/clay zones. In the remaining wells, headspace readings were in the single digit to fractional ppm range. Subsequent sampling and analysis gave consistent information with the established pattern. VOC concentrations were highest at VR-1 and dropped off an order of magnitude at

a radial distance of 100 feet from the sump location (Soil Gas Report, pp.1-7, Appendix 1).

9) A soil vapor extraction (SVE) pilot test was conducted onsite in February 1997. The pilot test was conducted in VR-1 and demonstrated a useable radius of influence of 175 to 200 feet at a flow of 65 cfm and an extraction well vacuum of five inches of water. The effects of the clay zones could be easily seen in the vapor probe cluster vacuum readings some six feet away from the recovery well (Soil Gas Report, pp. 16-21, Appendix 3).

10) In lieu of any soil gas data, the areal extent of soil gas outside the source area could be inferred from the areal extent of the groundwater plume. Assuming that soil gas constituent concentrations are in equilibrium with aqueous-phase concentrations at the groundwater surface, Henry's Law could be used to calculate soil gas concentrations. As given in Appendix 2 of the CMS:

- TCE gas concentration in  $\text{ppm}_v = 0.072$  water concentration in  $\text{ug/l}$
- TCA gas concentration in  $\text{ppm}_v = 0.030$  water concentration in  $\text{ug/l}$

At equilibrium, the 10  $\text{ppm}_v$  soil gas limit would correspond to groundwater concentrations of 139  $\text{ug/l}$  for TCE and 333  $\text{ug/l}$  for TCA.

However, as the April 1996 deep soil gas investigation showed, actual soil gas concentrations (with the single exception of TCA at MW-17) are significantly below predicted equilibrium concentrations--particularly with distance from the pond/sump area.

- 11) From 1984 through the present date, soil gas information has been obtained through a variety of investigations; however, the information provides a consistent description.
- (a) The area of elevated soil gas concentration ( $>10 \text{ ppm}_v$ ) is finite and within the boundaries of the Sparton Property.
  - (b) Primary constituents are TCE and TCA.
  - (c) Soil gas concentrations are highest in the immediate vicinity of the original solvent sump.
  - (d) Concentrations decrease rapidly with increasing horizontal distance from the original solvent sump area.

- (e) Soil gas impact occurs through the entire unsaturated vadose zone with highest constituent concentrations corresponding to silt/clay layers with sorbed residual VOC.
  - (f) All data (and regression analyses) indicate that elevated (>10 ppm<sub>v</sub>) soil gas concentrations may extend out approximately 200 feet from the sump area--at least on the north side of the building.
  - (g) Because of the capping effect of the building and the pavement around the building, elevated concentrations may extend slightly beyond the south side of the building.
- 12) An AcuVac SVE system began extraction from VR-1 on April 8, 1998 at a rate of 50 cubic feet per minute (cfm). Influent sampling through August 5, 1998 showed that constituent concentrations had dropped over 2 orders of magnitude with a corresponding TCE removal rate of approximately 290 pounds. As predicted, influent constituent concentrations have dropped off exponentially with continued operation (See Figure 1). Emissions to the atmosphere were approximately 20 pounds of TCE over the same operating period. Vacuum measurements from the operating system obtained on June 6, 1998 (and subsequent regression analysis) indicate an effective radius of influence of 125 to 150 feet for the 50 cfm extraction rate.

#### ROBUST SVE SYSTEM MODIFICATION CONCEPT

Previous characterization and operation of the AcuVac SVE system to date indicate that a higher extraction rate or "robust" SVE system at well VR-1, discharging directly to the atmosphere (without treatment) can meet prevailing City/County emission requirements. AcuVac system operation at VR-1 has reduced influent concentration to the point where higher extraction can be initiated without exceeding Sparton's current air permit requirements. Based on the multi-step vacuum-flow relationship developed during pilot testing at VR-1 in February 1997, the VR-1 capacity at three-inches Mercury vacuum will be in the range of 150 to 250 cfm.

The "robust" modifications would initially provide a "packaged" blower system at VR-1. The packaged system would include a positive displacement blower, electric motor, and discharge silencer mounted on a steel-frame skid. This system would have a maximum flow capacity of 300 cfm at a vacuum of three-inches of Mercury. The system would be located close to

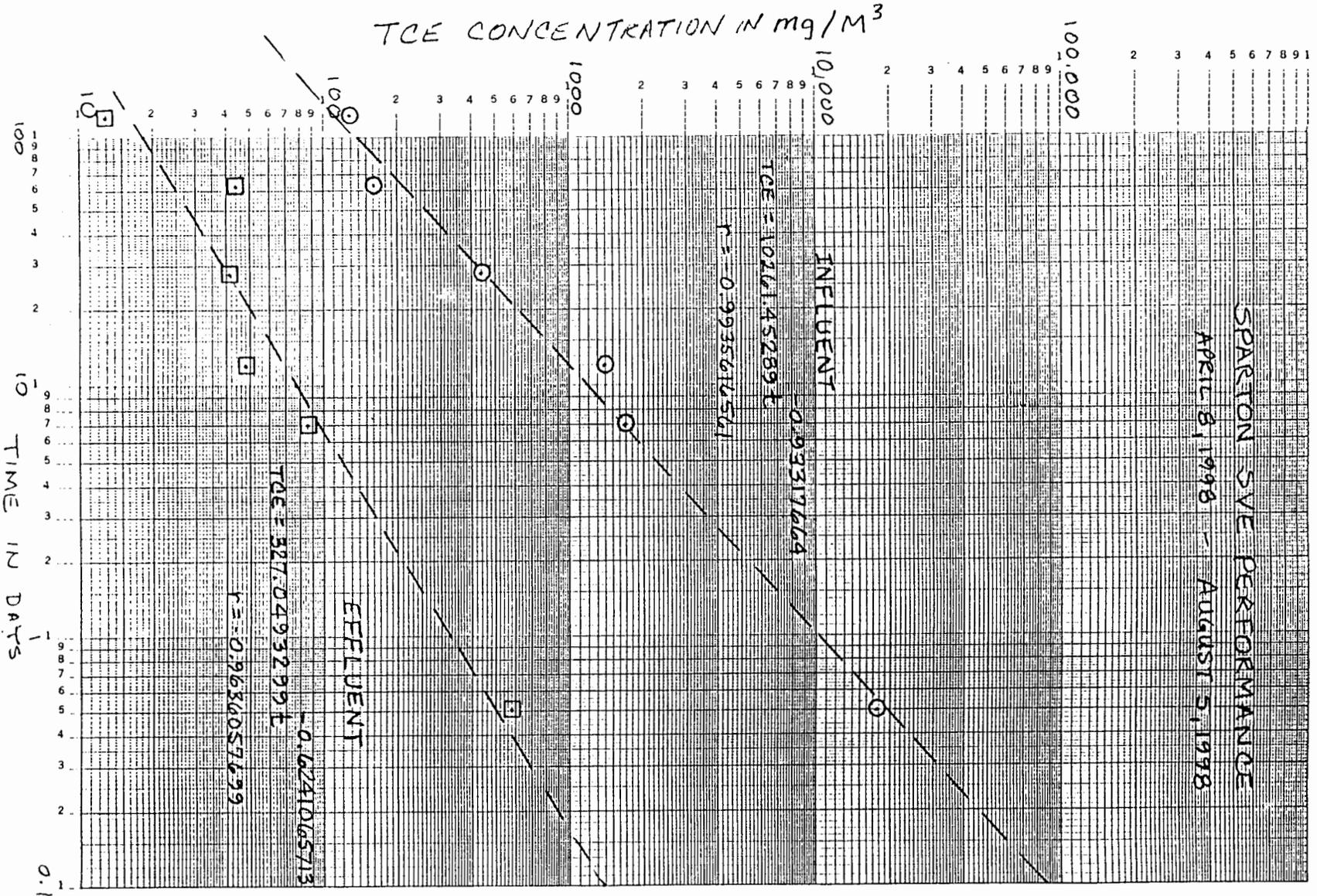


Figure 1

VR-1 to minimize unnecessary friction loss. As additional characterization discussed in this workplan is completed, additional packaged systems up to a total combined extraction rate of 500 cfm (at three-inches Mercury vacuum) may be installed to remediate elevated soil gas concentration beyond the influence of the VR-1 robust system. At these other locations, the AcuVac system would be operated until influent concentrations will meet direct discharge requirements.

#### ADDITIONAL CHARACTERIZATION

Location. Additional characterization of soil gas will be conducted using pipe probe methodology at locations shown in Figure 2. The three probe locations north of the building are of an approximately 200-foot radial distance from the solvent sump (VR-1). The three probe locations immediately south of the building will be near existing groundwater monitoring wells MW-18 and MW-23 and in an accessible location near the middle of the building. A seventh probe will be located along the south property line between MW-13 and MW-33 (1991 Tracer Soil gas probe #61 location). An eighth probe will be located inside the plant building at a location approved by the EPA if elevated soil gas concentrations are found south of the building. The actual location of the eighth probe will be based on analyses of results, from outside the building footprint, subject to restrictions posed by current operations such as the machine shop, etc.

Sampling/Purging. Pipe probe sampling will utilize conventional soil gas exploration methodology. A 3/4 to 1-1/4 inch steel pipe with a disposable steel drive point will be pushed or driven into the subsurface. Beginning at the ten-foot bgs, and each additional five foot depth interval thereafter down to probe penetration refusal, the pipe will be retracted slightly to allow extraction of a soil gas sample through the pipe probe tip. At each sampling depth, the pipe will be purged of at least three pipe volumes. Sampling/purging procedures will be similar to that described in the Corrective Measures Study (CMS) Report, Appendix 2(b) with the exception that a second vacuum gauge will be installed at the top of the pipe probe. A copy of the procedure is included in Appendix A of this workplan. Flow rate will be adjusted at the rotameter to purge the pipe probe in approximately five to ten minutes. During purging, the extracted well gas will be screened continuously using a PID (Hnu with 10.2 eV lamp or comparable unit) calibrated in accordance with the manufacturer's procedures in Appendix B of this workplan. Probe vacuum and flow rates along with PID readings will be recorded during purge activities. At the completion of purging, a vacuum box will be used to obtain replicate samples of soil gas using new one liter tedlar bags. If conditions such as excessive vacuum and/or widely fluctuating PID

Figure 2

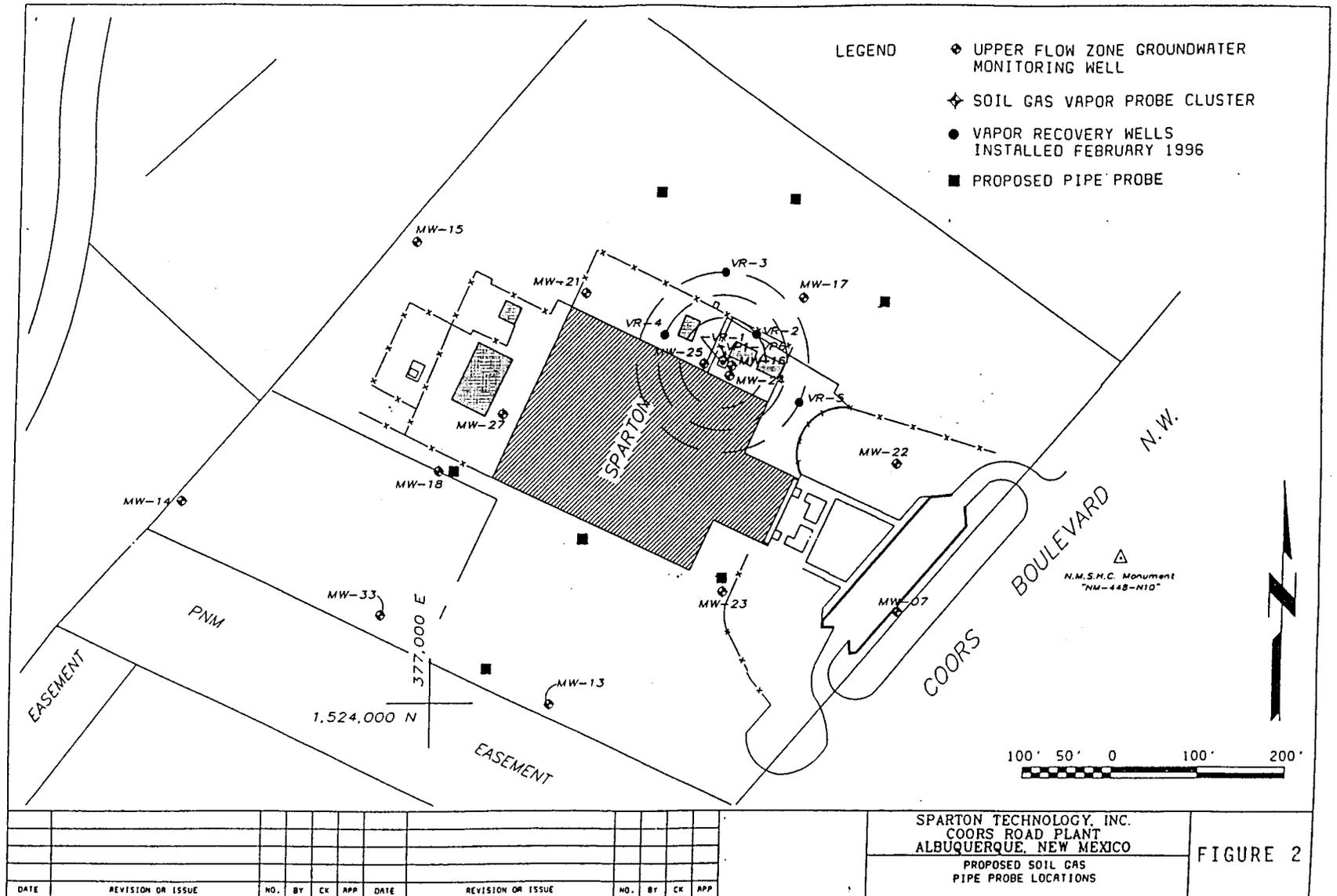


FIGURE 2

measurements are encountered, sampling will be postponed until the cause has been identified and corrected. The purging/sampling procedure will be repeated at five-foot intervals down to the depth of pipe probe refusal. If field screening results are at nominal background level, no samples will be taken at that depth interval; however, at least one sample will be obtained at each probe location.

As the pipe probe is withdrawn, a relatively permanent soil gas monitoring probe will be installed at the depth corresponding to the highest field screening value. The permanent soil gas monitoring probes will consist of  $\frac{1}{2}$ -inch Schedule 40 PVC screen and riser. The screen will be sandpacked using a manufactured sand. The remaining vertical interval above and/or below the screen will be sealed with hydrated bentonite to insure monitoring of a discrete depth interval. If field screening results indicate soil gas concentrations less than 10 ppm<sub>v</sub>, a permanent monitoring probe will not be installed at that location.

All investigations will be conducted in accordance with the site Health and Safety Plan.

Soil gas investigations generate little, if any, contaminated material requiring treatment/disposal. Decontamination of vapor phase generally requires only adequate purging to obtain representative samples. However, to ensure representative sample information, all pipe probe and permanent monitoring probe materials will be decontaminated prior to installation using, as a minimum, detergent wash and potable water rinse. Non-dedicated equipment, such as the steel drive pipe, will be decontaminated between each use. Materials and/or equipment outside or downstream of the pipe probe/sampling train will not require decontamination. Decontamination wash water will be either processed through the onsite air stripper system or evaporated.

Sample Analysis. At the completion of sampling at a given probe location, the field screening results will be reviewed. The two samples corresponding to the highest field screening results will be submitted under standard SW-846 chain-of-custody procedures to a local laboratory for analysis. If field screening results do not indicate a second vertical interval with soil gas concentration above 10 ppm<sub>v</sub>, only the gas sample with the highest concentration will be analyzed. At least one replicate sample will be analyzed from each pipe probe showing elevated soil gas concentration. Other replicate samples will be provided to regulatory agency representatives on request.

All soil gas samples will be analyzed in the laboratory using EPA Method 8260 with constituent detection limits of 10 ug/l or less (approximately 2 ppm). Higher detection limits will be used for high-concentration samples. A copy of the laboratory's QAPP is provided in Appendix C.

#### REPORTS

In accordance with the City Air Permit, Sparton will furnish quarterly reports on the operation of the SVE system. Information on vadose zone characterization obtained under this workplan will be combined with historical data to define the areal extent of elevated soil gas concentrations above 10 ppm, and confirm the design of the "robust" SVE system modifications. All soil gas results, copies of field reports, and probe installation data will be provided in a Vadose Zone Investigation Report. The report will include a mapping of the limits of elevated soil gas concentration relative to existing site features and monitoring points.

#### CONTINGENCY

In the event that the additional pipe probes proposed in this workplan, together with previous data, do not adequately define the 10 ppm soil gas constituent limits, Sparton will conduct additional pipe probe characterization as necessary.

#### SCHEDULE

A schedule for conducting the additional vadose zone characterization and for designing and implementing the "robust" SVE system modifications is given in Figure 3.

FIGURE 3

ADDITIONAL VADOSE ZONE INVESTIGATION AND ROBUST SVE IMPLEMENTATION SCHEDULE

TASKS	Oct. 19	Oct. 26	Nov. 2	Nov. 9	Nov. 16	Nov. 23	Nov. 30	Dec. 7	Dec. 14	Dec. 21	Dec. 28	Jan. 4	Jan. 11	Jan. 18	Jan. 25	Feb. 1	Feb. 8	Feb. 15	Feb. 22	Mar. 1	Mar. 8	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
Vadose zone investigation plan	X																					
EPA approval		X	X																			
Allow vadose zone to equilibrate		X	X	X																		
Conduct vadose zone investigation						X	X															
Prepare report							X	X	X	X												
Prepare robust SVE design plans & specs							X	X	X	X												
Prepare construction work plan							X	X	X	X												
Prepare health & safety plan <sup>1</sup>			X	X	X																	
EPA approval plans & specs											X	X										
Equipment procurement												X	X	X	X							
Construct SVE system													X	X	X	X	X	X	X	X	X	X
O&M plan (preliminary)															X	X	X	X	X	X	X	X
Modify air permit						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Operate robust SVE system																						X
Operate AcuVac system	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

<sup>1</sup> One plan will address all 1910.120 activities.

## APPENDIX A

# Pipe Probe Vapor Sampling Procedure

## PIPE PROBE VAPOR SAMPLING PROCEDURE

Calibrate PID in accordance with the manufacturer's procedure. Test and/or calibrate PID between probes. Record background level at each probe location prior to purging/sampling.

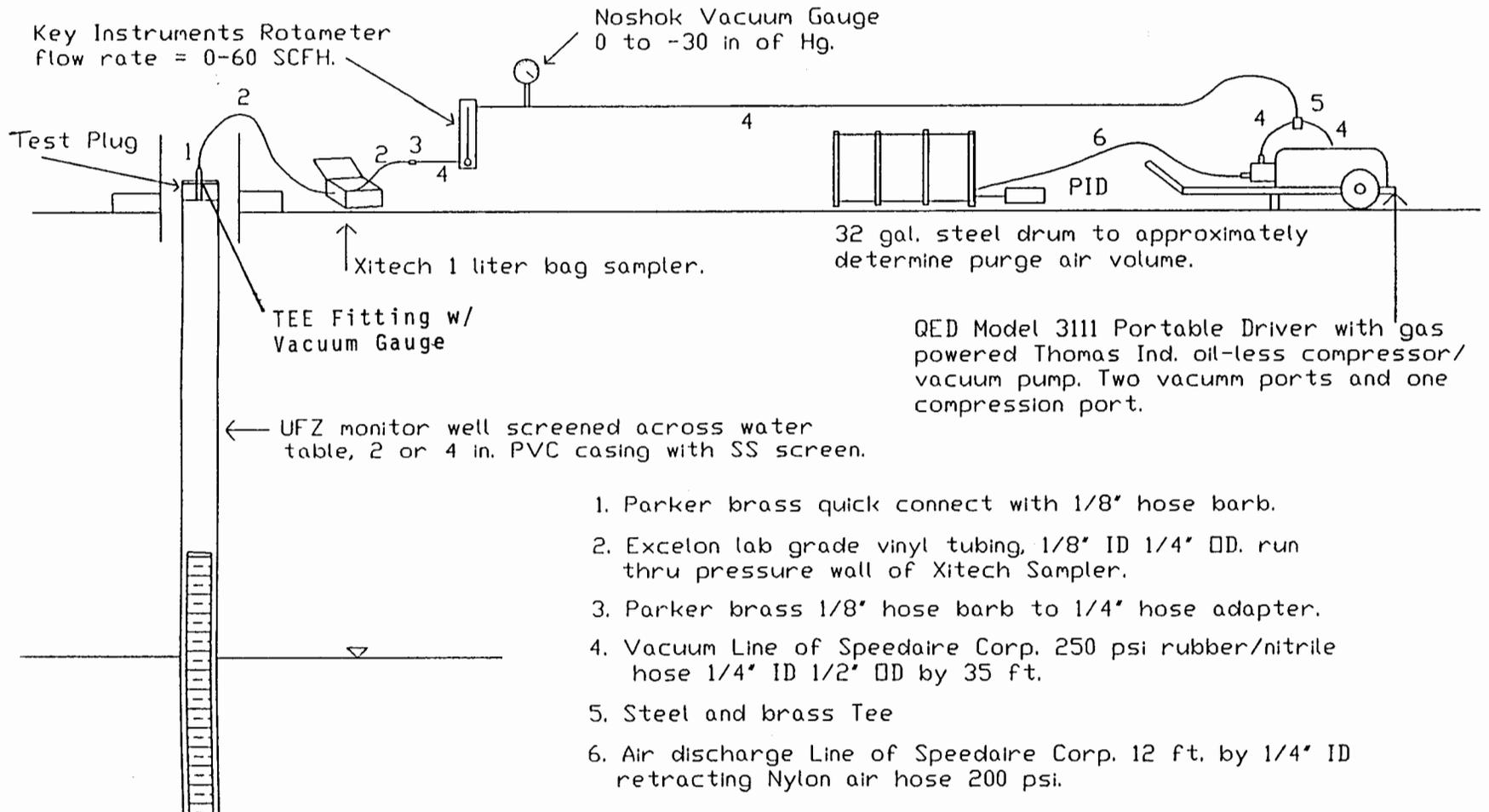
After the probe has been retracted to open the probe tip for purging/sampling, install a Tee fitting on the probe head with a vacuum gauge and 1/8-inch hose barb. Connect the hose barb to the vacuum sampling box inlet with new vinyl tubing. The vacuum box outlet will be connected to a vacuum source. Flow through the sampling train will be controlled by a regulating valve and rotameter type flow meter. The sampling train components will be arranged in similar fashion to that previously used for monitor well and vapor probe sampling--see accompanying sketch from the CMS Report, Appendix 2(b).

Secondary measurement of flow rate and PID screening will be obtained by discharge into a new plastic bag installed in a 32 gallon steel container. Rotameter flow rates, vacuum readings, purge duration, purge volume, and PID readings will be recorded.

When at least three probe volumes have been purged and PID readings are relatively stable, the vacuum pump will be stopped. If conditions such as excessive vacuum and/or widely fluctuating PID measurements are encountered, sampling will be postponed until the cause has been identified and corrected. The 1/8-inch vinyl sampling tubing will be crimped to prevent backflow and a new 1-liter Tedlar bag will be connected inside the vacuum sampling box. The box will be closed and vacuum applied to the outlet to fill the Tedlar bag. After the Tedlar bag is filled, it will be removed from the vacuum sampling box, labelled, and placed in a cooler. The Tee fitting will be decontaminated with detergent wash and potable water rinse and the vinyl sampling tube disposed.

SPARTON TECHNOLOGY, INC.

Equipment Illustration For  
Monitor Well Vapor Sampling  
April 10, 1996  
Not to Scale



## APPENDIX B

# PID Calibration Procedure

INSTRUCTION MANUAL

S/N 701346

5.0

Hess

MODEL PI 101

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Portable  
Photoionization  
Analyzer

**hnu**

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## SECTION 3

### CALIBRATION

#### 3.1 INTRODUCTION

The PI 101 Analyzer is designed for trace gas analysis in ambient air and is calibrated at HNU with certified standards of benzene, vinyl chloride and isobutylene. Other optional calibrations are available (e.g., ammonia, ethylene oxide, H<sub>2</sub>S, etc.). Calibration data is given in the data sheet. If a special calibration has been done, the data is given in the Application Data Sheet, which notes the sample source, type of calibration (see Section 8, Appendix), and other pertinent information.

Good instrumentation practice calls for calibration on the species to be measured in the concentration range to be used. This procedure assures the operator that the analyzer is operating properly and will generate reliable data.

Some general points to consider when calibrating the PI 101 are that the analyzer is designed for operation at ambient conditions and therefore the gas standards used for calibration should be delivered to the analyzer at ambient temperatures and pressure and at the proper flow rates.

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WARNING:  
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The PI 101 is a non-destructive analyzer; calibrations using toxic or hazardous gases must be done in a hood.

The frequency of calibration should be dictated by the usage of the analyzer and the toxicity of the species measured. If the analyzer has been serviced or repaired, calibration should be done to verify operation and performance. It is recommended that calibration be checked frequently at first (daily or every other day) and then regularly based on the confidence level developed.

The normal meter scaleplate is 0 to 20. If the scaleplate is different, refer to the Application Data Sheet. If there are questions, consult the HNU representative before proceeding with calibration check.

An accurate and reliable method of calibration check is to use an analyzed gas cylinder in a test setup as shown in Figure 3-1 and described below. Additional material on calibration is given in Section 8, Appendix.

#### 3.2 ANALYZED GAS CYLINDER

- a. Concentration - The calibration gas cylinder is to contain the species of interest made up in an air matrix at or near the concentration to be analyzed. If the component is unstable in air, another matrix is to be used. The final calibration mixture should be similar to the sample the PI 101 will analyze. If the expected concentration is not known then a concentration should be chosen that will cause a scale displacement of 50 to 80% on the X10 range. Calibration on X10 range will provide accurate values on the X1 range as well.

SECTION 3.2, ANALYZED GAS CYLINDER cont.

For use on the 0-2000 range, a two-standard calibration is preferred: one at 70 to 85% of the linear range and the other at 25 to 35% of the linear range. With the linear range of approximately 600 ppm for most compounds these points would lie between 420 to 510 ppm and 150 to 210 ppm, respectively.

- b. Stability - The calibration gas must be stable within the cylinder during the period of use. If the calibration is required in the field, then use of a small cylinder is recommended. In addition, the choice of cylinder material in contact with the gas must be considered (steel, aluminum or teflon). If there are any questions, the operator should request stability and usage information from the gas supplier.

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WARNING  
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Extreme care must be taken in the handling of gas cylinders. Contents are under high pressure. In some cases, the contents may be hazardous. Many gas suppliers will provide data sheets for the mixtures upon request.

- c. Delivery - The cylinder containing the calibration mixture must be connected to a proper regulator.

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WARNING  
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Never open the valve on a gas cylinder container without a regulator attached.

Leak test all tank/regulator connections as well as the main cylinder valve to prevent toxic or hazardous materials from leaking into the work area. Care must be taken that the materials of construction of the regulator will not interact with the calibration gas.

One method of sampling the calibration gas is illustrated in Figure 3-1. Connect the cylinder to one leg of the tee, a flow meter to the opposite leg, and the probe to the third leg. The flow meter does not require a valve. If there is a valve, it must be left wide open. The flowmeter is only to indicate excess flow. Adjust the flow from the regulator such that only a little excess flow is registered at the flowmeter.

## SECTION 3.2, ANALYZED GAS CYLINDER cont.

This insures that the PI 101 sees the calibration gas at atmospheric pressure and ambient temperature.

- d. Usage - Generally, a gas cylinder should not be used below 200-300 psi as pressure effects could cause concentration variations. The cylinder should not be used past the recommended age of the contents as indicated by the manufacturer. In case of difficulty, verify the contents and concentration of the gas cylinder.
- e. Alternate means of calibration are possible. For more information, contact the HNU Service Department.

## 3 PROBE

- a. Identify the probe by the lamp label. If a question exists, disassemble the probe and inspect the lamp. The energy of the lamp is etched into the glass envelope.
- b. Connect the probe to the readout assembly, making sure the red interlock switch is depressed by the ring on the connector.
- c. Set the SPAN pot to the proper value for the probe being calibrated. Refer to the calibration memo accompanying the probe.
- d. Check the Ionization Potential (IP) of the calibration gas to be used. The IP of the calibration gas must be at or below the IP of the lamp.
- e. Proceed with the calibration as described in Section 3.4. Check the calibration memo for specific data. If any questions develop, call the HNU representative.
- f. NOTE: The 11.7eV lamp has a special cleaning compound. Do not use water or any other cleaning compound with the 11.7 eV lamp. Do not interchange ion chambers, amplifier boards or lamps between probes. (See Section 5.2).

## 4 PROCEDURE

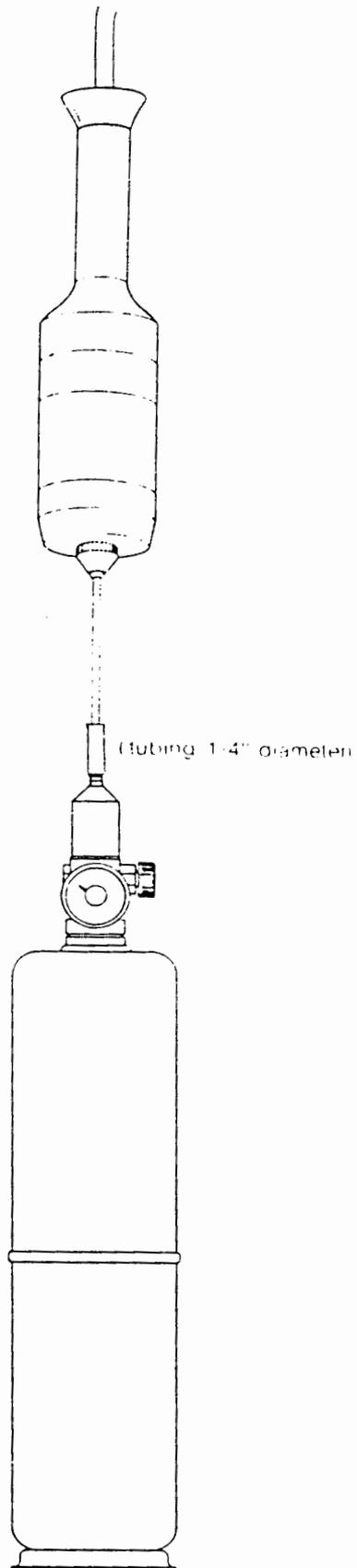
- a. Battery check - Turn the function switch to BATT. The needle should be in the green region. If not, recharge the battery.

## SECTION 3.4, PROCEDURE cont.

- b. Zero set - Turn the function switch to STANDBY. In this position the lamp is OFF and no signal is generated. Set the zero point with the ZERO set control. The zero can also be set with the function switch on the X1 position and using a "Hydrocarbon-free" air. In this case "negative" readings are possible if the analyzer measures a cleaner sample when in service.
- c. 0-20 or 0-200 range - For calibrating on the 0-20 or 0-200 range only one gas standard is required. Turn the function switch to the range position and note the meter reading. Adjust the SPAN control setting as required to read the ppm concentration of the standard. Recheck the zero setting (step b.). If readjustment is needed, repeat step c. This gives a two-point calibration; zero and the gas standard point. Additional calibration points can be generated by dilution of the standard with zero air if desired (see Section 8).
- d. 0-2000 range - For calibrating on the 0-2000 range, use of two standards is recommended as cited in Section 3.2a. First calibrate with the higher standard using the SPAN control for setting. Then calibrate with the lower standard using the ZERO adjustment. Repeat these several times to ensure that a good calibration is obtained. The analyzer will be approximately linear to better than 600 ppm, (see Figure 3-2). If the analyzer is subsequently to be used on the 0-20 or 0-200 range, it must be recalibrated as described in steps b. and c. above.
- e. Lamp cleaning - If the span setting resulting from calibration is 0.0 or if calibration cannot be achieved, then the lamp must be cleaned (see Section 5.2).
- f. Lamp replacement - If the lamp output is too low or if the lamp has failed, it must be replaced (see Section 5.3).

## 3.5 CALIBRATION CHECKING

Rapid calibration checking in the field can be accomplished by use of a small disposable cylinder containing isobutylene. Immediately after a calibration has been completed, a reading is taken on a special isobutylene standard. This provides a reference concentration measurement for later checking in the field. This can be done at any time with a portable cylinder containing this same special standard, using this reference reading as a check, and making adjustments to the analyzer if necessary. In effect, this is an indirect method of calibration, one maintaining the calibration to give direct readings for the original gas mixture, but using the portable isobutylene cylinder. Details are given in Section 8.2 of the Appendix.



**FIGURE 3-1  
CALIBRATION TEST SET UP**

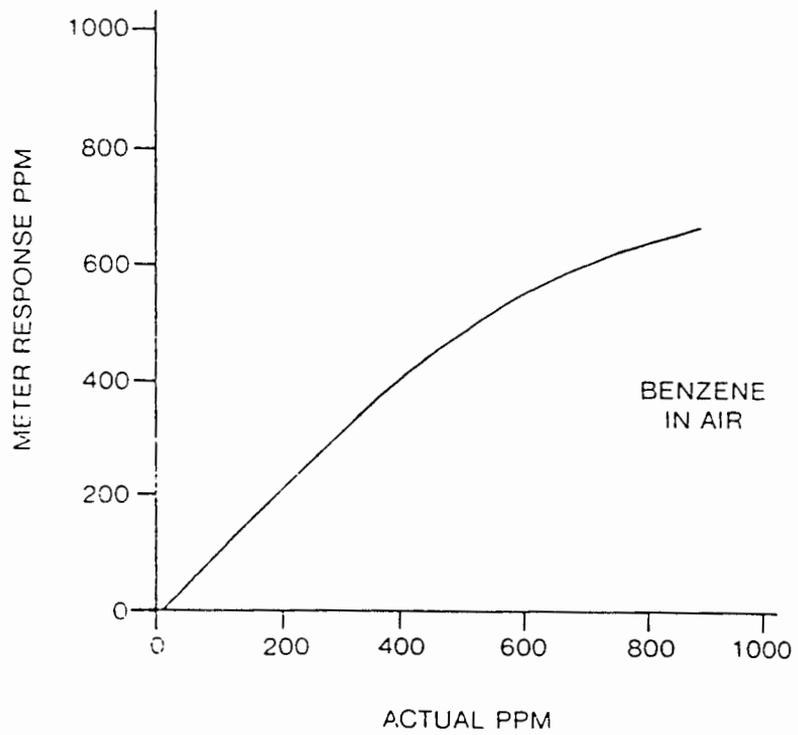
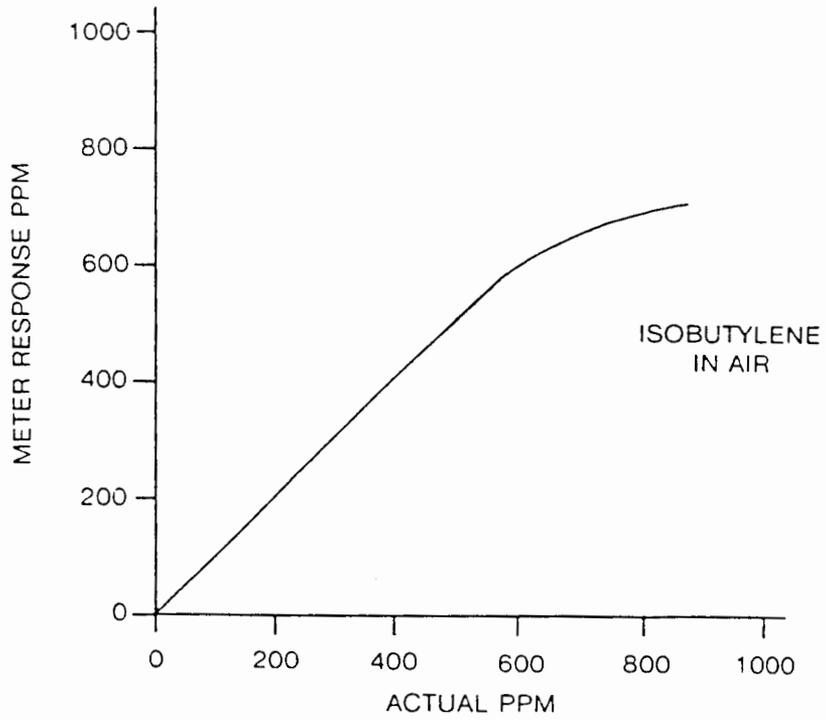


FIGURE 3-2  
TYPICAL CALIBRATION CURVES (10.2 eV)

APPENDIX C  
Laboratory QAPP