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Fluor Federal Services, Inc. Paducah Deactivation Project

CP4-ER-1035 **Rev. 0**	**TITLE:** Vapor Sampling	Page 1 of 17

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1.0 PURPOSE AND SCOPE

1.1 Purpose

To define the methods and equipment available to collect vapor samples.

1.2 Scope

The requirements of this procedure apply to work performed for Fluor Federal Services, Inc. Paducah Deactivation Project (FPDP) and its subcontractors at the U.S. Department of Energy (DOE) Paducah site. This procedure applies to sampling of vapor utilizing Tedlar bags, summa canisters, or a photoacoustic analyzer. The sample may be collected either passively (using an evacuated canister) or actively (using a pump).

2.0 REFERENCES

2.1 Use References

- CP2-SM-0017, *Measuring and Test Equipment Program*
- CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*

2.2 Source References

None

3.0 COMMITMENTS

None

4.0 PRECAUTIONS AND LIMITATIONS

4.1 Precautions

- Sources of contamination include combustion engines, air conditioning compressors, cigarette smoke, room deodorizers, cleaning products, and perfumes. Care should be taken by sampling personnel to avoid cross-contaminating the sample collected with these and any other aerosol or vapor producers.
- Any anomalies in the way the equipment operates must be reported to line management and documented in the logbook used to document the sampling event.
- Care must be used with Summa canister valves, DO **NOT** OVER TIGHTEN the valves.
- Summa canisters should **NOT** be dented or punctured.
- Do **NOT** connect Summa canisters to a source with positive pressure greater than 40 psi unless authorized to do so by manufacturer or laboratory instructions.
- Do **NOT** remove the bar code or serial number labels from the Summa canisters.
- Do **NOT** make any markings directly on the Summa canisters or affix any labels.
- Summa canister flow controllers must be securely wrapped in bubble wrap prior to shipping back to the laboratory.

- Care should be taken to keep Summa canisters away from sources of heat or extreme cold. Canisters should be capped and stored in a dry, clean atmosphere when not in use.
- Refer to applicable project-specific Job Hazard Analysis (JHA) for precautions concerning specific hazards that may be encountered and to determine personal protective equipment (PPE) requirements.

4.2 Limitations

None

5.0 PREREQUISITES

5.1 Field personnel shall be familiar with project-specific documents prior to sampling. Project-specific documents may include, but are **NOT** limited to, the JHA, sampling and analysis plan, Health and Safety Plan, Quality Assurance Project Plan, Waste Management Plan, and necessary permits. These documents should be consulted, as necessary, to obtain specific information regarding equipment and supplies, health and safety, sample collection and identification, sample packaging, and decontamination.

5.2 Prior to performing sampling, notify Radiological Control Organization (RCO) and Safety Personnel for monitoring requirements

5.3 Current revisions of all documents referenced in this procedure shall be utilized. Field personnel shall be knowledgeable of the procedures listed in **5.1**before beginning any sampling activities using this procedure.

6.0 INSTRUCTIONS

Sampling Personnel

6.1 Equipment and Supplies Needed

Ensure that all needed materials are readily available to take to the field and all are in good working condition. The items listed in this section may be used as a guide; however, additional items also may be required. Gather the following items as applicable to each sampling event.

- A portable vacuum pump (Gilian is a common brand name) with Teflon or Tygon tubing. Tygon tubing shall not be used as the path through which the media to be sampled will travel.
- A U-tube manometer or Magnehelic gauge
- New Tedlar bags or laboratory-cleaned Summa canisters complete with necessary fittings
- A box in which a vacuum is created for Tedlar bags
- **If** connecting to a port, **then** a Teflon sampling tube typically less than or equal to 0.25 inches interior diameter with any necessary compatible connectors for the sample port
- A tool box containing a socket set, two adjustable wrenches, one pipe wrench, two flat-head screwdrivers (one large, one small), one Phillips screwdriver, one pair of channel lock pliers, one pair of vise grips, Teflon tape, spare tubing fittings, nipples for the fittings on the vacuum pump, etc.
- Logbook
- Indelible black ink pens and markers

- Chain of custody (COC) forms, custody seals (as required), sample labels
- PPE
- Two-way radio or cellular telephone

6.2 General Requirements

Sampling Personnel

NOTE:
The following steps may be performed in any order unless otherwise directed.

6.2.1 Operate all instrumentation according to the operating instructions as supplied by the manufacturer, unless otherwise specified in the project-specific work plan or instructions.

6.2.2 **Prior** to sampling/operation, verify necessary equipment calibration activities occur **and** documented in the logbook used to document the sampling event or other appropriate project record.

6.2.3 Verify measurement and test equipment (M&TE), which is designated by the owner/user based on the end use of the data gathered by the instrument is calibrated, if required, according to CP2-SM-0017, *Measuring and Test Equipment Program.*

6.2.4 Refer to the appropriate section for sampling steps:

- **If** sampling with Tedlar Bags, **then 6.3**
- **If** Summa Canisters-Grab Samples, **then 6.3**
- **If** Summa Canisters-Time Integrated Samples, **then 6.5**
- **If** Sampling with an Innova Photoacoustic Field Gas-Monitor Model 1412, **then 6.6**

6.3 Sampling with Tedlar Bags

Sampling Personnel

6.3.1 Keep the bags as far away as possible from sources of potential contamination during transportation and storage to minimize the chances of external contamination.

6.3.2 Bags must be attached only to clean Teflon tubing.

6.3.3 Fill out labels with a ballpoint pen, **NOT** a permanent marker. Permanent markers contain volatile compounds that may contaminate the sample.

NOTE:
Steps **6.3.4**through **6.3.7**may be performed in any order prior to step **6.3.8**.

6.3.4 **Prior** to sampling, review precautions in Section **4.1**.

6.3.5 Ensure the requirements in Section **6.2**are complete.

NOTES:

The flow rate for the vacuum pump must be defined prior to sampling.

The usual flow rate for bag sampling is 3 liters/minute. Project-specific requirements may specify a different flow rate.

6.3.6 Prior to arriving on site or at the site, adjust the flow rate of the vacuum pump, as needed to save time in the field. Set the flow rate by performing the following, if needed:

1) Assemble the train using a rotameter (**NOT** managed as M&TE unless otherwise indicated in project-specific requirements), vacuum pump, and a section of sampling tube (see Appendix B, *Typical Tedlar Bag System and Flow Rate Adjustment Train* for diagram). The section of sampling tube is a representative tube that is the same diameter, length, and material used for sampling.
2) Turn on the pump **and** adjust the flow using the pump until the float ball on the rotameter is aligned with the desired flow rate value.
3) Affix a sticker to the pump indicating the flow rate.

NOTE:

When shipped from the manufacturer, the valve on the Tedlar bag typically is in the open position. Occasionally, a piece of debris will clog the valve, making it necessary to close the valve stem to clear the debris.

6.3.7 **If** there is debris in the valve, **then** pull out the valve stem to close the valve. **If** the valve stem is difficult to pull, **then** spin the valve stem while pulling it.

6.3.8 Insert the valve stem on the Tedlar bag into the Teflon tube that runs through the vacuum box (see Appendix B). The Teflon tubing is the path through which the gaseous media will travel.

6.3.9 Check the O-ring gasket in the vacuum box to see if it is in place with the proper fit. O-rings that have been stretched out will **NOT** remain in place.

6.3.10 Place the Tedlar bag in the vacuum box **and** seal the vacuum box by applying pressure to the top and bottom (ensure that the O-ring is in place and unobstructed).

NOTES:

The seal between the top and bottom half of the vacuum box must be air tight in order for the system to work.

Occasionally, a corner of the Tedlar bag will stick out between the two halves of the vacuum box causing a poor seal.

6.3.11 Connect the vacuum pump to Tygon or Teflon tubing that is connected to the vacuum fitting on the vacuum box.

NOTES:

The pump evacuates the air in the vacuum box, creating a pressure differential causing the sample to be drawn into the bag.

The sample drawn into the Tedlar bag never flows through the pump.

6.3.12 **Before** opening the sample port **or** turning on the vacuum pump, don all PPE as defined in the project-specific JHA and/or Radiological Work Permit (RWP).

6.3.13 Connect the Teflon sample tube to the desired source **or** place the tube into the media of concern, then connect the other end of the sampling tube to the sample port on the vacuum box.

6.3.14 Check that all the fittings associated with the vacuum joints are securely in place.

> NOTE:
>
> **When** inserting the valve stem of the Tedlar bag into the Teflon tubing, the fitting may have been pushed loose.

6.3.15 Turn on the vacuum pump.

6.3.16 Allow the bag to fill. Observe the bag **and** listen to the changes in the sound of the pump.

> CAUTION:
>
> Since the bags will hold only a given volume, over inflation will cause the bags to break.

6.3.17 Turn off the vacuum pump **and** remove the tube from the pump.

6.3.18 Disconnect the Teflon sample tube from the source **or** remove the sample tube from the media of concern.

6.3.19 Remove the bag **and** pull out the valve stem.

6.3.20 Lock the valve stem.

> CAUTION:
>
> Adhesives found in the label may permeate the bag if placed on the body of the bag. DO **NOT** write on the bag itself.

6.3.21 Using a ball point pen, label the bag using a sticker placed on the edge of the bag **or** tie the labels to the metal eyelets provided on the bags

6.3.22 Place the Tedlar bag in a clean cooler or opaque trash bag to prevent photo degradation.

6.3.23 Purge the sampling tube with ambient air for a minimum of three minutes using the vacuum pump.

6.3.24 **Before** moving to the next location **or** finishing for the day, complete all entries in the logbook, data sheets, and COC forms as applicable.

> NOTE:
>
> It is essential that sample analysis be conducted within 48 hours from the time of collection; after this time, compounds may escape or become degraded.

6.3.25 Repeat Steps **6.3.4** through **6.3.24** until sampling is completed.

6.3.26 Go to Section **8.0**.

6.4 Summa Canisters-Grab Samples

NOTES:

For grab sampling, the canister valve is simply opened and the vacuum inside the canister draws in a sample within a matter of seconds.

Summa canister valve fittings typically are ¼" male Swedgelock fittings. Typically the inlet side of the Summa canister flow controller is 1/8" outer diameter. Typically the inlet side of the critical orifice assembly is ¼" outer diameter. Typically a stainless steel ¼" nut with rubber ferrule will be provided to attach sample point tubing to critical orifice assembly.

Sampling Personnel

6.4.1 Review precautions in Section **4.1**prior to sampling.

6.4.2 Ensure the requirements in Section **6.2**are complete.

6.4.3 Record the vacuum (negative pressure) in the Summa canister, which typically should be less than -25 inches of mercury (remember that -26 is less than -25 and -24 is greater than -25).

NOTE:

At the Paducah site, Southwest Research Institute (SWRI) is the lab commonly used to analyze the Summa canisters. SWRI doesn't distribute canisters for use with greater than -25 inches of mercury vacuum.

6.4.4 **If** a Summa canister is from SWRI **and** the gauge reads -24 inches of mercury or greater, **then** contact the Sample Management Office (SMO).

NOTE:

The gauges provided by the laboratory are provided to obtain a relative measure of change and not precise readings. **If** the exact gauge readings are needed by the project, **then** a calibrated gauge that is managed under CP2-SM-0017, *Measuring and Test Equipment Program*, should be used.

6.4.5 Ensure that the canister valve is in the fully closed position (check by turning knob completely clockwise).

6.4.6 Using a wrench or other appropriate hand tool, remove the brass cap above the valve on the top of the Summa canister.

6.4.7 **If** a particulate filter is to be used, **then** install the filter on Summa canister inlet port.

6.4.8 **Before** opening the sample port **or** opening the valve on the summa canister, don all PPE as defined in the project-specific JHA and/or RWP.

6.4.9 **If** collecting an ambient air sample, **then** place the summa canister in the area to be sampled and then go to Step **6.4.12**. If not, **then** go to Step **6.4.10**.

6.4.10 **If** sampling a port, **then** connect the Summa canister inlet port to the sampling port. It may be necessary to use Swedgelock fittings and Teflon or stainless steel tubing to make the connection.

6.4.11 After the Summa canister is connected to the sampling port, open the sampling port.

6.4.12 Open the canister valve, turning the knob counterclockwise until there is no resistance (approximately 1¼ turns), **then** turn back clockwise slightly until resistance is detected.

NOTE:

A hissing noise will be heard as the vacuum dissipates and draws in vapor. Once the hissing noise stops, the vacuum has fully dissipated and the sample has been collected. This takes approximately 5-30 seconds, depending on the degree to which the flow is restricted.

6.4.13 Shut off the hand valve immediately to avoid the canister becoming neutral with atmosphere (it should remain in a slight vacuum), then close the valve by turning the knob clockwise.

Caution:

Do not over tighten the valve to avoid damage to the valve.

6.4.14 **If** connected to a sampling port, **then** close the sample port **and** disconnect the Summa canister from the sample port.

NOTES:

During sampling, the gauge reading will move towards 0, at which time the canister pressure is almost at equilibrium with atmosphere. Be sure to include the final vacuum reading (taken from the same gauge used in Step **6.4.3**) on the COC form and logbook or data sheet.

The residual vacuum typically is between -10 and -2 inches of mercury.

6.4.15 Replace the brass cap on the canister valve **and** tighten it with a wrench or other appropriate hand tool.

6.4.16 Label the sample with the tag provided, **then** attach the tag to the canister with a plastic tie **and** note the canister ID number on the COC form.

6.4.17 **Before** moving to the next location or finishing for the day, complete all entries in the logbook, data sheets, and COC forms as applicable.

6.4.18 Repeat Steps **6.4.1**through **6.4.18**until sampling is complete.

6.4.19 Go to Section **8.0**.

6.5 Summa Canisters-Time Integrated Samples

Sampling Personnel

NOTES:

Time-integrated samples require an additional piece of laboratory calibrated equipment (flow controller or critical orifice) to be placed in line with the canister.

Flow controllers/critical orifice assemblies are equipped with fine particulate filters and are set for any user-defined duration (or flow rate) from 5 minutes up to 24 hours.

The sampling period of time is determined by the project to meet the project-specific needs.

Summa canister valve fittings typically are ¼" male Swedgelock fittings. Typically the inlet side of the Summa canister flow controller is 1/8" outer diameter. Typically the inlet side of the critical orifice assembly is ¼" outer diameter. Typically a stainless steel ¼" nut with rubber ferrule will be provided to attach sample point tubing to critical orifice assembly.

Steps 6.5.1 and 6.5.2 may be performed in any order prior to Step 6.5.3.

6.5.1 Review precautions in Section **4.2** prior to sampling.

6.5.2 Ensure the requirements in Section **6.2** are complete.

6.5.3 Record the vacuum (negative pressure) in the Summa canister, which typically should be less than -25 inches of mercury (remember that -26 is less than -25 and -24 is greater than -25).

NOTE:

At the Paducah site, SWRI is the lab commonly used to analyze the Summa canisters. SWRI doesn't distribute canisters for use with greater than -25 inches of mercury vacuum.

6.5.4 If a Summa canister is from SWRI and the gauge reads -24 inches of mercury or greater, contact the SMO.

NOTES:

The gauges provided by the laboratory are provided to obtain a relative measure of change and not precise readings.

If the exact gauge readings are needed by the project, then a calibrated gauge that is managed under CP2-SM-0017, Control and Calibration of Measuring and Test Equipment, should be used.

6.5.5 Ensure that the canister valve is fully closed (check by turning knob completely clockwise).

6.5.6 Using a wrench or other appropriate hand tool, remove the brass cap above the valve on the top of the Summa canister.

6.5.7 **If** a particulate filter is to be used, **then** install the filter on Summa canister inlet port.

6.5.8 Attach the flow controller or critical orifice assembly directly to the valve on the top of the canister **and** tighten down with the fingers first, then tighten gently with a wrench or other appropriate hand tool.

6.5.9 **Before** opening the sample port **or** opening the valve on the summa canister, don all PPE as defined in the project-specific JHA and/or RWP as applicable.

6.5.10 **If** collecting an ambient air sample, **then** place the summa canister in the area to be sampled and then go to Step **6.4.13**. **If not**, **then** go to Step **6.5.11**.

6.5.11 **If** sampling a port, **then** connect the Summa canister inlet port to the sampling port. It may be necessary to use Swedgelock fittings and Teflon or stainless steel tubing to make the connection.

6.5.12 After the Summa canister is connected to the sampling port, open the sampling port.

6.5.13 To open the canister valve, turn the knob counterclockwise until there is no resistance (approximately 1¼ turns), **then** turn back clockwise slightly until resistance is detected.

> NOTE:
>
> Since the flow controller restricts the airflow, a hissing noise will **NOT** be heard as the vacuum dissipates and draws vapor in.

6.5.14 At the end of the sampling period, close the valve by turning the knob clockwise. Do **NOT** over tighten. **If** connected to a sampling port, **then** close the sample port **and** disconnect the Summa canister from the sample port.

> NOTES:
>
> During sampling, the gauge reading will move toward 0 psig, at which time the canister pressure is almost at equilibrium with atmosphere. Be sure to include the final vacuum reading (taken from the same gauge used in step 3) on the COC form and logbook or data sheet.
>
> The residual vacuum typically is between -10 and -2 inches of mercury.

6.5.15 Remove the flow controller/critical orifice assembly and/or analog gauge (used for time-integrated sampling only), then wrap securely in bubble wrap.

6.5.16 Replace the brass cap on the canister valve **and** tighten it with a wrench or other appropriate hand tool.

6.5.17 Label the sample with the tag provided, then attach the tag to the canister with a plastic tie.

6.5.18 Note the canister ID number on the COC form. For time integrated sampling, note the flow controller or critical orifice assembly identification number with the corresponding canister.

6.5.19 Place the COC form, the bubble-wrapped flow controller, **and** the canister back into the original boxes in which they were shipped.

6.5.20 **Before** moving to the next location or finishing for the day, complete all entries in the logbook, data sheets, **and** COC forms as applicable.

6.5.21 Repeat Steps **6.5.1**through **6.5.20**until sampling is completed.

6.5.22 Go to Section **8.0**.

6.6 Sampling with an Innova Photoacoustic Field Gas-Monitor Model 1412

Sampling Personnel

NOTE:

The following instructions assume that the photoacoustic analyzer has been set up for use as directed by the manufacturer's instructions.

CAUTION:

Never operate the 1412 Photoacoustic Field Gas-Monitor in potentially explosive environments.

6.6.1 **When** monitoring potentially flammable or toxic gases it is essential that the following applies:

- The instrument itself is placed in a well-ventilated area outside the potentially hazardous zone.
- A sufficiently long tube is connected to the air-outlet on the back panel so that the sampled gas is carried away to the open air or to an extraction and/or filtration unit.

6.6.2 Avoid water condensation in the instrument. **If** condensation is likely, **then** it is recommended that heated sample lines, a MICROPROBE, a sample dryer, **or** other project specified remedies be used to avoid water condensation in the instrument.

6.6.3 Switch off all equipment before connecting or disconnecting their digital interface. Failure to do so could damage the equipment.

6.6.4 Whenever it is likely that correct function or operating safety of the apparatus has been impaired, the apparatus must be tagged out of service.

CAUTION:

Any adjustment, maintenance and repair of the open apparatus under voltage must be avoided as far as possible and, if unavoidable, must be carried out only by trained personnel, qualified in service of electronic instrumentation.

6.6.5 **If** a fault is reported by the monitor that indicates correct function of the instrument may be impaired, **then** consult your local LumaSense Technologies representative.

CAUTION:

Under no circumstances should repair be attempted by persons **NOT** qualified in service of electronic instrumentation.

NOTE:

Steps **6.6.6**through **6.6.9**may be performed in any order prior to Step **6.6.10**.

6.6.6 Review the manufacturer's instructions before using the photoacoustic analyzer.

6.6.7 Ensure the photoacoustic analyzer has been set up for use according to the manufacturer's instructions prior to use.

NOTES:

Before a measurement task can begin, there are a variety of parameters that must be defined first. Chapter 7 in the instruction manual provides instructions on how to set up the monitoring system before starting to measure. The parameters can be defined using the PC Use instructions (i.e. when using a PC, or the stand-alone use instructions or when using the front panel push-keys on the monitor).

Before leaving the factory, each of the parameters found in the setup "tree" is given factory value (default value). When setting-up the Monitor as a stand-alone instrument, those values with a cursor underneath them are the active values. It is the active values that determine how the Monitor will operate. Failure to define any parameter may result in the default parameters being used. This can result in the monitor measuring incorrectly or being unable to start the measurement task.

6.6.8 Maintain a copy of the manufacturer's instructions in the field while the photoacoustic analyzer is being operated.

6.6.9 Ensure the requirements in Section **6.2** are complete.

6.6.10 Cut a short section of Teflon sampling tubing.

6.6.11 Attach one end of this tube to the air-inlet stub on the back-panel of the Monitor **and** push one end of the Teflon tubing through the non-threaded end of the nut.

6.6.12 Hold the end of the tubing between the fingers and gently push the tubing over the end of the Monitor's air-inlet stub as far as it will go. **If** the tubing is bent **or** broken during this step **then** remove the tubing from the stub **and** repeat this step using an undamaged length of tubing.

6.6.13 Screw the threaded nut firmly onto the end of the air-inlet stub.

6.6.14 Don all PPE as defined in the project-specific JHA and/or RWP before opening the sample port.

6.6.15 Set up the monitoring task according to the Innova Photoacoustic Field Gas-Monitor Model 1412 instruction manual Section 4.3.3 (if using a PC) or Section 4.4.4 (if using a stand-alone unit).

6.6.16 Open the sample port, if applicable.

6.6.17 Start the monitoring task according to the Innova Photoacoustic Field Gas-Monitor Model 1412 instruction manual's Section 4.3.4 (if using a PC) **or** Section 4.4.6 (if using stand-alone unit).

6.6.18 To stop a monitoring task, pull down the "Sequence" window **and** click on "Stop" if using a PC **or** stop a monitoring task according to the Innova Photoacoustic Field Gas-Monitor Model 1412 instruction manual's Section 4.4.6 (if using a stand-alone unit).

6.6.19 Close the sample port, if applicable.

6.6.20 Ensure that the results are recorded and transferred to the appropriate storage location.

6.7 Photoacoustic Analyzer Maintenance

Perform regular maintenance required for the Innova Photoacoustic Field Gas-Monitor Model 1412 according to the following:

- Calibration – approximately every 3 months (see Chapter 14 in the instruction manual).
- Changing the fine air-filter paper in the internal and external air filtration units (see Section 13.1 in the instruction manual).
- Cleaning of the filter in the ventilation unit (see Section 13.2 in the instruction manual).

7.0 ACCEPTANCE CRITERIA

None

8.0 POST PERFORMANCE WORK ACTIVITIES

Sampling Personnel

8.1 Complete logbook, data sheets, and COC forms as necessary.

8.2 Maintain custody of the samples according to CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals,* **and** transfer custody of the samples to the designated sample management facility or laboratory for analysis as soon as possible.

8.3 Coordinate with RCO for sample containers to undergo radiation surveys by a radiological controls technician (RCT) prior to off-site release according to applicable RCO procedures.

8.4 Following completion of sampling activities, submit samples and related COC documentation to the designated personnel for shipment to an off-site laboratory **or** deliver the samples to the on-site laboratory.

8.5 Submit a copy of the COC form and logbook pages to the FPDP Data Manager for entry into Paducah Environmental Measurements System.

9.0 RECORDS

9.1 Records Generated

The following records may be generated by this procedure:

- The field logbook
- Sample container Certificate of Analysis **or** certificates of cleanliness
- Calibration documentation
- COC forms

9.2 Records Disposition

The records are to be maintained in accordance with CP3-RD-0010, *Records Management Process*.

Appendix A – Acronyms/Definitions

ACRONYMS

COC – chain of custody

DOE – U. S. Department of Energy

FLM – Frontline Manager

FPDP – Fluor Federal Services, Inc. Paducah Deactivation Project

JHA – Job Hazard Analysis

M&TE – Measurement and Test Equipment

PM – Project Manager

PPE – personal protective equipment

RCO – Radiological Control Organization

RCT – Radiological Control Technician

RWP – Radiological Work Permit

SMO – Sample Management Office

SWRI – Southwest Research Institute

DEFINITIONS

Flow Controllers – A flow controller is used to regulate the sampling duration and/or volume on a Summa canister. It is pre-set to a specific flow rate prior to use.

Inches of Water – One of the systems of measurement used for pressure, either positive or negative (vacuum). It refers to the number of inches a column of water moves against the ambient or measured pressure at a specified temperature. Approximately 407 inches of water is equivalent to 29.9 inches of mercury or 14.7 psi.

pounds per square inch – A system of measurement for pressure. It generally refers to either a positive or negative pressure relative to that at sea level, which is considered to be 14.7 psi, and is normally read from a gauge that is set to read 0 at sea level.

Standard Reference Conditions - The National Institute of Standards and Technology version of standard reference conditions is a temperature of 20 °C (293.15 K, 68 °F) and an absolute pressure of 101.325 kPa (14.696 psi, 1 atm).

Summa Canister – A sampling device used to collect and store a gaseous sample. The inner metal surface of the canister is coated with a layer of passivated pure chrome-nickel oxide that is inert to most chemicals and able to preserve many organic compounds.

Tedlar bag – A plastic bag with a resealable port used for collecting and containing gas samples.

Appendix B - TYPICAL TEDLAR BAG SYSTEM AND FLOW RATE ADJUSTMENT TRAIN

Figure 1. Typical Tedlar Bag System

Figure 2. Flow Rate Adjustment Train