Quality Assurance Project Plan for SPod Monitoring at the Denka Performance Elastomer Facility in LaPlace, Louisiana

QA Category: A / Measurement

Prepared for:

Office of Enforcement and Compliance Assurance (OECA)
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Prepared by:

Eastern Research Group, Inc.
601 Keystone Park Drive
Suite 700
Morrisville, NC 27560

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Approval Sheet

Quality Assurance Project Plan for SPod Monitoring at the Denka Performance Elastomer Facility in LaPlace, Louisiana

Daniel Hoyt, EPA Task Manager (Contract #EP-W-15-006)
Signature/Date: Daniel Hoyt 2/19/2020

Paul Buellesbach, ERG Program Manager (Contract #EP-W-15-006)
Signature/Date: 2/19/2020

Andy Loll, ERG Program Manager (Contract #68HERH19C0004)
Signature/Date: Andrew W. Loll 2/19/2020

Scott Sholar, ERG Task Manager (Contract #EP-W-15-006)
Signature/Date: 2/19/2020

Jason Sese, ERG Work Assignment Manager (Contract #EP-W-15-006)
Signature/Date: Jason Sese 2/19/20

Jill Lucy, ERG Project QA Manager (Contract #EP-W-15-006)
Signature/Date: Jill Lucy 2/19/20

David Bordelon, Weston Solutions Task Manager (Contract #EP-S5-17-01)
Signature/Date: 3/3/2020

Shaun Burke, OCE Work Assignment Manager (Contract #EP-W-15-006)
Signature/Date: Shaun Burke 2/24/2020

Jeffrey Kimes, Contracting Officer's Representative (Contract #68HERH19C0004)
Signature/Date: 2/24/2020

Charlie Collins, EPA HQ QA Manager
Signature/Date: Charlie A. Collins 3/6/2020

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Acronym List

AED	Air Enforcement Division
AMCD	Air Methods and Characterization Division
AOC	Administrative Order on Consent
ASOS	Automated Surface Observing System
BFB	Bromofluorobenzene
CAA	Clean Air Act
CCV	Continuing calibration verification
CEMM	Center for Environmental Measurement & Modeling
COC	Chain-of-custody
COV	Coefficient of Variation
DOJ	Department of Justice
EPA	U.S. Environmental Protection Agency
ERG	Eastern Research Group Inc.
GC	Gas chromatograph
GC/MS	Gas chromatography/mass spectrometry
GPS	Global positioning system
HAPs	Hazardous air pollutants
Hg	Mercury
Hz	Hertz
ICAL	Initial calibration
ICV	Initial calibration verification
ID	Identification
IS	Internal standard
kPa	Kilopascal
LDEQ	Louisiana Department of Environmental Quality
lpm	Liter per minute
m	Meter
MB	Method blank
MDL	Method detection limit
MET	Metrological station
MOP	Miscellaneous operating procedure
MQO	Measurement quality objective
NATA	National Air Toxics Assessment
NATTS	National Air Toxic Trends Stations
NEIC	National Enforcement Investigation Center
NIST	National Institute of Standards and Technology
NWS	National Weather Service
OAQPS	Office of Air Quality Planning and Standards
OCE	Office of Civil Enforcement
OECA	Office of Compliance and Enforcement
ORD	Office of Research and Development
PID	Photoionization detector

ppbV	Parts per billion by volume
ppm	Parts per million
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RH	Relative humidity
RPD	Relative percent difference
RRT	Relative retention time
RSD	Relative Standard Deviation
RT	Retention time
RTO	Regenerative Thermal Oxidizer
RTP	Research Triangle Park
SD	Secure digital
SIM	Selected-ion Monitoring
SIS	Stochastic Industrial Sources
SOP	Standard operating procedure
$\mu g/m^3$	Micrograms per cubic meter
µm	Micrometer
VOC	Volatile organic compound
WAM	Work assignment manager

Acknowledgments and Disclaimer

This Quality Assurance Project Plan (QAPP) was prepared with input from the broad project team. Portions of this document were prepared by ERG under contract EP-W-15-006 WA 2-1. Technical information pertaining to SPods in this document was drawn from the EPA ORD CEMM/AMCD SPod Procedure (MOP 3010, see references section) and the Sensit SPod Sensor Operational Manual and Configuration Guide found in Appendix E. Any mention of trade names, products, services, or enterprises does not imply an endorsement by the U.S. Government, or by EPA.

1.0 Introduction

Denka Performance Elastomer LLC ("Denka") owns and operates a neoprene manufacturing facility (the only neoprene production facility in the U.S.) at the Pontchartrain Works Site in Laplace, Louisiana (the "Facility"). Denka acquired the Facility from E.I. du Pont de Nemours and Company (DuPont) on November 1, 2015. On December 17, 2015, EPA released the results of the 2011 National Air Toxics Assessment (NATA). These results indicated the highest modeled cancer risks in the country were associated with an area in St. John the Baptist Parish, Louisiana, attributable to chloroprene (a likely human carcinogen) emissions from Denka's Facility. EPA Region 6 began monitoring the air at six locations in the surrounding community in May 2016 (see Figure 2-2), conducted a Clean Air Act (CAA) inspection of the Facility in June 2016, and subsequently referred CAA violations to the Department of Justice (DOJ) for civil enforcement.

2.0 Project Management Elements

This section addresses project management, including project objectives, roles and responsibilities, and project goals. In addition, this section discusses the mechanisms ERG will use to ensure that all participants understand the goals and the approach used in the investigation of stochastic industrial sources (SIS) from the Denka Facility in LaPlace, LA.

In its Requirements for Quality Assurance Project Plans QA/R-5 (1), EPA identified twenty-four elements to be discussed in this document. Table 2-1 presents the elements and corresponding document sections.

Table 2-1. Crosswalk Between Document Sections and EPA Quality Assurance Project Plan Elements

Quality Assurance Project Plan Element		Document Section
A1 and A2	Title and Approval Sheet, Table of Contents	Title Page and Approval Sheet Table of Contents
A3 through A9	Distribution List, Project Organization, Problem Definition/Background, Project/Task Description, Quality Objectives and Criteria, Special Training/Certification, Documents and Records	2.0
B1 through B10	Sampling Process Design; Sampling Methods; Sample Handling and Custody; Analytical Methods; Quality Control; Instrument/Equipment Testing; Inspection, Maintenance, and Calibration; Inspection/Acceptance of Supplies and Consumables, Non-Direct Measurements; Data Management	3.0
C1 and C2	Assessments and Response to Actions, Reports to Management	4.0
D1, D2, and D3	Data Review, Verification, and Validation; Verification and Validation Methods; Reconciliation with User Requirements	5.0

2.1 Element A.3: Distribution List

Copies of this plan and all revisions will be sent to the following individuals. It is the responsibility of the U.S. Environmental Protection Agency (EPA) OECA Project Lead, EPA Region 6 contract oversight, EPA NEIC technical leads, Weston Solutions, Inc., and Eastern Research Group, Inc. (ERG) Task Managers to make copies of the plan available to all project personnel.

EPA

Daniel Hoyt, EPA OECA/OCE/AED

James Leathers, EPA Region 6

Bill Squier, EPA NEIC

Brad Venner, EPA NEIC

Eben Thoma, EPA ORD/CEMM/AMCD

Shaun Burke, EPA OECA/OCE/AED

Jeffrey Kimes, EPA OECA/OCE/AED

Aunjaneè Gautreaux, EPA Region 6

Weston Solutions, Inc.

David Bordelon

Eastern Research Group, Inc.

Scott Sholar, ERG

Jill Lucy, ERG

2.2 Element A.4: Project Organization

Table 2-2 provides a list of project personnel, their organization, and their responsibilities on this project. Figure 2-1 presents the project organization and key personnel.

Table 2-2. Key Individuals and Responsibilities

Individual or Organization Assigned	Role	Responsibility
Daniel Hoyt EPA/OECA/AED	EPA OECA Project Lead	Responsible for the oversight, review, and acceptance/approval of all project activities.
James Leathers EPA/Region 6	Project co-leader for EPA Region 6	Communications within EPA R6 and with other parties and technical support for the effort
Bill Squier EPA/NEIC	EPA NEIC SPod deployment and training support	Responsible for SPod technical support
Brad Venner EPA/NEIC	EPA NEIC SPod data analysis support	Responsible for management of SPod data analysis/summaries for the project.
Eben Thoma EPA/ORD/NRMRL	EPA ORD Scientist, lead for SPod QA Testing	Lead for SPod measurement systems support, technical support, and data processing support.
David Bordelon Weston Solutions, Inc.	Weston Task Manager	Responsible for all aspects of Weston work that is tasked related to this project. Responsibilities include onsite sample collection and troubleshooting.

Individual or Organization Assigned	Role	Responsibility
Scott Sholar Eastern Research Group, Inc. (ERG)	ERG Task Manager	Responsible for all aspects of analytical lab work related to this project. Responsibilities include management of the canister sample analysis and reporting both canister and SPod data retrieval, processing, comparison to 24-hr canister data, and delivery to EPA.

Weston's role includes performing the SPod bump tests, collecting canister samples, filling out chain of custody forms, and connecting clean canisters. Weston will communicate with the ERG Task Manager or the EPA OECA Project Lead if there are any problems with the SPods, SPod operation, canister leaks, or canister sampling.

ERG's roles include setting up the SPods, retrieving the raw SPod data remotely, conducting quality assurance evaluations, processing raw SPod data, delivering the SPod data to the EPA OECA Project Lead, and providing routine project data analyses to EPA OECA Project Lead.

ERG will also perform canister sample analysis for canisters triggered by the SPods. ERG will perform comparisons of the processed SPod data to the 24-hour canister sample data to help determine appropriate SPod canister trigger thresholds and verify the presence of chloroprene when the threshold level has been exceeded. ERG will communicate with the EPA OECA Project Lead if there are any problems with the SPods determined from the SPod or canister analysis data. ERG will deliver canister analysis data to EPA OECA Project Lead.

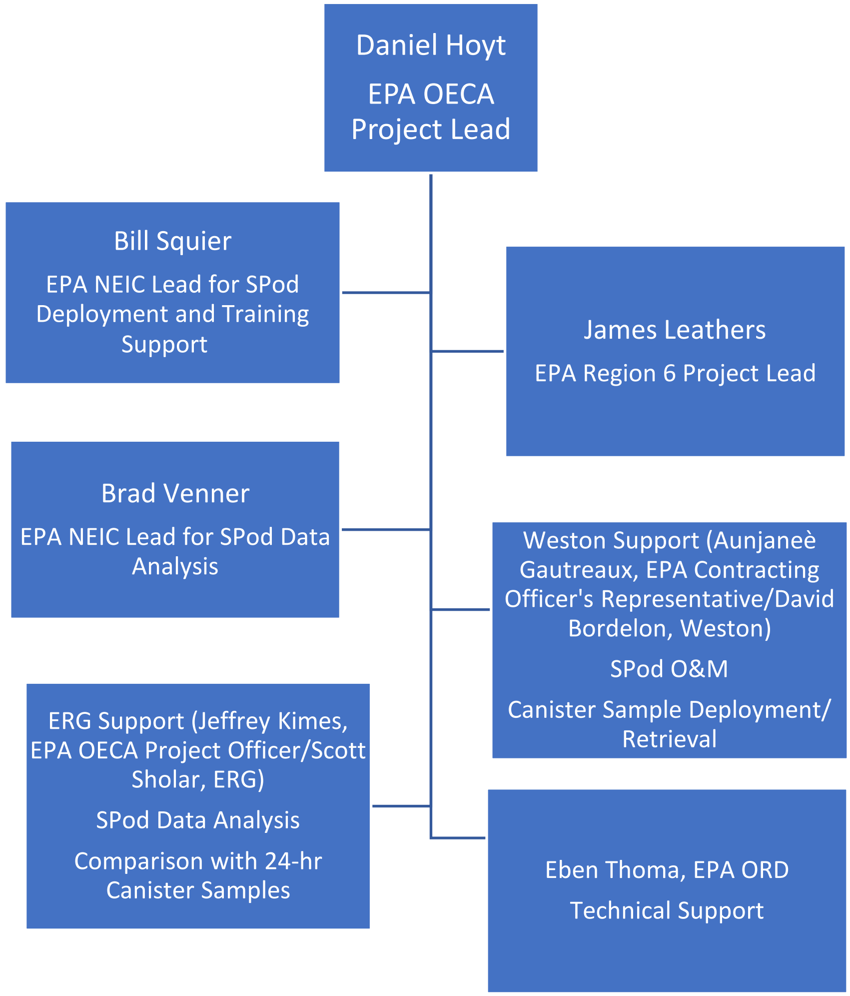


Figure 2-1. Project Organizational Chart

2.3 Element A.5: Problem Definition/Background

2.3.1 Stochastic Industrial Sources

Volatile organic compounds (VOC), hazardous air pollutants (HAPs), and odiferous species can be emitted from a variety of sources in industrial facilities and commercial operations. Known and/or permitted emissions can originate from stacks, tanks, vents, and other sources as part of normal operations. These sources are typically well-understood and lend themselves to standard emission inventory approaches. Some industrial emissions can be less predictable (randomly occurring) and can originate from unanticipated sources or sources that are generally not well understood.[1]

[1] EPA, 2018

In this Quality Assurance Project Plan (QAPP), these randomly occurring emissions are called stochastic industrial sources (SIS), and they are broadly defined to include fugitive emissions and equipment leaks, improperly vented emissions, variably emitting area sources and sewers, and emissions from malfunctioning processes or improperly controlled operations. Compared to most air pollution sources, emissions from SIS are more challenging to understand and manage. Whereas traditional sources have a definite emission origin (e.g. a stack or tailpipe) and are typically understandable through engineering models (e.g. fuel-based emission factors), SIS can have an unknown location (or even unknown existence). Emissions from SIS can be spatiotemporally heterogeneous and profoundly affected by environmental factors, making them difficult to detect, measure, and model. For example, detection of SIS becomes more challenging with increasing distance from the source. Information on facility SIS emissions can be obtained from systems operating on a variety of spatial and temporal scales. Information from multiple systems can provide additional diagnostic value for SIS detection and assessment.[2]

2.3.2 Chloroprene Emissions-Denka Performance Elastomer Facility

As presented in Section 1.0, Denka owns and operates a neoprene manufacturing facility (the only neoprene production facility in the U.S.) at the Pontchartrain Works Site in Laplace, Louisiana (the “Facility”). The 2011 National Air Toxics Assessment (NATA) results indicated the highest modeled cancer risks in the country were associated with an area in St. John the Baptist Parish, Louisiana, attributable to chloroprene (a likely human carcinogen) emissions from Denka’s Facility. EPA Region 6 began monitoring the air at six locations in the surrounding community in May 2016 (see Figure 2-2), conducted a CAA inspection of the Facility in June 2016, and subsequently referred CAA violations to the DOJ for civil enforcement.

Pursuant to a January 2017 Louisiana Department of Environmental Quality (LDEQ) Administrative Order on Consent (“State AOC”), Denka installed a Regenerative Thermal Oxidizer (RTO) and other controls, designed to achieve an 85% reduction in Denka-reported chloroprene emissions. While the RTO’s operation has decreased ambient concentrations of chloroprene in the community, ongoing monitoring results, presented in Table 2-3, indicate that ambient chloroprene concentrations remain higher than 0.2 microgram per cubic meter ($\mu g/m^3$), the inhalation exposure concentration associated with an estimated 100-in-1 million lifetime cancer risk (based on the current inhalation unit risk value from EPA’s Integrated Risk Information System). A 100-in-1 million lifetime cancer risk is generally described as the upper limit of acceptability for purposes of risk-based decisions at EPA. The post-RTO implementation monitoring results in Table 2-3 are based on the analysis of 24-hour time integrated canister samples with a method detection limit (MDL) of 0.0469 $\mu g/m^3$ by TO-15 GC/MS (reference method). Table 2-4 represents monitoring results of pre-RTO implementation for comparison.

[2] EPA, 2018

Table 2-3. Statistical Chloroprene Concentrations in LaPlace Post-RTO Implementation

Site	Average Concentrations* (µg/m^3)	Median Concentrations* (µg/m3)	Minimum Concentrations* (µg/m3)	Maximum Concentrations* (µg/m3)	Sample Count (N)	Sample count above MDL (N)
238 Chad Baker	2.27	0.433	0.0156	37.4	171	59
Acorn and Hwy 44	1.40	0.0234	0.0156	77.3	171	88
East St. John High School	0.494	0.0812	0.0156	5.51	171	79
Fifth Ward Elem. School	1.74	0.222	0.0156	52.8	170	61
Levee	2.35	0.386	0.0156	98.7	171	53
Ochsner Hospital	1.27	0.0642	0.0156	41.0	171	79

* Calculated after replacing non-detects with one-half the detection limit and includes results available starting March 2, 2018 through December 25, 2019. The monitoring data collected followed the national Quality Assurance Project Plan (QAPP) developed by EPA/OAQPS.

Table 2-4. Statistical Chloroprene Concentrations in LaPlace Pre-RTO Implementation

Site	Average Concentrations* (µg/m^3)	Median Concentrations* (µg/m3)	Minimum Concentrations* (µg/m3)	Maximum Concentrations* (µg/m3)	Sample Count (N)	Sample count above MDL (N)
238 Chad Baker	8.39	1.98	0.0180	70.0	213	55
Acorn and Hwy 44	3.52	0.0725	0.0180	153	213	101
East St. John High School	1.84	0.297	0.0180	39.5	213	79
Fifth Ward Elem. School	6.86	1.34	0.0180	150	213	63
Levee	5.64	0.932	0.0180	147	213	54
Ochsner Hospital	3.38	0.161	0.0180	89.2	213	88

* Calculated after replacing non-detects with one-half the detection limit and includes results available starting May 26, 2016 through March 1, 2018. The monitoring data collected followed the national Quality Assurance Project Plan (QAPP) developed by EPA OAQPS.

EPA believes there are unaccounted emissions at the Facility, likely attributable to SIS. The use of a continuous monitoring system is essential in identifying and characterizing the sources of emissions that could be controlled. Figure 2-3 is a seasonal wind rose for February through March 2019 using data from a Louisiana Automated Surface Observing System (ASOS) about 16 statute miles from the Denka Facility. This wind rose is representative of the time period for the Initial Phase of monitoring. Figure 2-4 is a seasonal wind rose for April through July 2019 and is representative of the period when the Sampling Phase will likely occur. Accordingly, the meteorological data presented may not be completely representative of the meteorological conditions encountered at the preferred monitoring sites but will provide a general understanding of patterns of wind flow.

Figure 2-2. Location of the Facility with Respect to Monitoring Locations

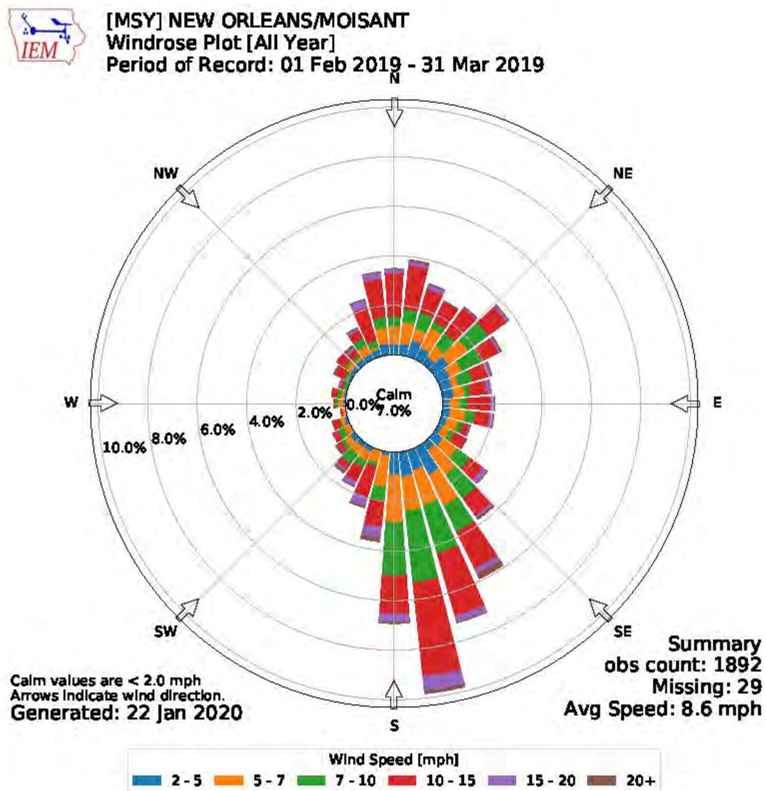


Figure 2-3. Seasonal Wind Rose for February - March of 2019, for Louisiana ASOS at MSY Airport (Iowa State University – Iowa Environmental Mesonet website).

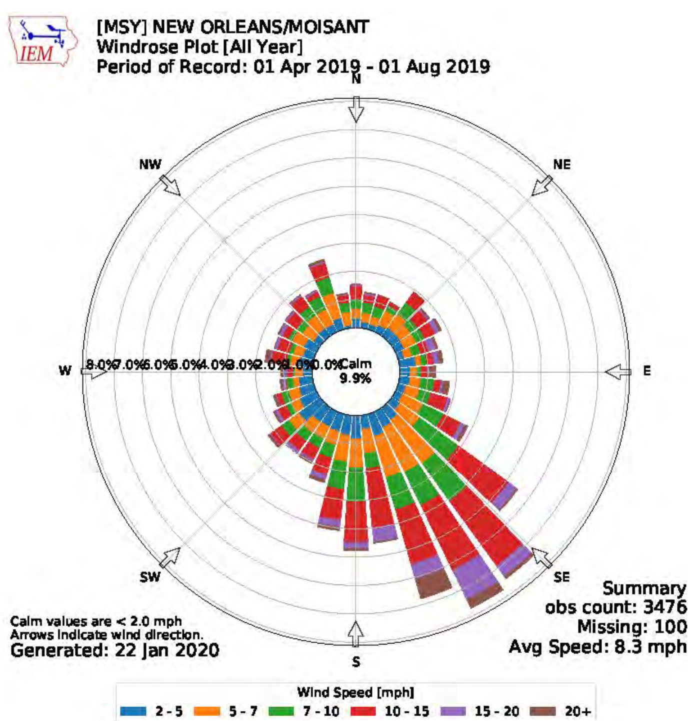


Figure 2-4. Seasonal Wind Rose for April - July of 2019, for Louisiana ASOS at MSY Airport (Iowa State University – Iowa Environmental Mesonet website).

The overall objectives for the SPod monitoring project are:

1) To field verify the effectiveness of continuous monitoring using the non-speciated VOC concentration SPod photoionization detector (PID) measurements to detect elevated chloroprene concentrations coming from Facility process areas at six discreet locations.
2) To better understand the relationship between PID measured VOC concentrations and chloroprene concentrations measured in 24-hour canister samples.
3) To better understand the data processing necessary to make useful determinations from these characteristics.
4) To help identify unknown or under-characterized emissions sources and activities in the Facility.
5) To evaluate suitability of each sampling location for SIS detection and the impact of proximity of sampling location to the emissions source.

2.4 Element A.6: Project/Task Description

Work for this project will be accomplished in phases. Information gathered from each phase will inform the next phase. This QAPP was written for SPod Monitoring to detect SIS emissions in conjunction with canister sampling to measure SIS emissions surrounding the Denka Facility. The first phase will be the field demonstration using Sensit Technologies' SPod systems for continuous monitoring and collecting canister samples. Once the monitoring systems are operating, the data obtained from the SPod monitoring will be used in conjunction with data obtained from SPod triggered canister sampling to identify potential emissions.

Proximity to source from sampling locations for SIS detection will be evaluated throughout monitoring. If it is determined that certain sampling locations are not suitable, alternative sampling locations may be identified. The QAPP will be updated if alternative sampling locations are identified.

The effectiveness of an SPod-type sensor to detect SIS emissions is impacted by the proximity of potential emission sources. In this project, the SPod sensors will be deployed at a variety of distances around the Denka Facility, at the locations of the ambient air sampling sites. To employ the SPod systems, a field demonstration will verify the effectiveness of the sensors at the identified locations. The relative distances from each site to the Denka facility are displayed in Table 2-5.

In addition to the commencement of this monitoring project, EPA will seek additional detailed operational and maintenance information from Denka to assist assessment.

Table 2-5. Distances from SPod Monitoring Sites to Denka Facility in LaPlace, LA

Site	Distance (m)	Distance (km)	Distance (miles)
238 Chad Baker	943.20	0.94	0.59
Acorn and Hwy 44	1375.78	1.38	0.85
East St. John High School	2529.70	2.53	1.57
Fifth Ward Elem. School	941.59	0.94	0.59
Levee	530.34	0.53	0.33
Ochsner Hospital	1832.73	1.83	1.14

The expected project schedule is presented in Table 2-6 and may be subject to change. As planned, the project will take approximately nine to ten months to complete.

Table 2-6. Project Schedule

Phase	Expected Initiation
QA Testing	January-February 2020
Initial Phase of Monitoring	March–April 2020
Sampling Phase of Monitoring	May-September 2020

Note: sampling phase could be delayed if the canister sampling automatic trigger software method needs further development.

2.5 Element A.7: Quality Objectives and Criteria

Overall measurement quality objectives (MQOs) for this project can be defined in terms of the following data quality indicators:

- Precision - a measure of mutual agreement between individual measurements performed according to identical protocols and procedures. This is the random component of error.
- Accuracy - in terms of bias is the systematic or persistent distortion of a measurement process that causes error in one direction. Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.
- Detectability - the determination of the low range critical value of a characteristic that a method-specific procedure can reliably discern.
- Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.
- Comparability - a measure of the level of confidence with which one data set can be compared to another.

Due to some known limitations in the SPod sensor's capability/environmental factors, the SPod is not expected to provide 100% data completeness; 70% is the anticipated completeness target.

There is a potential for project MQOs to change based on data collected in the Initial Phase. A summary of the overall MQOs for this project is presented in Table 2-7.

Table 2-7. Summary of Overall Project Measurement Quality Objectives

Parameter	Method	Accuracy	Precision	Completeness	Comments
SPod PID	Determination of plume detects by analysis of PID sensor data	±25%	±25%	70%	Indicative technique supporting plume detection/location based on PID measurements greater than five times the MDL.
Temperature, pressure, and relative humidity measured by SPod sensor	Determination of 5-min period plume detects by analysis of sensor data and reasonableness check against NWS*	±10°C@, ±4 kPa, ±20%	±10°C@, ±4 kPa, ±20%	70%	Reduced completeness reflects use of solar-powered units
Wind speed by SPod	Post analysis reasonableness check against NWS	±1 m/s	±1 m/s	80%	Reduced completeness reflects use of solar-powered units
Wind direction by SPod	Post analysis reasonableness check against NWS	±10°	±10°	80%	Reduced completeness reflects use of solar-powered units
Canister VOC	TO-15	±25%	±25% for detects ≥ 5 x MDL	80%	

@10°C SPod inlet heaters may affect comparisons.
*National Weather Service (NWS)
TO-15 Quality objectives based on ERG's EPA-approved QAPP for support of EPA's National Monitoring Programs[7]

2.6 Element BA.8: Special Training/Certification

Training for some roles is necessary. EPA ORD provided hands-on SPod training to the EPA contractor, ERG, during ORD QA testing of the SPod units. However, further training is needed as follows:

- ERG will train Weston to perform bump tests, troubleshoot the SPod systems, download data from secure digital (SD) cards, arm the canister trigger collection systems, recover the collected samples, and ship samples to ERG's lab upon deployment (and document training in project notebook).
- ERG will process SPod data. As a quality check on SPod data processing, a second ERG person will be trained and will process a percentage of data files, as specified by the EPA OECA Project Lead.

2.7 Element A.9 Documents and Records

Interim data products, notes, and QA information produced by individual groups will be organized and stored by those groups as per their office standard procedures. The EPA OECA Project Lead is responsible for collecting all data and associated notes from all individual groups. During the project, at the end of each day that on-site tasks are performed, the SPod data files will be backed up from Sensit database by ERG. Log sheets, forms, and QC information will be photo-copied or photographed, and two independent copies will be maintained. These data will be sent to ERG upon return from the field.

Data generated by the Sensit SPod will be stored on an internal SD card. The Sensit SPod data will simultaneously be transmitted via cellular network to a password protected Sensit server. This server will only be accessible by the ERG Task Manager or an appointed ERG personnel. ERG will access the password protected Sensit server to retrieve data daily at the beginning of each sampling effort and no less than twice weekly as the effort continues.

ERG will compile and process data as discussed in section 5.0 and transmit the data to the EPA OECA Project Lead. Data summaries will also be transmitted. Data will be sent from ERG to the EPA OECA Project Lead via a password-protected ERG ftp server. Only appointed ERG staff and the EPA OECA Project Lead will have access to the password protected ERG ftp server.

ERG will retain all files and records for a period of at least five years after the close of the project and for an extended duration per EPA's request.

3.0 Data Generation and Acquisition

This section discusses how project staff will ensure that data collection methods appropriate for the Denka SIS investigation are employed and documented.

3.1 Element B.1: Sampling Process Design

The goals of this project are multipurpose, impacting air quality, public health, and emission measurement methods. The SPod system is implemented to determine whether continuous SPod PID VOC/HAP measurements at six discreet locations will be effective in identifying SIS of chloroprene emissions from the Facility, which are believed to be the source of chloroprene emissions currently unaccounted for. The SPod system "detects" where the emissions are originating by instantaneously correlating elevated concentrations with wind direction. By deploying the SPods at the community monitoring sites surrounding the Facility, a potential emission event detected by the SPod PID sensor may be corroborated with chloroprene data from associated SPod canister sampling, as available. This allows potential confirmation that the SPod system is detecting a chloroprene plume, since the SPod PID cannot differentiate between VOCs and the canister samples are analyzed by EPA Method TO-15, an established and validated VOC method. By using the SPod PID sensor technology to identify potential elevated VOC/HAP concentrations, along with information obtained from associated SPod canister samples or the EPA's current 24-hour canister sampling, the efficacy of utilizing SPod systems for measurement and detection of plume containing VOC/HAP such as chloroprene can be determined for this application.

The project involves installing six Sensit SPods. These units are equipped with PIDs and with event-triggered evacuated canister systems. The SPods will be installed at the current community sampling sites surrounding the Facility, with the intent to detect elevated concentrations of total VOCs in the air, which may include chloroprene. The SPod PIDs can detect VOCs with ionization energies of 10.6 eV or below. Following the pre-deployment QA testing, field testing near the Denka Facility will include two phases:

1. The Initial phase consists of six SPods deployed separately at the six current community sampling sites surrounding the Facility (see Figure 3-1 for overhead photograph of facility operations) for approximately two months. The data gathered in this phase will be processed and used to assess the sampling equipment performance (see Table 3-2 for performance criteria) and develop a trigger concentration for canister samples and averaging period for that concentration. A seventh SPod may be added as a collocate at one of the sites.
2. The Sampling phase consists of six SPods deployed at the six current community sampling sites surrounding the Facility for at least four months. The purpose of this phase is to collect data and determine if SIS can be measured. During this phase, the plan is to collect continuous SPod data and collect event-triggered 24-hour canister samples at the previously determined trigger concentration. The determined trigger concentration is subject to change as more data become available. The entire project will be evaluated at four months to determine if it should continue for a longer duration and how much more sample collection time will be required. A seventh SPod may be added as a collocate at one of the sites.

The first phase of the project attempts to answer the following questions:

- Can the SPod network accurately characterize and identify VOC/chloroprene plumes as demonstrated by acceptance criteria in Table 3-2?
- Do the SPod data processing procedures need modification to better determine the characteristics of SIS?

The second phase of the project attempts to answer the following question:

- Can the SPod network identify SIS of chloroprene emissions from the Facility as demonstrated by acceptance criteria in Table 3-2?
- Can the SPod network identify and characterize spatial/temporal chloroprene concentrations and chloroprene emission sources at the Facility?

During this project, even data that do not meet acceptance criteria provide information that is useful to the project. As the Sensit SPods are an emerging technology, data processing procedures may need to be adapted from the procedures described in Section 4.7 of EPA’s MOP 3010.

The SPods will be installed at each of the six current community sampling sites, shown in Figure 3-1:

- Ochsner Hospital (30.071420°, -90.515436°)
- Acorn and Hwy 44 (30.058785°, -90.509599°)
- Mississippi River Levee (30.051803°, -90.522571°)
- 5th Ward Elementary School (30.051938°, -90.531859°)
- 238 Chad Baker (30.057070°, -90.533381°)
- East St. John High School (30.077830°, -90.532944°)

Figure 3-1. Aerial image of planned SPod deployment around Facility

Weston Solutions field personnel will visit each site, once every six days. During the site visits the sampling equipment will be checked, canister samples will be recovered or deployed, periodic bump tests will be performed, and SD card data will be downloaded.

A seventh EPA ORD Sensit SPod will collocated at one of the locations as determined by EPA's OECA Project Lead. This unit can also serve as a spare that could be used as a replacement of one of the primary six SPod units.

The procedures for the SPod preparation, initial evaluation, deployment, and use are described in MOP 3010 (Appendix B). Any changes made to SPod set-up will be recorded on a SPod Field Deployment Form from Section 7 of MOP 3010. A copy of all forms completed on-site will be sent to the ERG Task Manager.

3.2 Element B.2: Sampling Methods

3.2.1 SPod Measurement Approach

3.2.1.1 General SPod Description

The SPod is a low cost, solar-powered system that combines wind field and air pollutant concentration measurements to detect emission plumes and help locate the source of emissions. The Sensit SPods will be configured to collect 24-hour integrated air samples when a localized high concentration is measured by the SPod. The SPod sensor technology is used along with the established and validated canister method, to identify potential elevated chloroprene concentrations. Figure 3-2 shows a Sensit SPod system without the canister trigger. The SPods are equipped with sensors including PID sensors that provide a time-resolved indicator of VOC compounds (estimated, nonspeciated) present in the air.

Figure 3-2. Sensit SPod system

A subset of air pollutants can be ionized by the Sensit SPod's 10.6 eV PID, an Ion Science MiniPID 2. The PID detection sensitivity ranges from less than 0.001 ppm to > 40 ppm and responds to mixtures of VOCs usually present in fugitive plumes. When observed from a fixed single point location, the plume from a proximate emission source produces a time-dependent concentration signal that can be distinguished from the baseline through data analysis. If needed, the raw PID data can be processed using a custom software program, such as "R". Figure 3-3 shows an example of EPA SPod data from two co-deployed units near a refinery fence line, the red and black traces, with (a) showing raw signal, and (b) showing signal after data analysis. A zoomed in view of (b) shows peak events around 8:00 pm.[3]

[3] EPA, 2018

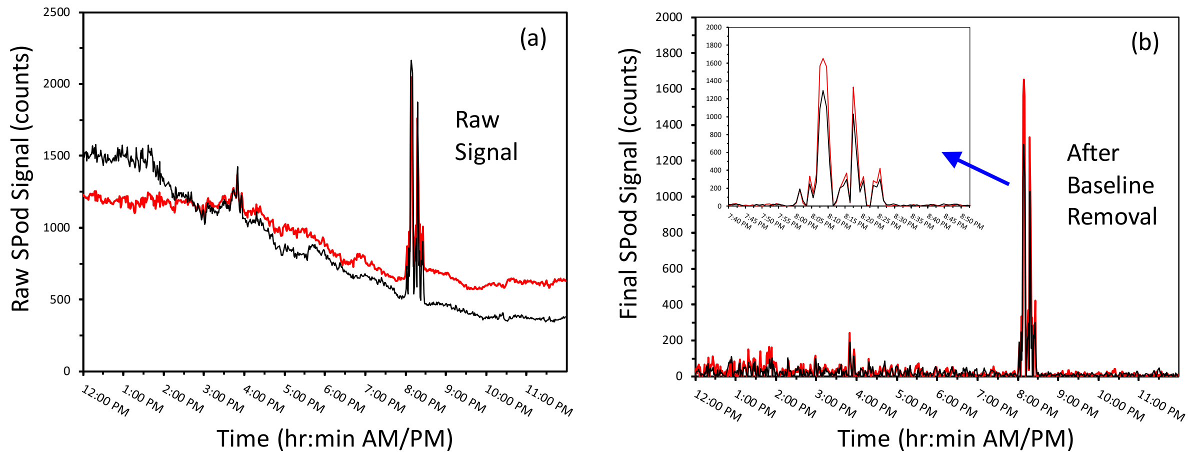


Figure 3-3. Example of (a) raw and (b) processed SPod data[4]

The SPods will be set up by the EPA contractor, ERG, to run continuously. A data logging system containing a micro SD card will be used, and wireless capability to connect the SPods for remote data retrieval will be used during the project.

The SPod sensors will be mounted on a pole system so the sensors stand at approximately 2 m above ground level. Further details for SPod setup, including pole or tripod, orientation, connections, and syncing, are presented in Section 4.6.3 of MOP 3010. It is critical to select an area with an unimpeded wind flow. ERG will orient the tripod so that the side of the anemometer marked with a notch is facing toward the north as accurately as possible. Ideally a GPS should be used to orient towards true north. ERG will note if a compass is used so the magnetic declination can be accounted for in data processing. If using tripods, ERG will make fine adjustments to the tripod legs (or other fixture) to achieve a level setup. ERG will verify using a bubble level placed on the tripod top (not the sonic anemometer).

The SPods will be solar powered (a fully charged Sensit SPod can operate for three to five days without sun). For solar powered deployments, the SPod should be oriented so that the solar panel is facing south (this should be verified using a compass, GPS, or smart phone) in an area free of shade for 8 hours daily.

3.2.2 Initial Phase

In the Initial phase sampling, SPods will be deployed at the six current community sampling sites. The field contractor will visit each monitoring location site every six days initially for a potential of up to four triggered canister samples per site every six days (see Section 3.2.4 for further discussion of the triggered canister sampling). The data collected in the initial phase will allow potential plume measurements to be compared between the SPods and the associated triggered canister samples. A seventh SPod unit will be a spare that can be used to replace one of the SPods, if one should need to be taken out of service.

[4] EPA, 2018

During the two-month Initial phase, the triggered 24-hour canister samples will be analyzed as follows:

- For the first two weeks, when an SPod detects a plume (i.e. a predetermined concentration level has been exceeded), the automatically triggered canister sample will be analyzed for fifty-nine VOCs by EPA Method TO-15 (including chloroprene). Table 3-1 lists the compounds and ERG's current MDLs.
- Thereafter, when an SPod detects a plume (i.e. a predetermined concentration level has been exceeded), the automatically triggered canister sample will be analyzed for chloroprene only. Other key VOCs may be analyzed for on a case-by-case basis, if it is determined by the Project Lead to aid with detection of SIS.
- When no plume is detected by the SPod no canister sample will be collected or analyzed.

During the Initial phase, the following will be accomplished:

- Determine a trigger concentration at each monitoring location site and averaging period for the concentration.
- Assess the sampling equipment performance for determining chloroprene plumes.
- Update the SPod data processing/analysis method, if needed, to aid characterization. The current data analysis method is described in section 4.7 of EPA's MOP 3010.
- Demonstrate the automated canister sampling trigger and remote trigger adjustment capabilities are functioning correctly. As such, the initial canister sampling trigger level will be based on initial monitoring PID monitoring data, at a level a canister sample would be expected to be triggered during the first week of deployment. The initial level will be above the average baseline fluctuation and but within a low enough threshold it should be triggered easily. After the initial collection at each monitoring location, each trigger level will be adjusted higher to try and only capture plume events. Trigger levels will be assessed throughout the project, including during the initial phase.

3.2.3 Sampling Phase

For the Sampling phase, the SPods will continue to be deployed at the six current community sampling sites to collect continuous data for at least four months. The basic purpose of the Sampling phase is to collect continuous SPod data, to collect event triggered canister samples, and to determine if SIS can be detected.

3.2.4 Triggered Sampling with Evacuated Canisters

While the Sensit SPod PID sensor will provide a total VOC concentration, canister sampling will provide the additional information of what species of VOCs contribute to the concentration measured on the PID sensor.

Each SPod is equipped with a system that can collect 24-hour integrated gas samples in evacuated canisters using an automated canister trigger system. When a concentration measurement by the SPod exceeds a set threshold average concentration the trigger will be activated and a 24-hour integrated canister sample will be collected. The automated canister trigger system can accommodate up to four canisters at a time to allow multiple triggered events. The trigger values will be set during deployment by ERG and will be re-assessed by ERG and the EPA OECA Project Lead throughout the project.

The Sensit SPod manual, found in Appendix E, states that the sample time can be set for 1-3600 seconds. The SPods used for this monitoring effort have been modified by Sensit to include a latching valve and a program that will allow for collections between 0 and 86400 seconds.

The flowrate into the canister triggers will be controlled by Entech CS1200E Flow Controllers. Each Entech flow controller has an internal calibrated flow orifice that allows enough air to pass through to fill up a six-liter Summa canister over a 24-hour period. The canister triggers utilized for this effort have been modified for four independent 24-hour samples to be collected.

3.2.5 Continuous Meteorology Measurements

The Sensit SPods for this project are fitted with an anemometer (Airmar WX-110 with humidity option) to measure wind speed, wind direction, and temperature. The SPod also has a sensor to measure pressure, temperature, and relative humidity. The SPod meteorological data are collected simultaneously with the SPod PID data.

3.3 Element B.3: Sample Handling and Custody

3.3.1 Canister Preparation

Canisters, in batches of 12, will be cleaned in ERG's laboratory by heated cleaning systems using three cycles of evacuation and pressurization with humidified ultra-pure nitrogen. Following canister cleaning, one of the batches 12 canisters will be analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA Method TO-15 for target VOCs. The acceptance criterion for the cleaned canister analysis is presented in Table 3-4.

Following the acceptance of the clean canister batch and prior to shipment to the site, the batch of canisters will be evacuated to a vacuum of 50 millitorr. Prior to shipment each canister will be tagged for field personnel to add field sample identification (ID) and then packaged with an associated chain-of-custody (COC). An example COC is presented in Figure 3-4. The analytical laboratory will ship prepared canisters in batches of twelve canisters and anticipates shipping at a frequency of 12 canisters every 14 days during this project. ERG will ship the clean evacuated canisters to:

David Bordelon
Weston Solutions, Inc.
13702 Coursey Blvd., Bldg 7
Baton Rouge, LA 70817
(225) 297-5403

ERG
601 Keystone Park Drive, Suite 700, Morrisville, NC 27560

ERG Lab ID # ________

AIR TOXICS SAMPLE CHAIN OF CUSTODY

Lab Pre-Sampling

Site Code: ________ Canister Number: ________
City/State: ________ Lab Initial Can. Press. ("Hg): ________
AQS Code: ________ Cleaning Batch # : ________
Collection Date: ________ Date Can. Cleaned: ________
Options:
SNMOC (Y/N): ________ Duplicate Event (Y/N): ________
TOXICS (Y/N): ________ Duplicate Can # : ________
METHANE (Y/N): ________
Relinquished by: ________ Date: ________

Field Setup

Received by: ________ Date: ________
Operator: ________ MFC Setting: ________
System #: ________ Elapsed Timer Reset (Y/N): ________
Setup Date: ________ Canister Valve Opened (Y/N): ________
Field Initial Can. Press.: ________ **psig psia "Hg (Circle one)**

Field Recovery

Recovery Date: ________ Sample Duration (3 or 24 hr): ________
Operator: ________ Elapsed Time: ________
Field Final Can. Press.: ________ **psig psia "Hg (Circle one)**
Status: **VALID VOID** (Circle one) Canister Valve Closed (Y/N): ________
Relinquished by: ________ Date: ________

Lab Recovery

Received by: ________ Date: ________
Lab Final Can. Press.: ________ **psig "Hg (Circle one)** Converted to psia: ________
Status: **VALID VOID** (Circle one) Gauge: 1 2 (Circle one)
If void, why: ________

Samples stored in Air Tox Lab (Room 130)

5-2018

Comments: ________

White: Sample Traveler Canary: Lab Copy Pink: Field Copy

Figure 3-4. Evacuated Canister COC Form

3.3.2 Canister Setup

The Weston Solutions field personnel will visit the site once every six days during the project. During the site visits the sampling equipment will be checked, canisters from triggered sampling events will be retrieved, and new evacuated canisters attached to the automatic trigger device. Each canister will be attached to the trigger device by inserting the canister's male Micro-QT™ fitting into the female Micro-QT™ fitting attached to the trigger device.

Once the cleaned evacuated canister has been connected to the SPod canister trigger, Weston will determine the initial canister vacuum (if initial vacuum is < 25 inches mercury ("Hg), the canister has leaked and must not be used) and record the following information on the associated COC:

- Initial canister vacuum,
- Canister ID,
- SPod ID,
- Any pertinent notes,
- Whether the canisters valve has been opened,
- The received date,
- The setup date,
- And the location where the sample was acquired.

The Weston Solutions field personnel will write the sample ID information specific to each canister on the canister tag when taking canister samples. This information will also be recorded on the COC documentation. The sample ID codes are as follows:

D-BB-MMDDYY

Where:

D = The fixed study site designation for this project (Denka = D)
BB = Sampling location (01, 02, etc.) link to field notes with GPS locations
MMDDYY = month, day, and year of grab sample acquisition

The canister trigger system will have equipment necessary to obtain a 24-hour canister sample with an approximate final pressure of 5”Hg vacuum. The field QC checks are presented in Table 3-3.

3.3.3 Canister Sample Recovery and Shipping

When collecting triggered canister samples, Weston will record on the COC form:

- Each final canister pressure;
- Any notes related to the sample (potential interfering sources, local climatic conditions, odors, observations), including if more evacuated canisters are connected in preparation for the next triggered canister sampling events;
- The operator’s name;
- The recovery date; and
- And whether the canister valve has been closed.

After sampling, Weston will ship the canister samples to ERG’s analytical laboratory with associated COCs within two weeks of sample collection. The total hold time for canister samples is 30 days from collection. Failure to ship canister samples to the laboratory within two weeks could cause the samples to be invalidated due to missed hold time.

If a canister sample is being collected at the time of the site visit, Weston staff will leave this canister attached to the SPod so it can finish sampling. Weston staff will recovery any other canister samples that collected and set up the next set of canister samples. The sample that is left to collect will be recovered on the following site visit trip six days later. Weston staff will ship the sampled canisters to:

ERG
601 Keystone Park Drive
Suite 700
Morrisville, NC 27560

3.4 Element B.4: Analytical Methods

3.4.1 Analysis of Canister Samples

After sampling, the canister samples will be shipped to ERG's laboratory for analysis by EPA Method TO-15, the Technical Assistance Document for the National Air Toxics Trends Stations (NATTS) Program, Revision 3[5], and ERG's EPA-approved QAPP for support of EPA's National Monitoring Programs[6]. These documents provide guidance on analytical procedures for the measurement of VOCs in ambient air. Initially, the analysis will be for a suite of VOCs including chloroprene. As the study goes on, chloroprene will be the only analysis target compound.

The canister samples will be received at ERG's laboratory. ERG will pressure-check the canisters and fill out the COC forms. ERG will analyze the canister samples within the 30-day hold time provided the sample are shipped to ERG in a timely manner. ERG's Task Manager will inform EPA OECA Project Lead if canister samples do not arrive within the 30-day hold time.

The canister samples will be analyzed using an Entech autosampler/Agilent GC/MS system in Selected-Ion Monitoring (SIM) mode following ERG's laboratory's standard operating procedure for EPA Method TO-15. The acceptance criteria for this analysis is presented in Table 3-4. The analytical laboratory will deliver the canister sample data in Excel and pdf form.

If canister sample results are greater than 10 percent of the highest calibration point of the curve used to calibrate the GC/MS used for analysis, the canisters will be diluted with air and reanalyzed.

[5] EPA, 2016
[6] ERG, 2019

Table 3-1. ERG's Laboratory VOC MDL – Compendium Method TO-15

Target Compounds	ppbv	µg/m^3	Target Compounds	ppbv	µg/m^3
1,1,1-Trichloroethane	0.0149	0.0815	Dibromochloromethane	0.0124	0.106
1,1,2,2-Tetrachloroethane	0.0165	0.114	Dichlorodifluoromethane	0.0371	0.184
1,1,2-Trichloroethane	0.0114	0.0623	Dichlorotetrafluoroethane	0.0103	0.0722
1,1-Dichloroethane	0.00728	0.0295	Ethyl Acrylate	0.0145	0.0595
1,1-Dichloroethene	0.0124	0.0493	Ethyl *tert*-Butyl Ether	0.00742	0.0311
1,2,4-Trichlorobenzene	0.141	1.05	Ethylbenzene	0.0178	0.0775
1,2,4-Trimethylbenzene	0.0330	0.163	Ethylene Oxide	0.0614	0.267
1,2-Dibromoethane	0.0132	0.102	Hexachloro-1,3-Butadiene	0.0727	0.777
1,2-Dichloroethane	0.00857	0.0348	*m,p*-Xylene	0.0325	0.141
1,2-Dichloropropane	0.0111	0.0514	*m*-Dichlorobenzene	0.0236	0.142
1,3,5-Trimethylbenzene	0.0114	0.0562	Methyl Isobutyl Ketone	0.0102	0.0419
1,3-Butadiene	0.0110	0.0244	Methyl Methacrylate	0.0750	0.308
Acetonitrile	0.0746	0.126	Methyl *tert*-Butyl Ether	0.0198	0.0715
Acetylene	0.110	0.117	Methylene Chloride	0.0512	0.178
Acrolein	0.144	0.331	*n*-Octane	0.0233	0.109
Acrylonitrile	0.0219	0.0476	*o*-Dichlorobenzene	0.0278	0.167
Benzene	0.00987	0.0316	*o*-Xylene	0.0225	0.0979
Bromochloromethane	0.0102	0.0541	*p*-Dichlorobenzene	0.0242	0.146
Bromodichloromethane	0.0111	0.0745	Propylene	0.141	0.243
Bromoform	0.0140	0.145	Styrene	0.0151	0.0645
Bromomethane	0.00994	0.0387	*tert*-Amyl Methyl Ether	0.0101	0.0423
Carbon Disulfide	0.0415	0.129	Tetrachloroethylene	0.0144	0.0979
Carbon Tetrachloride	0.0109	0.0687	Toluene	0.0182	0.0687
Chlorobenzene	0.0102	0.0471	*trans*-1,2-Dichloroethylene	0.0116	0.0461
Chloroethane	0.0161	0.0426	*trans*-1,3-Dichloropropene	0.0138	0.0571
Chloroform	0.00829	0.0406	Trichloroethylene	0.0123	0.0662
Chloromethane	0.0344	0.0712	Trichlorofluoromethane	0.0166	0.0935
Chloroprene	0.0222	0.0805	Trichlorotrifluoroethane	0.00982	0.147
cis-1,2-Dichloroethylene	0.0336	0.0777	Vinyl Chloride	0.0102	0.0250
cis-1,3-Dichloropropene	0.00994	0.0374			

3.5 Element B.5: Quality Control

3.5.1 Continuous SPod PID Measurements QC Checks

In this study, SPods provide general information on concentration and direction of plumes. The quality assurance/quality control (QA/QC) procedures for the SPod are described in MOP 3010 in Appendix B and summarized in Table 3-2. Corrective action for data with unacceptable QA/QC will be determined by ERG and the EPA OECA Project Lead.

Total VOC measurements from the PID are known to be affected by atmospheric conditions. Although a bump test will prove the PID is working and responding to gas properly, the PID is also affected by rapidly changing conditions causing a "false detect". To properly identify a "false detect" ERG will analyze temperature, humidity and pressure data during the time of spikes over 40 ppb, and all occurrences of a canister trigger that is analyzed over 5 µg/m3. ERG will flag this data or verify that the data are valid.

To assess how data compare across methodologies and between SPods, relative percent difference (RPD) and coefficient of variations (COVs) will be calculated based on Equations 1 and 2 below, as defined in 40 CFR, Part 58, Appendix A, Section 4.2.1. Precision will be assessed between a triggered canister sample and the associated PID measurement.

Equation 1

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \cdot 100$$

where:

d_i = the relative percent difference (%) for sample i

X_i = the result from the primary sampler for sample i

Y_i = the result from the collocated sampler for sample i

Equation 2

$$COV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2}{2n(n-1)}} \cdot \sqrt{\frac{n-1}{X^2_{0.1,n-1}}}$$

where:

d_i = the relative percent difference (%) for sample i

n = the number of valid data pairs being aggregated

$X^2_{0.1,n-1}$ = the 10^{th} percentile of a chi-squared distribution with n-1 degrees of freedom

For each triggered canister sample, an RPD between chloroprene, or other determined VOC in sample, and the measured PID concentration will be calculated using Equation 1. A dilution factor may have to be established based on the duration of the measured SPod reading to compare to the 24-hour integrated sample. Measured concentrations between canister measurements and the SPod concentrations should match up within 50% RPD.

Measured concentrations from any collocated sets of Sensit SPods will be compared to establish a COV. Initially, bump tests and concentrations measured on both systems above 40 ppb will be considered. Concentrations from collocated measurement analysis should be within 40% COV. If data do not fall within 40% COV an "estimate" or E flag will be assigned to the data from the last collocated measurement that passes until the next collocated measurement that passes.

As the Sensit SPods are an emerging technology and do not conform to a pre-established EPA method, QA criteria will be reevaluated throughout the monitoring effort.

Table 3-2. Summary of Field SPOD QA/QC Procedures

Parameter	Acceptance Criteria	Method Procedure / Corrective Action	Frequency
Verify proper SPod set up	Completion of SPod Field Deployment Form, items 1-20	Execute MOP 3010 Section 4.6 / If during installation test, specific sensors are found to be non-operational, consult with field lead on corrective actions	Once at installation, then monthly during study
Periodic SPod PID check (bump tests)	Positive deflection of baseline with each of 3 bump tests; agreement in amplitude of baseline deflection within ±25%*; completion of SPod Field Deployment Form or ERG generated form	Execute MOP 3010 Section 4.6.3.7 / If during check specific sensors are found to be non-operational, consult with field lead on corrective actions	Once at installation, monthly during study, and at end of study
Data Screen	Completion of SPod Data Analysis Review Form, items 1-11 (or digital equivalent)	Execute MOP 3010 Section 4.6/ No corrective action is required	Daily (or other frequency specified by project lead) for days data is acquired
Wind Measurement Check	Reasonableness (±40%) compared to independent values	Perform reasonableness check by comparing acquired data between SPods and NWS / if found problematic, exclude data or flag as an estimated measurement	10% review once per month
Method Comparison Check	Reasonableness of PID data compared to associated canister sample values (±50%[#])	Perform reasonableness check by comparing elevated PID data to associated canister samples, if applicable / if found problematic, check for larger changes in wind direction or RH, and PID drop out.	As available
Data Co-location Check	Reasonableness of PID data compared to any co-located SPod values (±40%COV)	Co-located: Perform reasonableness check by comparing SPod ppb PID data between any collocated SPods. During data processing perform reasonableness check by: • Comparing Bump Test results between paired SPods, • Comparing measured concentrations where both paired units measure concentrations above 40ppb, or a later defined value. If values do not compare reasonably a second comparison will be considered using the raw mV readings between the paired SPods. The next bump test or another point of comparison will also be considered to declare data back within reason. All data from the point of the failing comparison to the next passing comparison will be flagged as an estimate.	As available per bump test or weekly paired measurement comparison. Only for collocated SPods.
PID Check	Reasonableness compared to other SPod values (±50% COV)	Perform reasonableness check by comparing calculated PID results (ppb) across all Sensit SPod systems under certain “calm” overnight atmospheric conditions. This would help ensure the PIDs are not being individually affected by temperature or humidity.	Once per month

Parameter	Acceptance Criteria	Method Procedure / Corrective Action	Frequency
Heater Check	Reasonableness check that Sensit SPod PID heater is controlling temperature.	Determined during Pre-deployment testing by assessing heater output in data.	Pre-Deployment or when heater control is in question due to data observation.
Can Trigger Check (Pre-Deployment)	Leak check: <1.0” Hg in 48 hrs Verify system trigger command works	Perform leak check on trigger system for 48 hours, and send manual trigger to verify operation of system	Once before deployment
Can Trigger Leak Check (Deployed)	Leak check: <1.0” Hg in 1 minute	Perform leak check on trigger system for 1 minute.	At each canister deployment in the field.
Can Trigger “False Trigger”	Assessment to ensure canister trigger is functioning appropriately	Site operators would need to manually trigger a canister collection at the site to ensure the canister trigger is functioning and can collect a canister sample.	In the event that the data file denotes the SPod triggered a canister collection but the canister did not actually collect. Only necessary on incident

* 25% from average of 3 SPod measurements; rolling average if baseline drift at site becomes an issue.
\# Difference between two methods; SPod PID concentrations will be determined based on the response of the most recent bump test.

3.5.2 Continuous SPod Meteorological Measurements

The systems incorporate ultrasonic anemometers to measure wind speed, a sensor to measure relative humidity, and a sensor to measure ambient temperature. Measurements will be made at a height of approximately 2 meters above grade (to approximate breathing height without ground level interferences). Post-analysis reasonableness checks will be performed against meteorological data from the other SPods and/or NWS. The QC procedures for the anemometer are described in Table 3-2.

3.5.3 Canister Sample QC Check

Table 3-3 summarizes the in-field QA/QC checks for canister sampling.

Table 3-3. Summary of Field Canister Sample QA/QC Procedures

Parameter	Acceptance Criteria	Method Procedure / Corrective Action	Frequency
Initial Canister Vacuum	Between 25 and 29.9” Hg vacuum	Read gauge and record initial vacuum on COC, circle Valid or Void based on vacuum criteria / select another canister if Void and return Void canister with COC to Lab	Immediately prior to canister use for samples and upon connecting to SPod for triggered canister samples
Final Canister Vacuum	Vacuum 8 ± 5” Hg	Read gauge and record final vacuum on COC, circle Valid or Void based on vacuum criteria and return canister (Valid or Void) with COC to Lab	After a triggered canister sampling event
Ship Sampled Canister to Lab	Within 2 weeks of sampling	Longer than 2 weeks reduces Lab hold time (total hold time 30 days from sample collection)	NA

NA – Not applicable

Table 3-4 summarizes the analytical QA/QC activities for canister sample analysis.

Table 3-4. Summary of Analytical Laboratory Method TO-15 QA/QC Procedures

Parameter	Acceptance Criteria	Corrective Action	Frequency
Bromofluorobenzene (BFB) Instrument Tune Performance Check	Evaluation criteria presented in the lab SOP	Retune; clean ion source and/or quadrupole	Daily prior to sample analysis
Initial calibration (ICAL) consisting at least 5 points	1) %relative standard deviation (RSD) of response factors < ±30% (with two exceptions of up to ±40%) 2) internal standard (IS) response ±40% of mean curve IS response 3) relative retention time (RRTs) for target peaks ±0.06 units from mean RRT 4)IS retention time (RTs) within 20 seconds of mean	Repeat individual sample analysis; repeat ICAL; prepare new calibration standards and repeat analysis	Following any major change, repair or maintenance or if daily QC is not acceptable. Recalibration not to exceed three months.
Second source initial calibration verification (ICV)	The response factor ≤ ±30% deviation from calibration curve average response factor	Repeat ICV; repeat ICAL	Following the calibration curve
Continuing calibration verification (CCV)	The response factor ≤ ±30% deviation from calibration curve average response factor	Repeat CCV; repeat ICAL	Before sample analysis on the days of sample analysis
Method Blank (MB)	Targets <3x minimum detection limit (MDL) or 0.2 ppbV, whichever is lower and IS area response ±40% and IS RT ±0.33 min. of most recent ICAL	Repeat analysis; repeat analysis with new blank canister; check system for leaks, contamination	Daily following BFB and calibration check; prior to sample analysis
Replicate Analysis	≤25% relative percent difference (RPD) for compounds greater than 5 x MDL	Flag data	One per analytical sequence
Canister Cleaning Certification	Targets <3x MDL or 0.2 ppbV, whichever is lower	Reclean canisters and reanalyze	One canister analyzed on the Air Toxics system per batch of 12
Preconcentrator Leak Check	≤ 0.2 pounds per square inch (psi) change/min	Retighten and reperform leak check; perform maintenance; re-perform leak check	Each standard and sample canister connected to the preconcentrator/autosampler
Retention Time (RT)	RT within ± 0.06 RRT units of most recent initial calibration average RT	Repeat analysis	All qualitatively identified compounds
Samples - Internal Standards (IS)	IS area response within ±40% and IS RT within ±0.33 min. of most recent ICAL average IS response	Repeat analysis	All samples
Canister Sample Hold Time	30 days from collection	Qualify samples over total hold time of 30 days from sample collection	NA

NA not applicable; TO-15 QA/QC procedures based on ERG's EPA-approved QAPP for support of EPA's National Monitoring Programs[7]

[7] ERG, 2019

3.6 Element B.6: Instrument/Equipment Testing, Inspection, and Maintenance

3.6.1 Pre-deployment Isobutylene Testing

This study utilizes a commercially available SPod unit developed by Sensit Technologies. Once procured and delivered to ERG's Morrisville, NC laboratory the seven units will be thoroughly tested prior to deployment. This pre-deployment assessment will include the following:

- Set up of seven SPods
- Verify the operation of all sensors
- Verify the solar panels and batteries for the SPods
- Establish the baseline for the SPods over several days
- Verify heated inlet operation
- Verify each individual SPod's response to isobutylene gas standard bump tests
- Verify each individual SPod's response to chloroprene gas standard bump tests
- Assess logging in, downloading data, processing data, and remotely setting canister triggers and thresholds
- Leak check and test all SPod canister trigger systems to ensure all functions are working properly
- Test and analyze the canister trigger systems with nitrogen to identify potential bias or contamination in the can systems components

The isobutylene cylinder needed for the PID bump test must be 0.5 to 2.0 ppm ± 5%. If using a larger cylinder, a rotameter must be in line to regulate flow to 0.5 liters per minute (lpm). A vendor and part number for the isobutylene cylinder and regulator are in the project equipment list located in Appendix A. ERG will retain a copy of gas standard certification of analysis documentation for the project file.

3.6.2 Pre-deployment Isobutylene and Chloroprene Bump Tests by ERG

Isobutylene and chloroprene bump tests will be performed by ERG prior to deploying the Sensit SPods. The chloroprene bump test will follow the isobutylene bump test. Example certificates of analysis for the two gas standards used are in Appendix D. The pre-deployment bump tests are necessary to establish that each SPod is functional, to identify the response of each SPod PID to both isobutylene and chloroprene, and to determine if there is a general relationship between the response to each gas. The pre-deployment bump testing results will be compared to the Ion Science published response factor for chloroprene (1.3).

3.6.3 SPod Operational Tests

Once the micro SD card is installed and power cable is attached, the SPod will begin acquiring continuous data. ERG will perform and document the following operational tests at ERG's Morrisville, NC laboratory prior to deployment and both after installation on-site in LaPlace, LA and prior to take-down of the equipment on-site in LaPlace, LA:

1. SPod sensors are operational – PID on/off button is blinking, pressure, temperature, RH, sonic anemometer data are recording to the SIM card and comparable to local conditions.
2. Data are being transmitted to the Sensit server via cellular connection (see list of applicable data in Section 3.12).
3. Canister trigger test – a threshold close to baseline will be set to initialize a 24-hour canister collection within the first day of operation. This collection will verify the canister trigger is working properly and provide a potential background or non-event related canister sample.

Testing of PID response with an isobutylene bump test will be conducted by Weston Solutions monthly to verify operation of each SPod. The bump test produces a quick spike in concentration on the PID sensor, similar to an encountered plume, without changing the sensor's ambient state. The bump test is described in detail in Section 4.6.3.7 of MOP 3010.

The SPod pressure, temperature, relative humidity, sonic anemometer sensors will be assessed by cross comparing the SPod measurements with each other and with any available local meteorological data. The wind direction and wind speed measurements will be checked by comparing the measurements across all SPods and/or comparing to data obtained from the National Weather Station (NWS). For additional information on the sensors used in the SPod, refer to the Senist SPod Operational Manual found in Appendix E.

3.6.4 Interferences

Potential interferences may result in loss of operation of all or part of the SPod system. This loss of operation (loss of data) may be temporary or permanent in nature. Possible interferences include:

- Physical interference, such as heavy rain or dew (condensation) may negatively impact the PID sensor causing the SPod to enter a temporary nonoperational state.
- Physical obstructions, such as accumulated dirt or insects may impact the inlet to the sensors, and therefore operation.
- Loss of power as may occur if the solar panel experiences many cloudy days.
- Component malfunctions or operational issues with the SPod sensors or communications systems. If a sensor ceases to operate or begins to operate in an unstable fashion a physical fault is likely.
- Analytical interference, such as PID baseline drifts may occur due to atmospheric effects (particularly humidity changes) and real ambient air shed VOC concentration trends. These signals (either real or artefactual) compete with the detection of potential of near-field emissions plumes. Typically, the near-field emission plumes have a different temporal character than interferences allowing mathematical decoupling of the signals.

In the case of the analytical interference of the PID measurements, the signals can be examined as discussed in Section 3.12.1.

3.6.5 SPod Routine Quality Checks

Bump tests will serve as quality checks for the SPod PIDs. Weston will conduct in-field bump tests on each SPod unit at monthly intervals and at the end of the deployment. ERG will perform the pre-deployment bump tests on all the SPods.

Weston will perform canister leak checks and monthly bump tests, taking three isobutylene measurements for each SPod. The bump test produces a quick spike in concentration on the PID sensor, similar to an encountered plume, without changing the sensor's ambient state. Data from these bump checks will be recorded in the field notebooks and on the SPod Field Deployment Form (as shown in the SPod MOP in Appendix B or equivalent). The bump test is described in detail in Section 4.6.3.7 of MOP 3010. Bump tests will last for 30 seconds in duration for each measurement. The acceptance criteria for these tests are presented in Table 3-2.

At the end of the deployment, Weston will perform bump tests, taking nine isobutylene measurements for each SPod (three measurements in triplicate performed over a 3-day period totaling nine measurements). Data from these bump checks will be recorded in the field notebooks and on the SPod Field Deployment Form (as shown in the SPod MOP in Appendix B).

The temperature, relative humidity, pressure, wind direction, and wind speed measurements of the SPods are non-critical data. This will be documented and checked for reasonableness once a month by comparing to the SPod measurements and/or the NWS. The acceptance criteria for these tests are presented in Table 3-2.

3.7 Maintenance and Troubleshooting

If the PID bump tests indicate sensor malfunctions, Weston will communicate the issues to the ERG Task Manager. If tests or repairs can be handled on-site, Weston will be given instructions on repairs. PID data graphs can provide significant information on the PID operations. A large variation in baseline, such as prolonged elevated spikes, below average readings or large diurnal swings may require investigation.

During the field investigation, the only on-site maintenance possible to the SPod is a PID sensor replacement. Any other maintenance must be handled by ERG or Sensit Technologies. If possible, a supply of spare PID sensors, will be maintained during the project.

3.8 Equipment Retrieval

The following operational tests will be performed and documented after sampling prior to take-down of the equipment by Weston:

1. SPod sensors are operational – PID on/off button is blinking, pressure, temperature, RH, sonic anemometer data are recording to the SIM card and comparable to local conditions.
2. Data are being transmitted to the Sensit server via cellular connection.

3.9 Element B.7: Instrument/Equipment Calibration and Frequency

ERG's GC/MS instruments are calibrated with National Institute of Standards and Technology (NIST)-traceable TO-15 standards minimally every 3 months and use internal standards to monitor instrument performance. The TO-15 calibration gas stock cylinders are recertified annually by the vendor. The initial calibration is verified daily with a second source continuing calibration standard. The acceptance criteria for the GC/MS calibration is presented in Table 3-4.

3.10 Element B.8: Inspection/Acceptance of Supplies and Consumables

The ERG Task Manager is responsible for ensuring all materials meet project requirements according to ERG's standard procurement procedures for project-related supplies and consumables. This process includes inspection and acceptance criteria and procedures for tracking, storage, and receiving supplies.

3.11 Element B.9: Non-direct Measurements

Secondary or supporting data will be gathered by the project team and used to inform aspects of the SPod monitoring program. Examples of relevant supporting data include information on Denka's operations and maintenance, Denka's monthly ambient air monitoring reports, and EPA's off-site meteorological monitoring results.

3.12 Element B.10: Data Management

Data management for the canister samples will follow ERG's EPA-approved QAPP for support of EPA's National Monitoring Programs[8]. This document provides guidance on analytical procedures for the measurement of VOCs in ambient air.

SPod data are logged to a micro SD card located on the data logger board. These data are also transmitted via cellular network to a password-protected server owned by Sensit. Only appointed personnel will be able to access the server stored data. Data files will be downloaded by ERG personnel via remote connection every day (or other frequency established by the project lead). Appendix C presents the Standard Operating Procedure for SPod data retrieval. Figure 3-5 shows the flow path of SPod project data.

[8] ERG, 2019

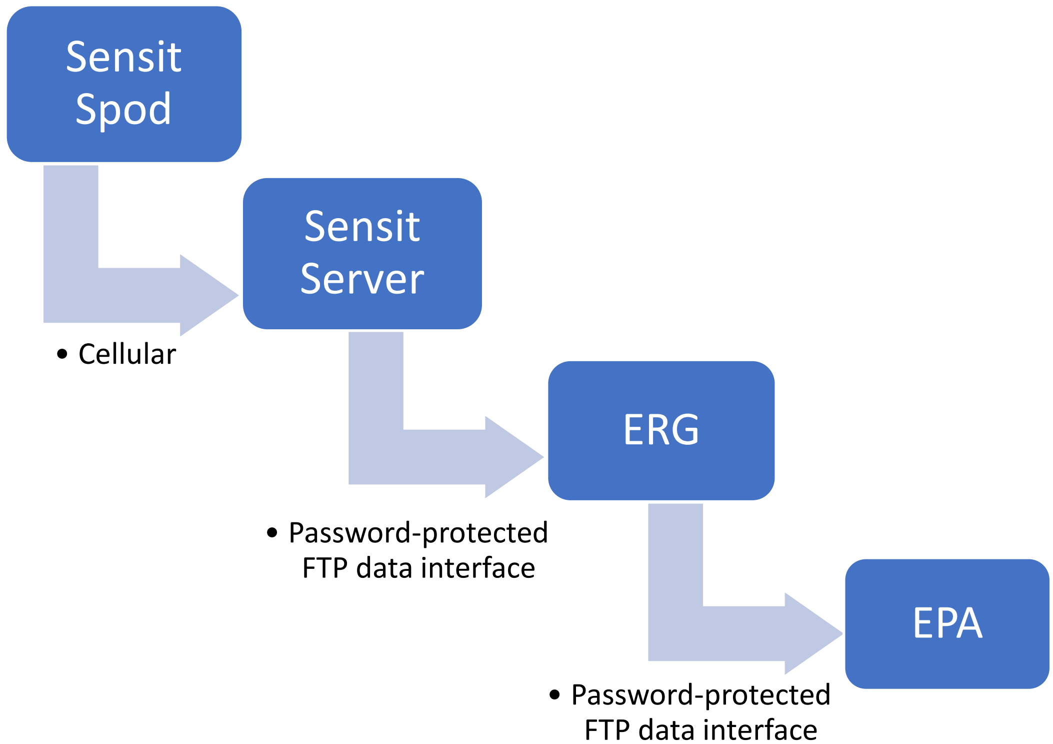


Figure 3-5. Flow diagram for Sensit SPod data retrieval

ERG will inspect recovered data. The SPod Data Analysis Review Form or digital equivalent will be completed by ERG during data review. The form is located in Section 7 of MOP 3010.

The data feed from each Sensit SPod node consists of:

- Date/time stamp (MM/DD/YY HH:MM:SS – 24H),
- Non-speciated VOC indicator by PID (ppb),
- Non-speciated VOC indicator by PID (mV counts),
- Temperature (°C),
- Relative Humidity (%),
- Pressure (mBar),
- Wind Speed (mph),
- Wind Direction (Degrees),
- Sensor Temperature (Arb Units),
- Sensor Heater Output (Arb Units),
- Battery Voltage (Volts),
- Charging Current (mA),
- Operating Current (mA),

- Trigger Flag (0 or 1 if threshold exceeded),
- Trigger Counter (Adjustable),
- Sample Flag (0 or 1 if sample acquired),
- GPS Latitude (Degrees), and
- GPS Longitude (Degrees).

3.12.1 SPod Data Processing

To ensure data quality and to remove unacceptable data caused by physical and analytical interferences of the SPod PID, ERG will follow the procedures listed in Section 5.0 of this QAPP, which are based on Section 4.7 of MOP 3010. ERG will summarize and assess the SPod data.

Baseline removal algorithms will separate plume events from background changes and sensor drift. The Sensit SPods output a ppb value that has removed the baseline internally. The Sensit SPods use an exponential moving average that is determined by the output data rate. The SPod software does not modify the baseline itself. The raw mV is filtered as well, and the Sensit SPod calculates the ppb concentration based on the zero offset and the span for isobutylene.

ERG will use the “calculated” ppb value for all data processing techniques and may not have a need for baseline removal. If the “calculated” value is in question, ERG will attempt to use the raw mV output and use the baseline removal algorithm to compare to the SPod internal algorithm output.

The following steps, discussed in greater detail in Section 5.0, will be used for SPod data analysis:

- SPod data visual inspection and thresholding to protect against “off scale” conditions where events are missed due to having the threshold set too high.
- SPod data visual inspection to investigate rapid relative humidity swings to ensure any measured events are not due to rapid climate changes which can affect the PID sensors.
- SPod data visual inspection to identify anomalous data drop-out conditions.
- Use of concentration wind rose plots to understand source direction.
- Review of 5-minute averaged PID data summary files for each SPod performed daily.
- Review of all daily data (one full 24-hour period from 00:00 to 24:00) including met sensors from each SPod, performed at least once per week.

Due to the calculations performed by the Sensit’s SPod data processing algorithm, ERG will likely not need to make use of baseline removal algorithms to separate plume events from background changes and sensor drift (if SPod is fluctuating). This step discussed in MOP 3010 will most likely not be necessary. ERG will perform a visual check of the daily data to verify there is no baseline drift due to sensor drift.

After the data are downloaded and sent to ERG, ERG will use “R” (or other equivalent software) to evaluate baseline shift for each daily period of data and conduct monthly QA data reasonableness checks. ERG will conduct monthly analyses using the PID and meteorological data to evaluate the location of the sources when any time integrated 24-hour sample's chloroprene concentration exceeds 5 μg/m^3. The processed SPod data will be delivered to the EPA OECA Project Lead.

4.0 Assessment and Oversight

4.1 Element C.1: Assessments and Response Actions

Assessment of the canister sample data will follow ERG's EPA-approved QAPP for support of EPA's National Monitoring Programs.[9] This document provides guidance on analytical procedures for the measurement of VOCs in ambient air.

Although this project uses continuous monitoring technology, it also relies on data retrieval on a predetermined schedule. Communication is key to ensuring ongoing operation of the monitoring and quality data. Project decisions, such as trigger level, may have to be made quickly in order to ensure collection of the best data. Any pertinent information and/or potential issue will be brought to the attention of the EPA OECA Project Lead immediately.

4.2 Element C.2: Reports to Management

ERG will prepare daily summary reports for SPod data for the EPA OECA Project Lead. ERG will prepare weekly data summaries to compare data elements other than the PID data. The weekly reports will also include any QA efforts conducted according to this QAPP.

ERG will report canister sample data, along with applicable MDLs, as available.

Any quality deficiencies detected by technical reviewers or QA Manager will be communicated to the EPA OECA Project Lead. The EPA OECA Project Lead and ERG's Task Manager will then determine the appropriate corrective action to be taken.

5.0 Data Validation and Usability

5.1 Elements D.1: Data Review, Verification, and Validation and D.2: Verification and Validation Methods

5.1.1 SPod Data Compilation and Reduction

Data reduction procedures for this SPod monitoring project are discussed in MOP 3010. Data reduction activities will be conducted during the study to:

1) verify that the data have met the criteria in Table 3-2, and

2) compare the results of techniques yielding repeat measurements, in order to verify the observed sources.

These comparisons will help determine whether SPod systems can accurately characterize and identify VOC/HAP emissions. These comparisons will be performed by ERG after compilation

[9] ERG, 2019

and delivery of the preliminary data to the EPA OECA Project Lead. Table 5-1 describes the planned post-study data comparisons.

Table 5-1. Summary of Post-Study Data Comparisons

Measurement	Comparison	Comments
SPod: VOC conc. (PID output)	Comparisons of averages for plume detects with co-deployed canister measurements	Indicative technique supporting plume detection/location
	Comparisons of downwind and upwind averages	Indicative technique supporting plume detection/location
SPod: temperature, pressure, relative humidity	Comparison with meteorological (MET) data from NWS	Indicative technique supporting plume detection/location
Wind speed by SPod	Comparison with secondary MET data (other SPods and/or NWS)	Comparisons in open area during stationary operation
Wind direction by SPod	Comparison with secondary MET data (other SPods and/or NWS)	Comparisons in open area during stationary operation
GPS	Post-study comparisons to Google Earth location/stationary precision test	Infield reasonableness check to cell phone; GPS also performed

5.1.2 Canister Results

The data reduction procedures for canister data are specified in the analytical laboratory's standard operating procedure for EPA Method TO-15. The ERG Task Manager will deliver the interim and final canister sample data to the EPA OECA Project Lead, with supporting raw data.

5.1.3 Data Validation, Validation Methods and Verification

All persons participating in this project will adhere to the procedural requirements of the QAPP including criteria to accept, reject, or qualify project data. Proper sample collection technique will be verified by the surveillance audits as detailed in Table 5-2. In-process data validation includes reviews of data reduction and storage activities to ensure that utilized procedures are being followed and modified or adjusted, if required.

In addition, the datasets for the SPod systems will be compared to established and validated data source (e.g., 24-hour canister sample data and meteorological data); ERG will perform this comparison at least once a month during the field study, as data become available, with a goal of checking at least one value for each comparable parameter.

Table 5-2. Summary of Data Validation and Auditing

Type of Audit	Frequency	Details
Surveillance of field SPod and canister sampling	Conducted during first two days of sampling	Performed by ERG
Surveillance audit of laboratory analyses	Conducted prior to analysis of samples	Performed by EPA under the National Monitoring Program and the National Environmental Laboratory Accreditation Program (Appendix F)
Audit of lab data quality	Conducted prior to the analysis of samples	Performed by ERG for EPA under the National Monitoring Program
Audit of data reduction (SPod, canister, MET data)	10% check of PID, canister, and meteorological data at least once per phase, for available parameters	Performed by Brad Venner, EPA NEIC

The canister sample data will be verified and validated by ERG using the procedures in ERG's EPA-approved QAPP for support of EPA's National Monitoring Programs[10]. This document provides guidance on analytical procedures for the measurement of VOCs in ambient air.

The audit of lab data quality for VOCs will be assessed by ERG analyzing independently generated audit samples via Method TO-15. ERG manages and operates the National Monitoring Programs for EPA; one of these programs is the NATTS Program. As part of the Technical Assistance Document for this program, ERG regularly performs analyses to determine the presence and concentration of multiple VOCs from ambient air samples. VOC analyses for these proficiency samples are performed in the same laboratory, by the same staff, using the same instrumentation, and following the same procedures as applied to the NATTS Program

ERG's most recent Method TO-15 audit occurred in March 2019. The audit included comparing the percent difference between ERG's laboratory reported values for each VOC and the mean of participating laboratories. A percent difference within ±25% of the relative target values is deemed as acceptable. As shown in **Error! Reference source not found.**5-3, based on the results of this audit, VOC measurement accuracy ranged from -18 percent difference for acrolein to 23.8 percent difference for carbon tetrachloride. Not all VOC species are present in the audit sample, but they are chosen to be representative of all VOC species currently analyzed for under the NATTS program.

If another audit sample is analyzed by ERG during the duration of the project, results will be given to EPA OECA Project Lead as a continued demonstration of proficiency.

[10] ERG, 2019

Table 5-3. VOC Compound Performance Evaluation Audit Data

Analyte	Reported Value	Mean of Participating NATTS Laboratories	
	(ppbv)	(µg/ cartridge)	RPD
1,1,2,2-Tetrachloroethane	0.191	0.175	9.1%
1,2-Dibromomethane	0.632	0.545	16.0%
1,2-Dichloroethane	0.494	0.454	8.8%
1,2-Dichloropropane	0.543	0.485	12.0%
1,3-Butadiene	0.567	0.555	2.2%
1,3-Dichloropropene-cis	0.692	0.560	23.6%
1,3-Dichloropropene-trans	0.595	0.489	21.7%
Acrolein	0.310	0.378	-18.0%
Benzene	0.597	0.504	18.5%
Carbon Tetrachloride	0.234	0.189	23.8%
Chloroform	0.545	0.490	11.2%
Dichloromethane	0.356	0.339	5.0%
Tetrachloroethylene	0.496	0.437	13.5%
Trichloroethylene	0.463	0.427	8.4%
Vinyl Chloride	0.409	0.395	3.5%

5.2 Element D.3: Reconciliation with User Requirements

The ERG Work Assignment Manager will work with the EPA OECA Project Lead to determine if data generated for this project are of known and documented quality and if they are fit for their intended use. ERG will document data limitations in the summary reports for the project. The ERG Task Manager will convey data quality issues to EPA OECA Project Lead.

6.0 References

EPA, 1999 Compendium Method TO-15A, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition; Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/ Mass Spectrometry (GC/MS). EPA/625/R-96/010b, https://www3.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf (accessed February 23, 2017).

EPA, 2016 Battelle/OAQPS Technical Assistance Document for the National Air Toxics Trends Stations Program, C304-06 Revision Number: 3, October 2016. Available at: https://www3.epa.gov/ttnamti1/files/ambient/airtox/NATTS%20TAD%20Revision%203_FINAL%20October%202016.pdf. (accessed January 6, 2020).

EPA, 2018 ORD/NRMRL/AEMD/DSBB NRMRL Quality Assurance Project Plan, *Rubbertown Next Generation Emission Measurement Demonstration Project* QA Category: B / Measurement Extramural Research G-AEMD-XXXXXX-QP-1-0 Revision Number: 0, February 2018.

EPA, 2018a ORD/NRMRL/AEMD/ECPB NRMRL Quality Assurance Project Plan, *Region 6 Next Generation Emission Measurement Demonstration Project: VET and MPod* QA Category: B / Measurement Extramural Research G-AEMD-XXXXXX-QP-1-0 Revision Number: 0, February 2018.

EPA, 2018b "Draft Design Package for U.S. EPA Beta Version SPod Fenceline Sensor", Version January 2018.

EPA, 2019 EPA ORD NRMRL MOP 3010, *EPA Prototype SPod Procedures* (MOP 3010), Revision 2.0, August 01, 2019.

ERG, 2019 ERG Support for the EPA National Monitoring Programs (UATMP, NATTS, CSATAM, PAMS, and NMOC Support) QA Category 1/ ERG-QAPP-0344-5, EP-D-14-30, Revision 0, March 2019.

Appendix A: Equipment List

Equipment List for SPod Monitoring

Equipment	Description	Supplier	Part Number	Number Required
SPods				
SPods	w/can trigger, has a Ion Science MiniPID2 PID sensor	Sensit	NA	6
SPod	w/can trigger, has a Baseline Mocon® PID Sensor or an Ion Science Mini PID2 HS PID Sensor	Sensit	NA	1
Canister sampling triggers (also listed above with SPods)	1 with each Sensit SPod,	Sensit	NA	7
Pole attachments for can trigger systems	ERG will manufacture	ERG	NA	6
PID sensors (spares)	1ppb-40ppm, 10.6 eV	Sensit	MP3SHLHSCU2	6
SPod shipping containers (if needed)		ERG	NA	6
Tripod for SPods (if needed)	survey tripods	Grainger	1MM34	7
Attachment adaptors for tripods	manufactured by Sensit Technologies	Sensit	NA	7
Solar panel and battery		Sensit	NA	7
Tools				
Bubble level		Grainger	1UK57	1
Compass		ERG	NA	1
GPS		Grainger	464V19	1
Teflon tape		Grainger	4X227	1
Miscellaneous tools	open end 9/16" wrench/needle-nosed pliers/screwdriver, 4" shank and 1/4" flat head tip/6" adjustable wrench	Grainger	4RPD3/4YU73/53JR99/483J29	1/1/1/2
Isobutylene Bump Test				
Isobutylene gas standard	103 liter, 0.5 ppm	Grainger	103L-248-0.5	3
Regulator	C-10, 0.5 Lpm	Grainger	33V728	1
PID bump test sensor cap	manufactured by EPA ORD	EPA ORD	NA	1

Equipment	Description	Supplier	Part Number	Number Required
Canisters				
Canisters	6-liter, SUMMA,	Entech	01-29-MC14LSV, MQT-ST400S	40
Canister gauges	30-0 " Hg vacuum pressure gauge with Micro-QT® fitting	Entech	01-29-70010QT	2
Flow regulator	Calibrated 24- hour integrated canister flow orifice	Entech	01-39-CS1200ES4	6
Micro-QT® Female Fittings (for can analysis)	Micro-QT® to 1/4" Swagelok fitting	Entech	FQT-400S	14
SS tubing	SS, 1/8”	ERG	na	na

Equipment Used for SPod Testing at ERG

Equipment	Description	Supplier	Part Number	Number Required
Isobutylene Bump Test				
Isobutylene gas standard, 0.5ppm	103 liter, 0.5 ppm	Grainger	20ME50 (103L-248-0.5)	1
Regulator for isobutylene	C-10, 0.5 Lpm	Grainger	33V728	1
PID bump test sensor cap	manufactured by EPA ORD	EPA ORD	NA	1
Chloroprene Bump Test				
Chloroprene gas standard, 0.5ppm	98 liter, 0.5 ppm	Linde Gas	custom	1
Regulator for chloroprene	CGA 180	Linde Gas	NA	1
PID bump test sensor cap	manufactured by EPA ORD	EPA ORD	NA	1
Rotameter		ERG	NA	1
Canisters				
Micro-QT® Female Fittings	Micro-QT® to 1/4" Swagelok fitting	Entech	FQT-400S	4
Canisters	6 liter SUMMA, true seal valve, Micro-QT®	EPA ORD	NA	2

Appendix B: MOP 3010

MISCELLANEOUS OPERATING PROCEDURE NO 3010

TITLE: EPA Prototype SPod Procedures

PURPOSE: This miscellaneous operating procedure (MOP) describes the setup, operation, quality control (QC) procedures, and basic data analysis for the EPA prototype SPod Fenceline Sensor with and without a Base Station (BS) communication package.

1 SCOPE

This MOP describes:

- The physical set up and operation of the prototype SPod sensor package.
- Installation and ongoing QC checks
- Installation of SPod can trigger system
- Basic data analysis procedures.

This MOP does not describe the operation of support equipment, such as generators, transport trailers, meteorological stations, or distance measurement devices. The target audience for this MOP is field personnel utilizing this technology.

Basic SPod Description: The EPA Sensor Pod (SPod) is a low-cost sensor system that combines wind field and air pollutant concentration measurements to detect emission plumes and help locate the source of emissions in facilities. The SPod uses a combination of custom parts and commercially available components, such as air sensors, minicomputers, and communication cards. The SPod has the capability to operate using solar power if required. The SPod package contains a photoionization detector (PID) sensor that produces a non-speciated, uncalibrated concentration measure of a subset of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) that can be ionized with a 10.6 eV PID, as well as sensors for measuring temperature (temp), relative humidity (RH), and pressure (press). In the current configuration, the effective PID detection sensitivity ranges from approximately 0.01 ppm to approximately 2 ppm under best operating conditions. Other components of the package include a sonic anemometer, photovoltaic power source, onboard operating and data logging system containing a secure digital (SD) flash memory card and wireless capability used to connect to a BS computer used remote logging of one or more SPods and for cell phone modem remote communication. Additional information on the design and use of the prototype SPod can be found in "Draft Design Package for U.S. EPA Beta Version SPod Fenceline Sensor", version January 2018[1] and "South Philadelphia Passive Sampler and Sensor Study"[2].

The SPod is designed to detect emissions plumes. The current SPod design works only in "near-fenceline" applications where localized emission plumes may be present. The unit is not useful for ambient applications large distances away from sources. **Since the SPod is not intrinsically safe, it cannot be used in potentially explosive environments**. Figures 1 and 2 show SPod major components and configuration variants that use different sonic anemometers with a description of common terms used in the MOP contained in Table 1.

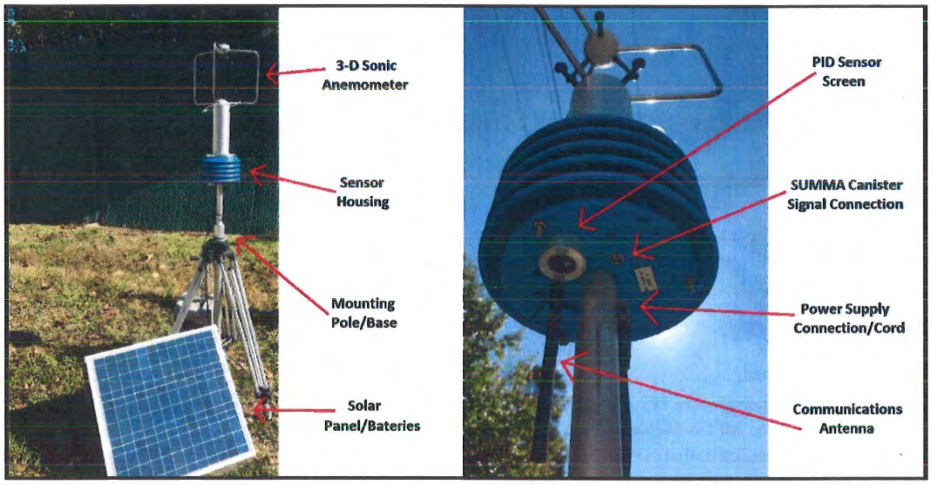


Figure 1: Example of a 3-D sonic SPod fenceline sensor

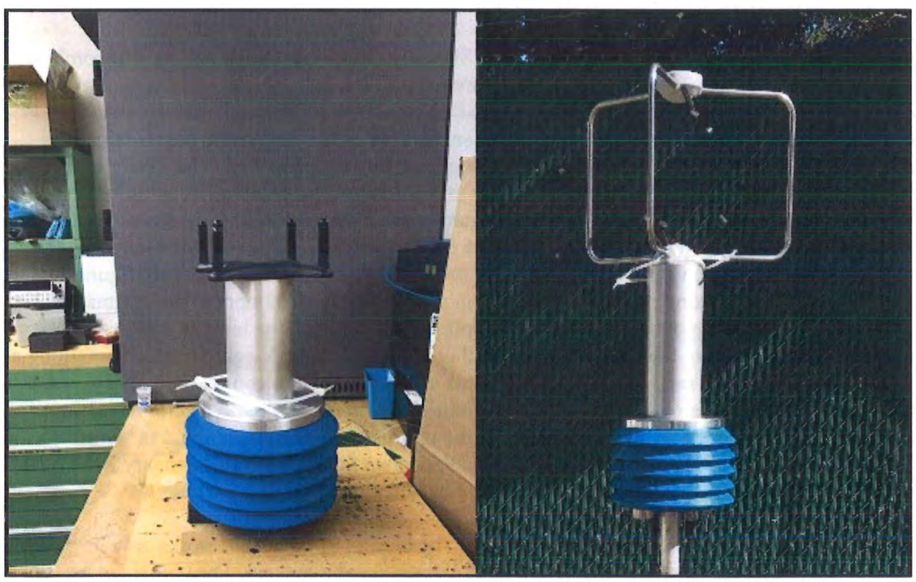


Figure 2: 2D sonic anemometer SPod (left), 3D sonic anemometer (right)

2 DEFINITIONS

Definitions and acronyms are listed in Table for terms used in this MOP that are non-standard.

Table 1: Common terms used in this MOP listed in alphabetical order

Term	Definition
2D Sonic	Two-dimensional sonic anemometer SPod variant. 2D sonic measures horizontal wind speed components
3D Sonic	Three-dimensional sonic anemometer SPod variant. 3D sonic measures both horizontal and vertical wind speed components and provides future potential for advanced inverse modeling.
BS	Base station, an optional communication module for an SPod network
BNC	A common type of coaxial cable used in the SPod for power connection from the solar panel/battery
BT	Bump test, a quick in-field test that verifies the operation of the SPod PID and sets a timing mark
cts	Counts produces by the SPod PID and RH, a unitless measure of signal level
Deg C	Unit of temperature, degrees Celsius
DQI	Data quality indicator (DQI), a test or data check that helps in understanding the operational state of the SPod
eV	Electron volt
GPS	Global Positioning System
HAP	Hazardous air pollutant
MOP	Miscellaneous Operating Procedure
Node	A single SPod location
Network	More than one SPod working in concert
PID	Photoionization detector, the sensor in the SPod that detects hydrocarbons
ppb	Part per billion by volume, a unit of measure of concentration, mixing ratio units per billion units
ppm	Part per million by volume, a unit of measure of concentration, mixing ratio in units per million units
Press	Atmospheric pressure measured by SPod sensor in units of mbar
PAC	Secure digital flash memory card for storage of SPod data
RH	Relative humidity measured by SPod sensor in arbitrary units counts (cts)
SD	Secure data card for storing SPod data
SPod	Sensor Pod, a low cost fenceline sensor system
Temp	Temperature of the air measured by a SPod sensor or conic anemometer in deg C
VOC	Volatile organic compound

3 ROLES AND RESPONSIBILITIES

The personnel roles and responsibilities of SPod field deployments are typically described in the project specific quality assurance project plan (QAPP) and are therefore not described here.

4 PROCEDURES

This section describes the procedures for an SPod system. Since the current version of the prototype SPod does not produce laboratory samples, some sections of the MOP template are not applicable.

4.1 Sample Preservation, Containers, Handling, and Storage

The SPod itself does not produce a laboratory sample. If the SPod can trigger system is deployed along with the SPod, the operating procedures described in **MOP 3090: Canister Field Grab Sampling using 1.4 L canisters** should be used. Ambient air grab samples will be collected using 1.4 L Entech Silonite® coated stainless steel canisters. Cleaned, field ready canisters are stored in the EPA VOC laboratory in room E-288 at the EPA-RTP facility. Before field deployment, canisters are cleaned according to SOP ECAB-133.0 "Standard Operating Procedure for Cleaning Air Sampling Canisters with the Entech 3100A Canister Cleaner" (US EPA, 2011). Canisters are evacuated to a final pressure of 10 milliTorr(30 inhg) and shipped within 48 hrs after cleaning in a carrying case to the field along with the chain of custody (COC) forms. Canisters must be shipped back to EPA within 2 weeks of being received in the field. Hold times in the laboratory upon return from field deployment is 2 weeks, within which time samples must be analyzed. Hold times may change depending on requirements stated in project-specific QAPP.

4.2 Health and Safety Precautions

The general health and safety precautions for field measurement activities are described in separate health and safety plans and are not detailed in this MOP. The primary safety hazard associated with SPod-deployment and use is the physical handling of heavy gas cylinders that may be used on the EPA test range and the installation of SPod mounting poles and fixtures at the deployment location. Proper safety precautions and safety equipment must be used for handling and/or installation functions along with "dig safe" procedures and proper site permitting. These safety and site permission functions should be covered in the project-specific safety plan related to the deployment. In general, care must be taken to secure equipment, so it does not produce a falling or tipping hazards under high wind or potentially interfere with unrelated site equipment or operations. Caution must also be used when deploying near roadways due to vehicle hazards and care must be taken to minimize or eliminate the possibility of creating driver distraction hazards while selecting the deployment site. General precaution with use of electrical equipment or in the field or installations near power lines must be followed and all necessary site safety checks must be performed, and permissions acquired. Typically, SPod PID operation is checked with low concentrations (500 ppb) of isobutylene, but if other gases are used, care must be taken with potentially hazardous aspects of these gases and details should be described in project-specify safety plans.

4.3 Interferences

There are two types of method interferences for the current version of the prototype EPA SPod: physical and analytical.

Physical interference refers to external conditions or component malfunctions that may negatively affect SPod operation. Heavy rain or dew (condensation) may negatively impact the PID sensor causing the SPod to enter into a temporary nonoperational state. Physical obstructions, such as accumulated dirt or insects may impact the inlet to the sensors, and therefore operation. Physical interference could also be loss of power as may occur if the solar panel is blocked by snow or experiences many cloudy days. Physical interferences additionally include component malfunctions or operational issues with the SPod sensors or commutations systems. If a sensor ceases to operate or begins to operate in an unstable fashion a physical fault is likely. For the purposes of this MOP, physical interferences may result in loss of operation of all or part of the SPod system. This loss operation (loss of data) may be temporary or permeant in nature. In addition to the physical interferences affecting PID performance, the performance of the SPod 3-D sonic may also be impacted by the presence of physical interferences (trees, telephone poles, etc) in vicinity of the 3-D sonic anemometer. The 3D sonic (or any other sonic anemometer used as part of the SPod sensor system) must be oriented correctly to ensure data validity.

Analytical interferences refer to the issues that prevent the SPod from performing its design function (detecting emission plumes), when no physical interferences are present. The most notable analytical interference is associated with PID operational capability. Under normal operation, the SPod PID produces an uncalibrated indicator of time-resolved plume concentrations. In the current low-cost SPod design, there is no attempt to condition the inlet air seen by the PID or other parameters. As a consequence, the baseline levels of the SPod PID may drift by large amounts due to atmospheric effects (particularly RH changes) and also by real ambient air shed VOC concentration trends. These signals (either real or artefactual) compete with the detection of potential of near-field emissions plumes and represent analytical interferences. Typically, the near-field emission plumes have a different temporal character than these interferences allowing mathematical decoupling of the signals (Section 4.7).

4.4 Reagents and Supplies

This section of the MOP template section does not apply to the current version of the SPod.

4.5 Equipment/Apparatus

SPod installation requires the following primary equipment and supporting apparatus. For long-term deployments, more robust mounting fixtures may be required.

- One or more SPods fitted with 4-16 gigabyte SD data cards
- Solar panel and battery for installations without electrical land power
- A low voltage SPod power supply for installations with electrical land power
- A base station (BS) - optional
- If BS is used, SPod logging software (VET v2.2) – available from EPA ORD NRMRL, (thoma.eben@epa.gov)
- If BS is used, TeamViewer™ (www.teamviewer.com) or equivalent remote communication software
- Tripod for mounting SPods for shorter term installations or other fixtures, such as installed poles for longer term deployments
- Safety equipment (as per safety plan)
- Compass
- GPS
- Camera
- Flathead screwdriver
- Teflon Tape
- Bubble level
- If SPod can trigger system is deployed, the following components are required:
    - Current canister system design described in Prototype SPod Design Package

- ¾" Pipe clamp, adjustable wrench and flathead/Phillips screwdriver.

- Equipment for PID Function Test
  - 0.5 ppm +/- 5% Isobutylene tank, 58L (or other), with Regulator CGA C10/CGA 590 (or as specified)
  - PID Bump Test sensor cap
  - Rotameter, set at 0.5 lpm. (Or on-demand regulator set at 0.5 lpm)
  - Approximately 5 feet of ¼ "Teflon tubing.
  - 1' of .25" ID flexible tubing. (For on-demand regulator)
  - ¼" Swagelok nut, ferrule, and union. (all should be attached to PID Bump Test sensor cap and tubing)
  - ¼" Swagelok toggle valve (If not using on-demand regulator)
  - Two small adjustable wrenches

4.6 Procedures

The following procedure describes a basic SPod setup and operation for a version that uses a solar panel/battery and tripod. Longer term deployments may employ permanent fixtures instead of a tripod and may use land power instead of a solar-powered configuration, but the procedures are the same except where noted. Some deployments may utilize a BS to allow remote communication via cell modem our internet connection in addition to standard SPod data recording on the SD card (described in Section 4.6.3.6).

4.6.1 SPod Deployment Location and Documentation

When choosing the deployment location for the SPod, it is critical to select an area with an unimpeded wind flow. This is important to ensure that efficient transport of potential emission plumes from the source to the sensor station and to collect wind data that is an accurate representation of the site conditions. The SPod should be deployed in a location with relatively flat terrain and away from local obstructions (e.g. trees, buildings, hills). If the monitoring station must be near a potential obstruction, ensure that the station is located at a horizontal distance that is two times the height of the obstruction if you are upwind, and six times the height of the obstruction downwind. This will help ensure an accurate display of the sites wind conditions. For solar powered deployments, the SPod should be oriented so that the solar panel is facing south (this should be verified using a compass, GPS, or smart phone), and the area should be free of shade for 8 hours.

- ***Complete data fields (1) through (8) of SPod Field Deployment Form in Section 7***

4.6.2 SPod SD data card install and check

Prior to deploying the system, verify a 4 Gigabyte SD is installed in the drive located on the microcontroller board (Figure 3). The microcontroller board (Figure 3 right) will be mounted inside the sensor housing prior to deployment, and the SD card drive is accessed via a slot on the underside of the sensor housing, as shown in (Figure 3 left). The SD card drive is spring-loaded. After inserting the card into the drive, press the card until the drive clicks to secure the card (install check).

- ***Complete data fields (9) and (10) under SPod Field Deployment Form in Section 7***

Figure 3. Location of SD card drive on bottom of SPod and (left) and internal view (right)

4.6.3 SPod & Base Station Setup

4.6.3.1: Set up the tripod as shown in Figure 1 and adjust legs as necessary. Take the ¾"" threaded mounting pole and ensure each end is properly wrapped with Teflon tape to avoid damaging the threads. Screw one end into the tripod as shown in in Figure 4 (left). Line-up the ¾"" hole on the bottom of the SPod housing, with the mounting pole on the base as shown in Figure 4 (right). Look in the hole to be sure there are no wires in the path of the pole, and then gently hand thread until tight.

Figure 4. SPod mounting example

4.6.3.2: Without loosening the SPod from its mount, pick up the tripod and reorient (rotate) so that the side of the anemometer marked "N" is facing toward the north as accurately as possible. Ideally a GPS should be used to orient towards true north. If a compass is used, this must be indicated in the deployment notes so the magnetic declination can be accounted for in data processing. Make fine adjustments to the tripod legs (or other fixture) to achieve a level setup. Verify using bubble level placed on the tripod top (not the sonic anemometer). A resource for determining magnetic declination can be found at https://ngdc.noaa.gov/geomag/declination.shtml (*last accessed 3/9/2018*). When deploying multiple units' side-by-side verify that the anemometers all appear to be pointing the same direction. When pole mounting the SPod tighten the SPod down on the ¾" pole, and then adjust the pole with a pipe wrench to turn the SPOD orientation to north.

4.6.3.3: Deploy the solar panel/battery (if used) near the SPod as shown in Figure 1. Orient the solar panel so that it is facing south. Before final setup, turn solar panel/battery on its side and connect one end of the BNC power cable to the port located on the underside of the panel (Figure 5). Note that if the deployment does not use a solar panel but instead uses land power, connect the BNC cable to the 12V supply used for the deployment.

Figure 5. Connecting BNC power cable to solar panel / battery

4.6.3.4: Connect the other end of the BNC power cable to the sensor station port, located on the underside of the sensor housing, as shown in Figure 6. At this point the SPod should be automatically acquiring data and storing it to the SD card. The confirmation of operation is discussed in Section 4.6.3.5 and tested in Section 4.6.3.7.

Figure 6. Connecting BNC Power Cable to Sensor Station

4.6.3.5: After the BNC power cable has been connected to the SPod power port, the sensor station should have power and be operating. Confirm power is supplied to the unit by verifying that an amber light is illuminated on the inside of the SPod housing. This should be visible by looking inside the sensor housing from a vantage point below the station, as shown in Figure 7. This provides first level confirmation of operation with further assurance provided in the operation test described in Section 4.6.3.7.

Figure 7. Illuminated lights confirming SPod is operating

4.6.3.6: (if applicable): An SPod deployment may include a BS which is a secondary computer that communicates with one or more SPod nodes via short range wireless network and with the outside world via a cell phone modem or internet connection. The BS uses a custom data acquisition program [VET v2.2] written in LabVIEW (National Instruments, Inc. Austin, TX) to sequentially acquire data from one or more SPod systems (max of 3). The BS is fitted with a cell phone modem or direct internet connection allowing the data to be retrieved from offsite. Data are still recorded on the SPod SD cards. The BS computer system can come in many forms ranging from a rack mount computer, laptop installed in a monitoring shelter or a dedicated field computer in a weather-proof box. Figure 8 shows examples of a three-unit SPod network with a BS. In all cases, the BS requires land power (120vac). The installation and operation of the BS will be deployment-specific but involves the following key steps (1) Build and configuration of BS with proper software and wireless and remote communication systems, (2) Pre-deployment confirmation of connection and data logging capability for the specific SPods to be deployed. (3) Proper field installation and powering within wireless range of SPod nodes, (4) auto boot-up and startup of logging software, (5) Verification of robust operation in the field before leaving the site. Basic installation and operation of the VET v2.2 data logging and remote communication software is described in Sections *4.6.3.6.1* to *4.6.3.6.6.* Please see Section 4.6.3.7 for SPod operational testing sequence.

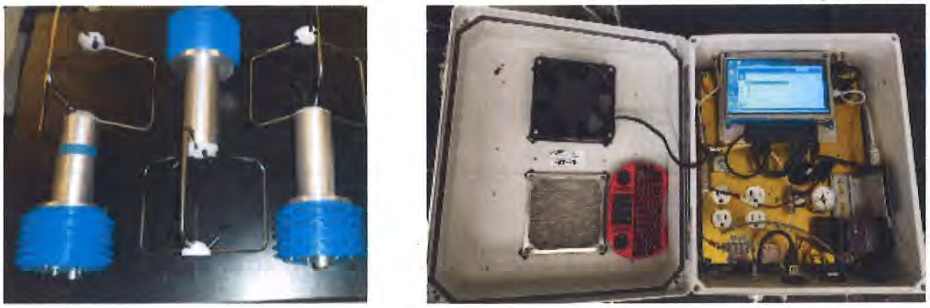


Figure 8: Three SPods (left). Close-up view of BS (right).

The VET v2.2 BS software for logging SPod data is based in a LabVIEW 2010 or later environment (it is an executable file). The version of software currently used will function as follows:

- The BS will send a request to each SPod for a data line and wait for its response.
- Data will be collected for all the SPods approximately once each second (sequentially).
- The Options Page allows the user to:
  - input/modify/delete expected SPod Addresses.
  - Setup data transfer to EPA VIPER server.
  - Add reading from an Auto-GC
  - Route data to a specific folder on the hard drive
- The 'Environ' Settings allows the user to send data to EnviroSuite
- The SPod settings allows the user to change internal SPod settings (non base-station)

The following steps describe the process for setting up the BS software to record and visualize the data.

4.6.3.6.1: Open the VET v2.2.0 BS program, click on Options and Input SPod addresses. Then select the sonic type associated with that SPod configuration. (Figure 9).

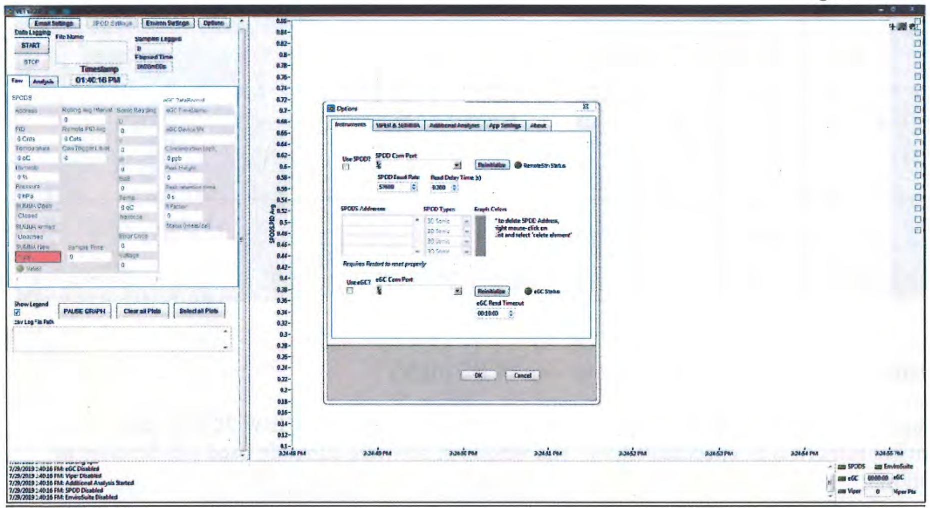


Figure 9: Options menu for initial SPod communication setup

4.6.3.6.2: Click reinitialize and exit out of options menu.

4.6.3.6.3: Verify that all SPods are communicating by moving the slider at bottom of data section. Each address that has been inputted, along with data input from that SPod should be visible (Figure 10).

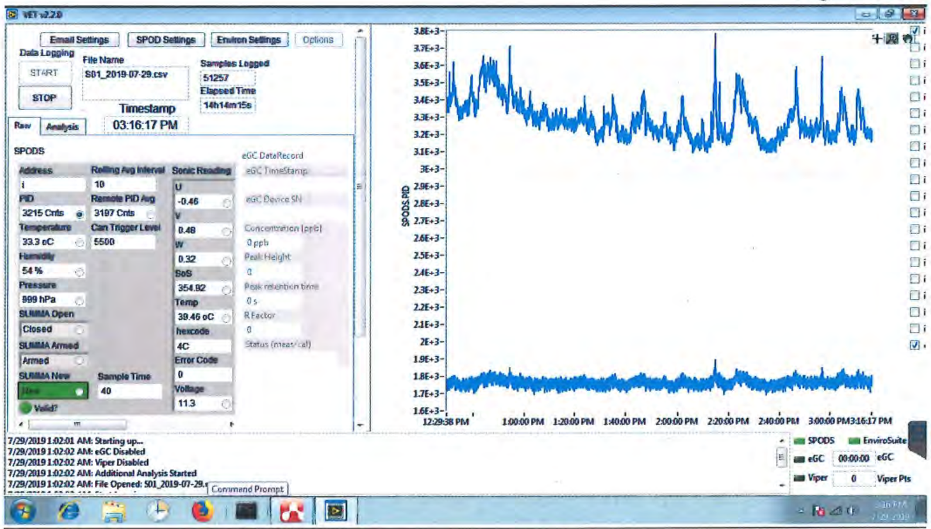


Figure 10: Example of initial few points of SPod data logging

4.6.3.6.4: Click the START button to begin logging. File name will show up in box next to START button (Figure 10). To stop logging press the STOP button. To change file name and auto-log on restart, navigate to options > APP Settings.

4.6.3.6.5: To download the data from the BS from a remote computer TeamViewer™ (https://www.teamviewer.us/or another remote link software must be installed on the BS and as well as the computer you are remotely downloading from. For TeamViewer™ to work, both computers must have an active internet communication. The BS has a cellular modem, so it should always have an active connection. Be sure the computer in the remote location has an active internet communication. For remote access the base station computer should be set to never go to sleep. The power settings can be found in Control Panel -> Power Options. Change these to "never". When TeamViewer™ is opened the display will look like Figure 11. To access the remote computer type in the Partner ID (the partner ID will have to be established prior to deployment) and hit connect to partner.

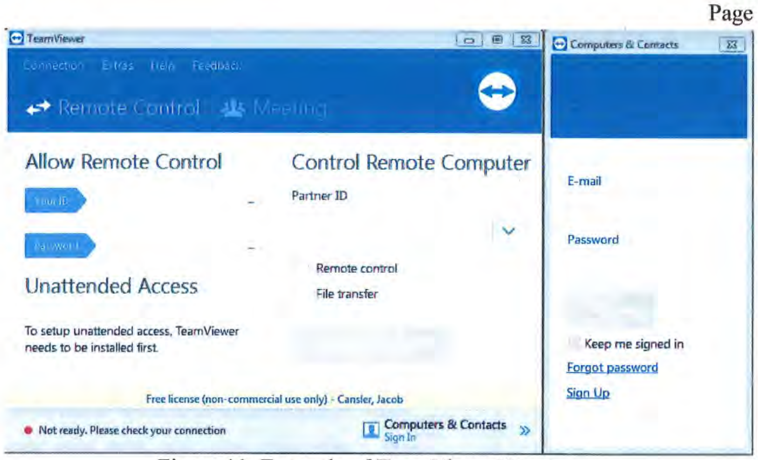


Figure 11: Example of TeamViewer™ setup

4.6.3.6.6: Once the computers have successfully synced, a window containing the "desktop" of the BS computer will appear (the standard startup desktop screen of any Microsoft Windows computer). In order to download the data from the remote computer, navigate to documents page on the BS computer and go to the VET data folder established in option > APP Data. Highlight and copy the data files, and paste into your remote PC's documents folder.

4.6.3.7: Conduct SPod operations tests. After the installation of the SPod(s) and BS (if used), the system installation operations test must be performed. These steps can also be used if a sensor fails and needs to be replaced in the field. Data will not be valid until a valid bump test is performed on the new sensor. This test is also performed at frequencies specified in the QAPP and prior to the take down of the equipment at the end of the field deployment. This test confirms: (1) the SPod sensors are nominally operational, (2) data are being recorded to the SD card(s), and the BS (if used), (3) the BS is properly communicating with the SPod(s) and remotely via cell phone modem or internet connection. The PID, press, temp, and RH sensors and sonic anemometer data acquired by each SPod are checked for reasonableness in this test and the PID sensor is also checked for functionality using an isobutylene gas cylinder in a procedure called the bump test (BT). After a minimum of 30 minutes of operation of the SPod(s)/BS system, the field personnel will conduct the BT on each SPod Node. During the time it takes to perform the BT, the other sensors should be recording nominal data. After the completion of the BT, the field person will confirm operation by visually examining the recorded data (*4.6.3.7.4)*

Description of PID Bump Test: Under normal operation, the SPod PID produces an uncalibrated measure (indicator) of time-resolved plume concentrations. As described in Section 4.3, the baseline levels of the SPod PID can change by large amounts due to analytical interferences (sensor drift, air shed changes) that are convolved with the signal from near-field emissions plumes (target detection parameter). The near-field emission plumes have a different temporal character than the analytical interferences allowing mathematical decoupling of the signals (Section 4.7). The known baseline variability of the SPod, coupled with the PID's varying (unknown) response to different compounds present in emission plume make calibration not feasible in the current SPod version. The aim of the SPod PID BT is to present a short duration concentration spike to the PID that simulates an emission plume it would encounter in the ambient environment. Because the PID baseline is a function of ambient conditions (particularly RH), the PID BT is designed to not alter the operational conditions of the PID (such as by bathing in dry gas from a calibration cylinder).

4.6.3.7.1: Setup 58L bottle of 0.5-2 ppm isobutylene with regulator with a CGA C-10 (or CGA 590) fitting. Slip flexible tubing over the barbed fitting on the top of the regulator and connect to ~5' tubing with Swagelok fitting. The final setup should appear as in Figure 12.

Note: If using a larger cylinder, a rotameter must be in line to regulate flow to 0.5 lpm. The CGA C-10 is an on-demand regulator set at 0.5 lpm.

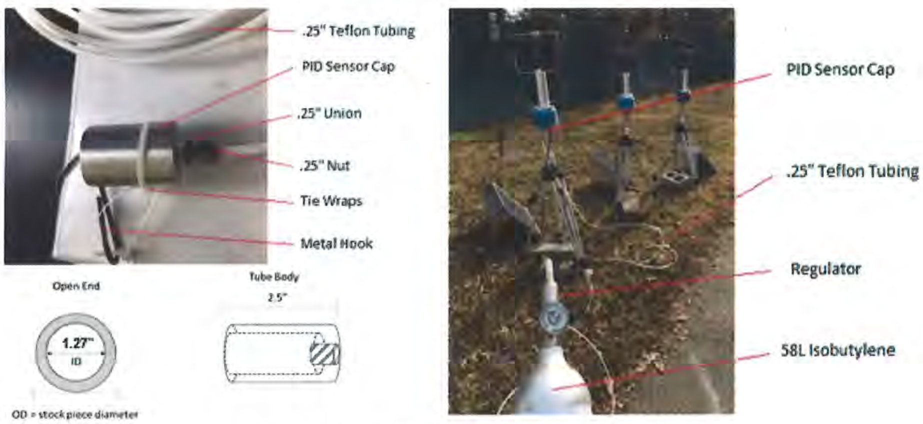


Figure 12: SPod Bump Test gear

4.6.3.7.2: Move gear to the position of the first SPod. Open cylinder valve for 10 seconds to clear line. The second field person (time keeper) should open cell phone app to record actual time to assist in duration indications to primary field person, and also take notes to document the test. The SPod Field Deployment Form (Section 7) should be filled out and ready. The recording of accurate times for the bump or "spike" in concentration is important. Once both field persons are ready, proceed to next step. (Step can be completed with one person if time intervals are written down ahead of time and followed accordingly)

4.6.3.7.3: Perform the SPod PID BT. (1) Time keeper provides countdown to BT field operator using cell phone time. (2) BT operator opens toggle valve at T-5 seconds and places the BT sensor cap over the PID at T = 0 seconds (can use hook) and holds for 15 seconds. (3) The sensor cap is removed and toggle switch closed. (4) Record cell time start on data form (Section 7) and wait for > two minutes. (5) Repeat the procedure to produce data point 2, (6) Repeat the procedure to produce data point 3. Move to next SPod and repeat procedure *4.6.3.7.3*. The BT should be performed in triplicate (three times for each SPod). This step can be completed with one person if time intervals are written down ahead of time and followed accordingly.

4.6.3.7.4: Complete SPod installation operation tests: (1) Turn off SPod by unplugging the power cable. (2) Remove the SD card from each SPod and insert it into a card reader and copy the data file(s) onto the hard drive. (3) Replace each SPod SD card, double check card installation (Section 4.6.2) and repower SPods. (4) Investigate data files to ensure data was being recorded by all sensors and that it is reasonable (e.g. check wind direction by comparing the value to other co-deployed units and to known values [nearby airport, onsite observed] to ensure values are reasonable). The sensor reasonableness check is passed if all values and cross-comparisons that are available to the installation team indicate that the SPod systems are operatizing nominally. (5) Verify that the PID BT was registered on each unit and record the time for signal appearance and approximate response level over baseline as recorded by the SPod [called "PID level (cts)"] in the appropriate sections on the data form (Section 7). The BT PID Level is determined by estimating the baseline level (in cts) just prior to the application of the BT concentration spike and subtracting this value from the observed highest estimated value during the BT concentration spike. This determined value is recorded as "PID Level (cts)" in the setup form. Repeat for the two other BT spikes. The BT test is passed if PID levels are above consistent at a value grater then the baseline for all three tests and the baseline signal is approximately the same before and after the application of each BT. This provides the primary time offset check for the SPod node in comparison to cell phone time. (6) investigate BS data file (if present) and perform similar checks and record times of BT. This provides a primary time offset check for the BS in comparison to cell phone time and confirms the identity of the SPod node in the BS data feed. Perform remote communications test with the BS by attempting communication from an independent computer (not on the local network). The communication test is passed if stable remote communication is demonstrated. Record all values or pass/fail assessments on the data form (Section 7). If any values fail, consult work assignment lead for corrective action. If using a BS all BT data can be monitored live on the BS screen.

- ***Complete data fields (11) through (18) under SPod Field Deployment Form in Section 7***

4.6.3.7.5: Deploy can trigger system (if applicable). All can system must pass a lab leak check and properly documented with the " Lab Can Trigger System Leak Check" Form. Follow the procedures established on this form. This ensures that the can system has been checked before field deployment. Once an installed SPod network is fully operational, mount SPod can trigger system directly below SPod. This can be done using pipe clamps applicable to the size of the pipe the SPod is mounted to (3/4"). See Figure 13 below:

Figure 13: SPod-Evacuated Canister system

1.4 L Silonite® coated stainless steel canisters will be prepared in accordance to the procedures described in **MOP 3070: Canister Field Grab Sampling using 1.4 L canisters.** The current can trigger system employs one evacuated canister per SPod. The can system must pass an initial in-field leak check. This can be done by installing a 1.4 L cannister and initializing the pressure ~30inhg. Then immediately take the can off and wait for 30 seconds. If the pressure in the system does not change with the can uninstalled, then it can be assumed there is no leak.

To operate the can trigger system, the grey three prong male connector will plug directly into the female receptor on the bottom of the SPod. The can's negative pressure must be noted before and after operation to verify proper operation. In order to pass the can must have a negative pressure remaining upon retrieval to be considered a usable sample. To control the sampling system, the user must access the SPod menu via Tera Term or other HyperTerminal. This can be done using a Xbee receiver compatible with the SPod (Or serial cord) setting to the associated serial port, and using the baud rate of 57600. Table 2 below shows the standard values set for the trigger system. When using a BS the VET v2.2 can also control the SPod and provide the commands through its interface under "SPOD Settings" as shown in Figure 14. Through this interface the user can also align the internal SPod time to the BS time.

Note: The letter "a" will be used to denote the SPod node. This letter will vary by SPod.

Table 2: Can operation

Command	Function	Description
a??	Open SPod Menu	When this is executed the SPod menu will appear.
aS35	Sample Time	When this is executed the can system will be set to pull a sample for 35 seconds when actuated.
aD1	Arm Can	When this is executed the can will be armed. Noting will happen unless this value is set to one. Disarm using aD0
aA10	Averaging Time	When this is executed the SPod internal rolling average period will be set to 10 seconds
aO1	Manual Trigger	When this is executed the can system will be manually triggered.
aC4000	Trigger Level	When this is executed the trigger level will be set to 4000 counts.

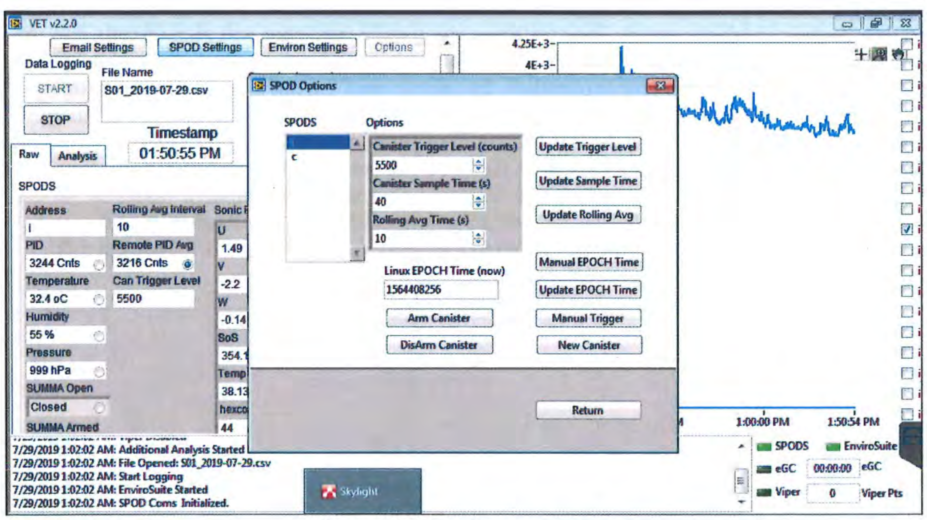


Figure 14: Resetting can system

During normal operation the system is triggered when the rolling average is greater than the set trigger value. Once the system is triggered the canister is disarmed until it is manually armed again by the user. The same is true for the manual trigger.

Note: The trigger algorithm is in constant development to ensure the best results.

4.6.3.8: Complete the installation process by performing a final site and installation safety inspection and cleaning up tools and materials. Take digital photographs of all the setup configurations from various vantage points and store for future reference(Section 7).

- ***Complete data fields (19) and (20) under SPod Field Deployment Form in Section 7***

4.6.3.9: Occasionally, an SPod component may fail and require replacement. If there is a component failure, the SPod can be field repaired if the part is "field swappable". For example, if a new PID, micro-processor or xbee receiver were to fail, trained field personnel may make the swap. The SPod data will not be considered valid until a proper pre-deployment bump test has been performed as per the project QAPP(this test can be performed at remote location). A field deployment sheet will need to be completed to start the official data collection.

4.7 Calculations

This Section describes SPod data along with the calculations and procedures that are performed to convert raw SPod data into plume detects. This Section also describes the data inspection procedures and calculations that identify physical and analytical method interferences and establish data acceptance criteria. Additional information on the Sensors that are used in the SPod is contained in "Draft Design Package for U.S. EPA Beta Version SPod Fenceline Sensor", version January 2018.[2]

4.7.1: SPod data are recorded in the format presented in Table 3. The example below is for a single SPod that is fitted with a 3D Sonic anemometer. If a 2D sonic is used, the Sonic.W column is not present in the data file. If multiple SPods nodes are part of the same network and a BS is used to record data from the units, a unique letter (a, b, c…) precedes each data field [e.g. a.PID (cts), a.Temp (degC), etc.]. For subsequent SPod units, the data field is repeated with a different preceding letter [e.g. b.PID (cts), b.Temp (degC), etc.]. The preceding letter is linked to the unique SPod S/N in the data form of Section 7. For a BS recorded system, each SPod node data line is acquired sequentially and there is a slight delay time associated with this acquisition so the data acquisition rate will slow to approximately 0.5 Hz for three units. Data are still recorded on the SD cards on each unit at 1 Hz. The time stamp for a BS controlled system is the computer time and may have some offset from individual SPod times due to SPod Arduino computer drift (initial offset established in *4.6.3.7.4).*

Table 3: SPod data format

TimeStamp	i PID (counts)	i Temp (oC)	i Hum (%)	i Press (hPa)	i SUMMA_O ()	i SUMMA_A ()	i SUMMA_N ()	i Sample Time (sec)	i Rolling Avg Int (sec)
4/5/19 0:00	2627	0	0	0	0	0	0	35	10
4/5/19 0:00	2630	0	0	0	0	0	0	35	10
4/5/19 0:00	2655	0	0	0	0	0	0	35	10
4/5/19 0:00	2696	0	0	0	0	0	0	35	10
4/5/19 0:00	2696	0	0	0	0	0	0	35	10
4/5/19 0:00	2651	0	0	0	0	0	0	35	10
4/5/19 0:00	2651	0	0	0	0	0	0	35	10
4/5/19 0:00	2685	0	0	0	0	0	0	35	10
4/5/19 0:00	2632	0	0	0	0	0	0	35	10
4/5/19 0:00	2686	0	0	0	0	0	0	35	10
4/5/19 0:00	2666	0	0	0	0	0	0	35	10
4/5/19 0:00	2637	0	0	0	0	0	0	35	10
4/5/19 0:00	2675	0	0	0	0	0	0	35	10
4/5/19 0:00	2626	0	0	0	0	0	0	35	10

i PID Avg (counts)	i Can Trig Level (counts)	i Sonic.U ()	i Sonic.V ()	i Sonic.W ()	i Sonic.SoS ()	i Sonic.Temp (oC)	i Sonic.hex code ()	i Sonic.Error Code ()	i Sonic.Vol (V)
0	0	1.48	-2.11	0.79	343.94	20.39	42	0	11.4
0	0	0.76	-2.11	0.39	343.96	20.43	45	0	11.4
0	0	0.52	-2.02	0.26	343.96	20.43	4F	0	11.4
0	0	0.64	-2.24	0.3	343.94	20.41	49	0	11.4
0	0	0.72	-2.35	0.39	343.92	20.37	40	0	11.4
0	0	0.82	-2.06	0.69	343.9	20.35	4A	0	11.4
0	0	0.43	-1.94	0.66	343.9	20.33	46	0	11.4
0	0	0.51	-2.14	0.56	343.88	20.29	4F	0	11.4
0	0	0.16	-1.54	0.12	343.9	20.35	4F	0	11.4
0	0	0.07	-1.81	0.08	343.88	20.29	48	0	11.4
0	0	-0.22	-1.67	-0.03	343.84	20.24	4D	0	11.4
0	0	0.13	-1.62	0.15	343.76	20.11	46	0	11.4
0	0	0.12	-1.53	0.31	343.78	20.14	48	0	11.4
0	0	0.37	-1.55	0.03	343.8	20.18	43	0	11.4

- Timestamp: date and time of acquired data line in mm/dd/yy hr:min:sec
- PID (counts): instantaneous signal level of PID sensor in counts, range from 0 to 32,000
- Temp (oC): uncalibrated temperature sensor output in degrees C
- Hum (%): Relative humidity percent
- Press (hpa): Atmospheric pressure in hpar
- SUMMA_O (): Indicates at which data points the Summa can was open.
- SUMMA_A(): Shows if the cannister is armed. Armed:1, unarmed:0.
- SUMMA_N(): Shows if system has a new can. new:1, old:0. System can only be armed if a new can is installed.
- Sample Time (sec): If triggered, length of time the can will pull a sample.
- Rolling Avg Int (sec): Interval at which the can trigger logic is averaging data.
- PID Avg (counts): When can is armed, represents the rolling average over the interval set.
- Can Trig Level (counts): When the PID Avg exceeds this value the can will trigger.
- Sonic.U (): U-axis (horizontal component 1) wind speed in meters per second from the sonic anemometer
- Sonic.V (): V-axis (horizontal component 2) wind speed in meters per second from the sonic anemometer

- Sonic.W (): W-axis (vertical component) wind speed in meters per second from the sonic anemometer
- Sonic.SoS (): Speed of sound as determined by the sonic anemometer
- Sonic.Temp (oC.): Temperature of air in degrees C as determined by the sonic anemometer
- Sonic.Hex.Code: Result of checksum in the sonic output string, expressed as a two-digit hexadecimal value
- Sonic.Error Code (0/other): If the sonic anemometer detects an operational error, value becomes non zero
- Sonic.Vol (V): The supply voltage the sonic anemometer is receiving, a surrogate for SPod power

4.7.2: General description of prototype SPod data analysis. The current version of the SPod is intended to be a low cost, easy to deploy system that can detect emission plumes in fenceline applications. Several data analysis approaches can be applied to single node and multinode fenceline sensor data to investigate aspects of source emissions, such as proximity, constancy, triangulation (location determination), and source strength. This MOP does not describe these types of data analysis. This MOP describes the basic data analysis approaches and screening procedures that support data quality assessment and QA functions. This MOP focuses on analysis of PID data quality since this is the most challenging aspect of current prototype PID design and use. As discussed previously, the current version of the SPod does not condition the inlet air but does heat the PID sensor. As such, physical and analytical method interferences can present significant issues with the current system and special procedures must be used to ensure data quality and filter-out unacceptable data (referred to as "QC screens" or "QC checks" in this document). These procedures are described in subsequent sections. The following steps are used for current prototype SPod data analysis:

- SPod data visual inspection and thresholding to protect against "off scale" conditions (Section 4.7.3)
- SPod data visual inspection to investigate rapid RH swings (Section 4.7.4)
- SPod data visual inspection to identify anomalous data drop-out conditions (Section 4.7.5)
- Use of baseline removal algorithms to separate plume events from background changes and sensor drift (Section 4.7.6)
- Use of concentration wind rose plots to understand source direction (Section 4.7.7)
- Use of dual SPod deployments to correlate emission events. (Section 4.7.8)

SPod raw data are processed using a custom software program written in "R" [See Section 8]. The code reads in the SPod data and produces first level summary allowing visual inspection QA procedures to be performed to screen-out unacceptable data. The program then applies baseline removal on acceptable data followed by wind comparisons. Optionally, this program will also generate a daily summary sheet described below. The code is contained in an EPA share drive and can be obtained by contacting Eben Thoma.

The first step in analysis of SPod data is to create a daily summary sheet(data record) for each day of operation that plots the raw SPod PID concentration counts (cts) throughout the day

(Figure 14). This is accompanied with filling out items (1) - (7) in the SPod Data Analysis form (Section 7). Hard copies of these records should be kept in a binder to allow each day of operation to be easily investigated. Optionally, an electronically generated summary sheet can be created in the place of the hand-written copy and stored on a share drive (figure xx). The electronic version provides the same written information, raw graphs, polar plots and other useful calculations. In the example of Figure 14, one can see some slower baseline variation and one period of "spikes" near 20:00 that will require further investigation. In this example, two independent PID systems are co-deployed (here called units A104 and B106).

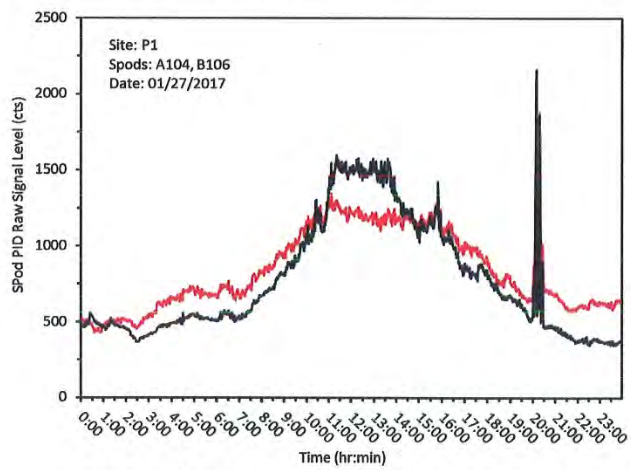
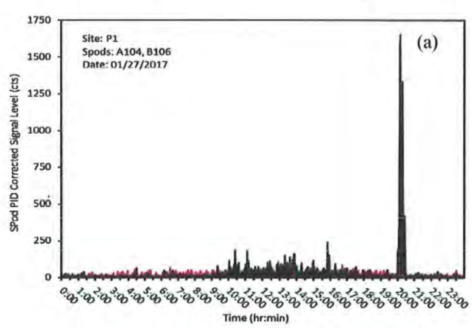
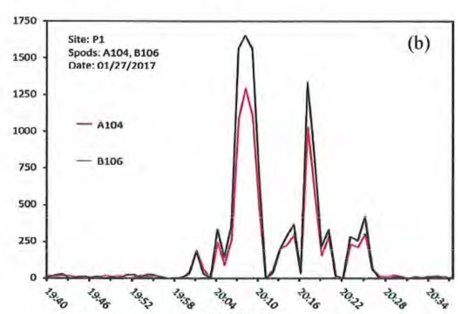


Figure 15: Example of a daily SPod PID raw data record

As discussed in subsequent sections, visual inspection of the daily data graph can provide critical information on the operational state of the PID. For the example of Figure 15, these tests are "passed" so provided here is an example of additional data analysis steps that include removal of the slowing varying baseline (analytical interferences) using a spline fit procedure, allowing the potential plume detects to be more easily observed [Figure 16(a)]. Figure 16(b) show a zoomed in view of the primary plume detects around time 20:00 showing simultaneous detection on two independent SPod units. Further analysis would bring in wind direction and other data.





 Printed copies of this document are uncontrolled. All users are responsible for confirming version status against the electronic version in the document control system.

Figure 16: (a) Data from Figure 15 after baseline removal, (b) zoomed in view of primary detects

After production of each daily data graph:

- ***Complete data fields (1) through (10) under SPod Date Analysis Review Form in Section 7***

4.7.3: SPod data visual inspection and data calculations are used to protect against "off scale high" and "off scale low" conditions. Under certain conditions, (like a heavy dew) the current SPod PID sensor can become contaminated with water causing the system to become non-operational (off scale high or low) for a period of time until it dries out. Note that this physical interference may be related to but is separate from the RH swing effects discussed subsequently. The off scale high or low condition may also be caused by other factors such as sensor malfunction or power loss. The off scale high condition is easy to visually detect and an R function "screenOffScale" has been written to remove data that have a five-minute average signal concentration greater than 31,000 cts. The off scale low condition can also be visually detected and the "screenOffScale" R function removes values where the five-minute average signal concentration less than ~250 cts

4.7.4 SPod data visual inspection to investigate rapid RH swings. The PID sensor responds to relative humidity and when it changes rapidly, producing an analytical interference that can be mistaken for a plume signal. As can been seen in Figure 17, the sharp increase in relative humidity Around 16:00 causes a spike in the PID sensor that should be removed prior to further analysis. An R function "screenRH" has been written to identify and remove these time periods, but visual inspection should be conducted as well.

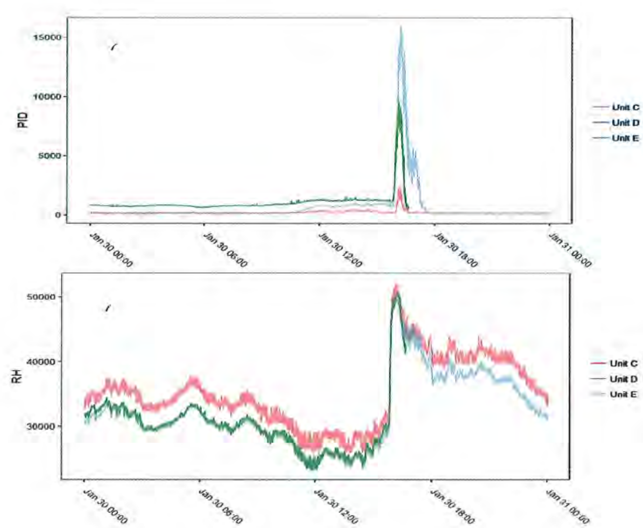


Figure 17: (a) PID reading show large spike on three SPod nodes coincident with (b) large RH swing.

4.7.5 Perform SPod data visual inspection to identify anomalous data drop-out conditions. In some cases, the SPod PID may exhibit sharp drops in signal (For example, Unit D in Figure 18). This effect can be caused by the SPod running near the power threshold for operation (for solar/battery systems) or by other sensor malfunctions. These time periods should be screened out before further analysis. The screening can be performed using the R function "screenDrops" but should be accompanied by visual inspection.

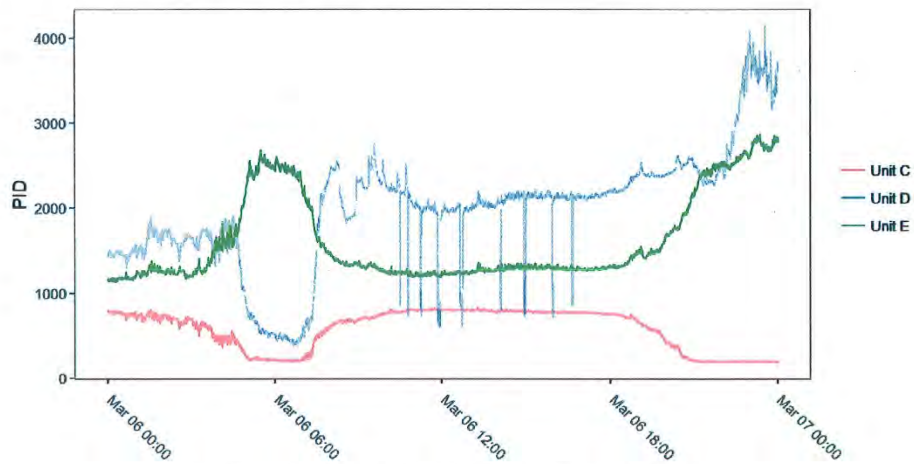


Figure 18: Example of data drop-out on Unit D.

4.7.6 Use baseline removal algorithms to separate plume events from background changes and sensor drift:Data that passes the above criteria should be further processed, by removing baseline drift using quantile regression with trend filtering. This can be accomplished using the R function "getBaseline". In Figure 19 on the left, the black trace represents raw PID counts from 3 SPods (top to bottom). In the case the bottom two SPods are exhibiting off-scale low conditions. The red trace represents data that has passed the QC screens. The figure on the right shows the sensor values after drift removal. Note that these values are still likely below plume detection threshold (Section 4.8).

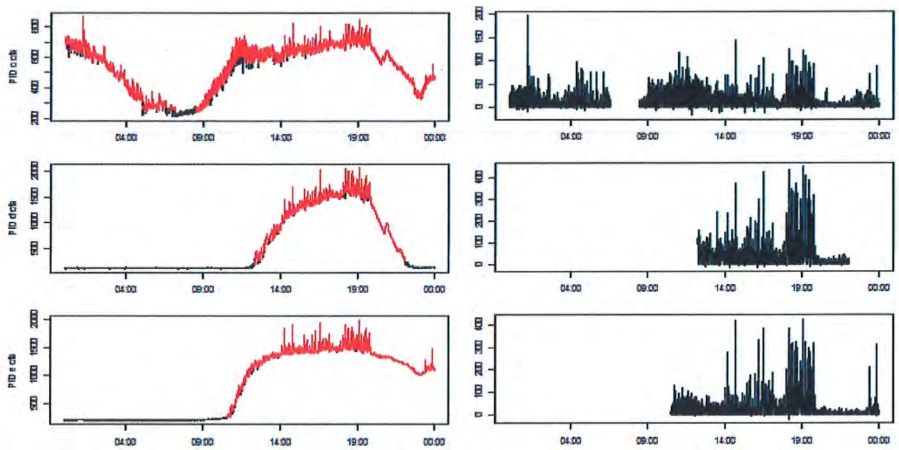


Figure 19: Example data QC check (right) with red trace indicating data that passed the check with baseline removal (left)

- ***Complete data field table in (11) under SPod Date Analysis Review Form in Section 7***

4.7.9 Further processing of data for those time periods recorded in step (11) of SPod Data Analysis Review Form that are viable (pass above data QC screens/checks) as required by the specific project. If plume detects are observed in initial data process, perform additional analysis such as direct comparison of co-deployed SPods units and use of concentration wind rose plots to understand source direction. After the drift has been removed, polar plots can be used to investigate relation between the PID signal and wind conditions (Figure 20). These diagnostics are meaningful when significant emissions plumes are isolated, so this represents advanced data processing and is not described in this MOP.

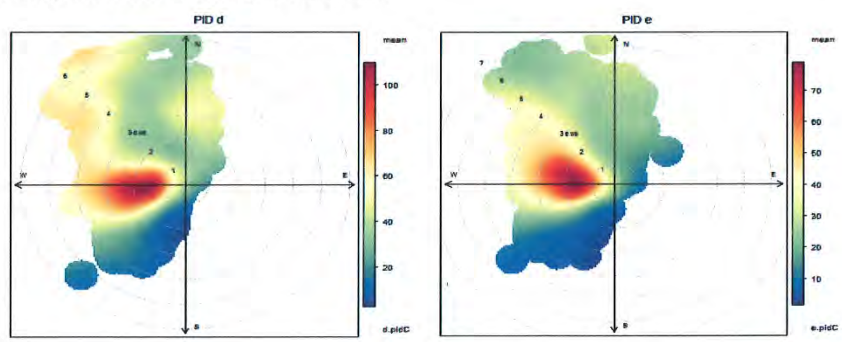


Figure 20: Example of a concentration wind rose plot for a strong emissions plume detection

4.8 Quality Assurance/Quality Control

This Section summarizes the basic quality assurance and quality control procedures used for SPod installation and operation (Table 4). Note that final data acceptance criteria will be project specific and discussed in the QAPP and reporting.

Table 4. Summary of basic QA/QC procedures for prototype SPod set up and use

Condition	Accepting Criteria	Method procedure / corrective action	Frequency
SPod pre-deployment test	SPod must prove normal operation over the span of a minimum of 36 hours.	At least three SPod bump test (one worksheet) must be completed on the test range (or other site), and all sensor data checked for reasonability before deployment	Once before deployment
Verify proper SPod and BS set up	Completion of SPod Field Deployment Form (1) - (20)	Execute MOP 3010 Section 4.6 / if during installation test specific sensors are found to be non-operational, consult with field lead on corrective actions	Once at installation
Periodic SPod operations check	Completion of SPod Field Deployment Form item (18)	Execute MOP 3010 Section 4.6.3.7 / if during specific sensors are found to be non-operational, consult with field lead on corrective actions	Once per month of deployment (or by frequency specified in the QAPP) and at decommission of deployment
Daily Data Screen	Completion of SPod Data Review form (1) - (11)	Execute MOP 3010 Section 4.6 / no corrective action is required	Once for each day of data acquired
Wind Measurement Check	Reasonableness compared to independent values	Perform reasonableness check by comparing acquired data other collocated data source / if found problematic, exclude data. Typically, 5-minute average wind direction and sped should agree within +/- 20% for collocated units at the same elevation.	Once per week recommended

Condition	Accepting Criteria	Method procedure / corrective action	Frequency
PID Check (if possible)	Reasonableness compared to independent values	Perform reasonableness check by comparing time periods with elevated PID data (confirmed plumes) with collocated other data source (e.g. on site GC). Typically, fast on-set plume events register by a field GC that exceed 50 ppbv (for PID-measured compounds) should be observed by the SPod.	100% as available
Heater Check	Reasonableness compared to resistance of heater being used.	Perform reasonableness check by using an ohm meter to check resistance across the heater to ensure values are similar to the resistance measured during system assembly (+/- 20%)	Once at installation
Lab Can Trigger Check	System must pass a 2 min leak check and 24 hour leak check before being taken to the field.	The method is described on the worksheet in section 7.	Once before deployment
Field Can Trigger Check	System must pass leak check of30 sec. System must trigger by command.	Perform leak check in the field by putting on a canister to make system pressure ~30 inhg and taking off immediately. The pressure in the system should not change over the course of 30sec. Then send manual trigger to verify operation of system.	Once at deployment

5 REFERENCES

[1]Draft Design Package for U.S. EPA Beta Version SPod Fenceline Sensor, version January 2018, contained as Appendix C2 of this QAPP

[2]E. D. Thoma, H. L. Brantley, K. D. Oliver, D. A. Whitaker, S. Mukerjee, B. Mitchell, B. Squier, T. Wu, E. Escobar, T. A. Cousett, C. A. Gross-Davis, H. Schmidt, D. Sosna, H. Weiss. J. South Philadelphia passive sampler and sensor study. J. Air Waste Manage. Assoc. (2016), Vol. No. 10, 959-970; doi:org/10.1080/10962247.2016.1184724.

[3]R Core Team R: A Language and Environment for Statistical Computing; R Foundation for Statistical Computing: Vienna, Austria, 2013.

6 MOP History

This MOP was based on previous SPod procedures. Biannual reviews and any revisions should be documented in the table below.

Revision #	Description	Prepared/Revised By:	Effective Date
0	First issuance	J. Cansler (JTI), H. Brantley, and E. Thoma (EPA)	05/11/2017
1	Revised version including canister trigger and PID heater with updates several sections	J. Cansler (JTI), P. Deshmukh (JTI) and E. Thoma (EPA)	03/12/2018
2	Updated procedures, software, data handling.	J.Cansler (JTI)	08/01/2019
3	Minor Edits/ Revisions/Review	P.Deshmukh (JTI)	08/05/2019

7 Deployment and Analysis Forms

SPod Pre-Deployment Form

Procedure Step 4.6.1 Date:___________

(1) SPod S/N(s):
(2) SPod(s) Location:
(3) Gas concentration and flow rate:
(4) Set SPod time sync to cell time: (Y/N)
(5) SPod anemometer pointed North check: (Y/N)
(6) True or Magnetic North: (T/M)
(7) Site notes:

	SPod __ Bump Test 1	SPod __ Bump Test 2	SPod __ Bump Test 3	SPod __ Bump Test 4*
Cell Time				
PID Level (cts)				
~PID Baseline Level (cts)				
~PID Spike (cts)				
Temp. Pass (Y,N)				
Press. Pass (Y,N)				
RH Pass (Y,N)				
Sonic Pass (Y,N)				

	SPod __ Bump Test 1	SPod __ Bump Test 2	SPod __ Bump Test 3	SPod __ Bump Test 4*
Cell Time				
~PID Baseline Level (cts)				
~PID Spike (cts)				
PID Pass (Y,N)				
Temp. Pass (Y,N)				
Press. Pass (Y,N)				
RH Pass (Y,N)				
Sonic Pass (Y,N)				

*Bump test 4 optional

(8) Certify SPods for the field: (Y/N)

Signature of tester:____

End.

SPod Field Deployment Form

Procedure Step 4.6.1

(1) Site name:
(2) Deployment date:
(3) Field personnel:
(4) SPod S/N(s):
(5) Base station S/N (if used):
(6) GPS coordinates of SPod(s):
(7) Set SPod time sync to cell time: (Y/N)
(8) Perform pre-install site safety check: (Y , N)
(9) Site notes:

Procedure Step 4.6.2

(10) Preform SD install check: (Y , N)

Procedure Step 4.6.3

(11) SPod anemometer pointed North check: (Y , N)
(12) Magnetic North or true North?
(13) SPod level check: (Y , N)
(14) SPod to tripod tightness check: (Y , N)
(15) SPod solar panel pointed South check: (Y , N, NA)
(16) SPod powered on light check: (Y , N)
(17) SPod BS operation check: (Y , N)

(18) SPod operation test:

	SPod __ Bump Test 1	SPod __ Bump Test 2	SPod __ Bump Test 3	SPod __ Bump Test 4*
Cell Time				
PID Level (cts)				
~PID Baseline Level (cts)				
~PID Spike (cts)				
Temp. Pass (Y,N)				
Press. Pass (Y,N)				
RH Pass (Y,N)				
Sonic Pass (Y,N)				
Can Sys Pass	Y - N - NA			

	SPod __ Bump Test 1	SPod __ Bump Test 2	SPod __ Bump Test 3	SPod __ Bump Test 4*
Cell Time				
PID Level (cts)				
~PID Baseline Level (cts)				
~PID Spike (cts)				
Temp. Pass (Y,N)				
Press. Pass (Y,N)				
RH Pass (Y,N)				
Sonic Pass (Y,N)				
Can Sys Pass	Y - N - NA			

*Bump test 4 optional

Add tables for additional SPods if required.

Procedure Step 4.6.4

(19) Perform final site and installation safety check (Y , N)

End

SPod Data Analysis Review Form

Procedure Step 4.7

(1) Site name:
(2) Date data were acquired:
(3) Date data were processed
(4) Analysis personnel:
(5) SPod(s) S/N:
(6) Base Station S/N (if used):
(7) Daily raw data file name:
(8) Daily raw data graph file name:
(9) Daily processed file name(s):
(10) Daily processed data graph(s) file name(s):
(11) Perform data visual inspection, thresholding, and basic processing (4.7.3 - 4.7.6).

Note hours (hrs) in the day (0.00 hrs -24:00 hrs) were conditions exist.

	SPod 1	SPod 2	SPod 3
SPod not operational hrs.			
PID off-scale hrs. (4.7.3)			
RH swing events (4.7.4)			
Data drop events (4.7.5)			
Successful Baseline removal hrs. (4.7.6)			
Potential plume detects			

(12) If potential plume detects exist, perform additional data analysis to confirm plume detects

End

SPod Data Analysis Review Form

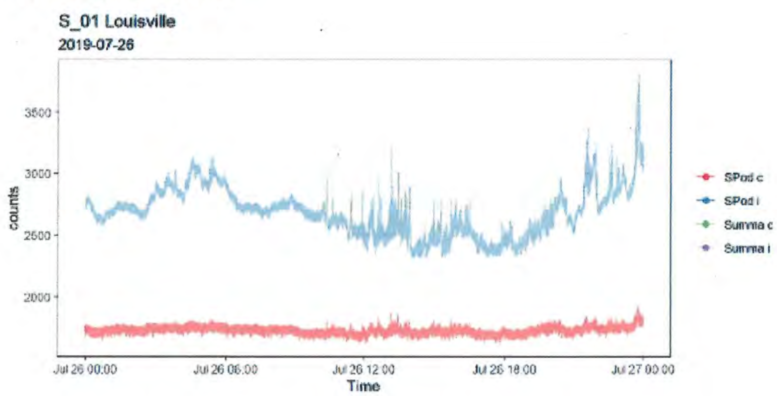
Procedure Step 4.7

(1) Site name, number and coordinates: Fire Arms Training Center, 1 ,38,231583, -85,231583
(2) Date data acquired: 2019-07-26
(3) Date data Processed:2019-07-30
(4) SPod Nodes: i, c
(5) Base station s/n: VET04
(6) Raw data file name: S01_2019-07-26,csv
(7) Raw data graph file name: rawplot_S01_ic_2019-07-26,png, rawplot_S01_cc_2019-07-26,png
(8) Daily processed filenames: Baseline_removed_10 sec_avg_2019-07-26.csv, SPod_summary_5 min_avg_2019-07-26,csv
(9) Daily processed data graphs file names: 2019-07-26Screened_timeSeries.csv, 2019-07-26baseline_removed.csv, 2019-07-26baseline_fit,csv
(10) Perform data visual inspections, threshholding, and basic procesing (4.7.3 - 4.7.6).

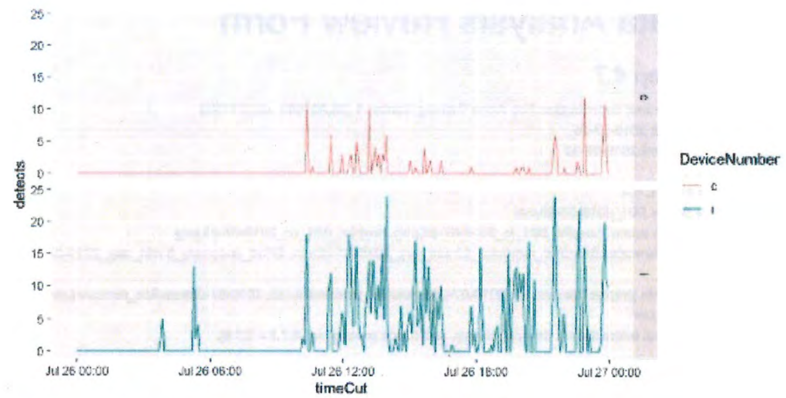
Summary Table (5min)

Spod,Summary	SPod1	SPod2
Detects	784,00	129,00
Percent Operational	99,91	99,91
Percent Detection	9,08	1,49
PID Corrected Mean (No Detect)	16.25	10.96
Detect Period Mean	69,08	21,97
SD - No Detect	8,07	2,59
Can Trigger	0,00	0,00

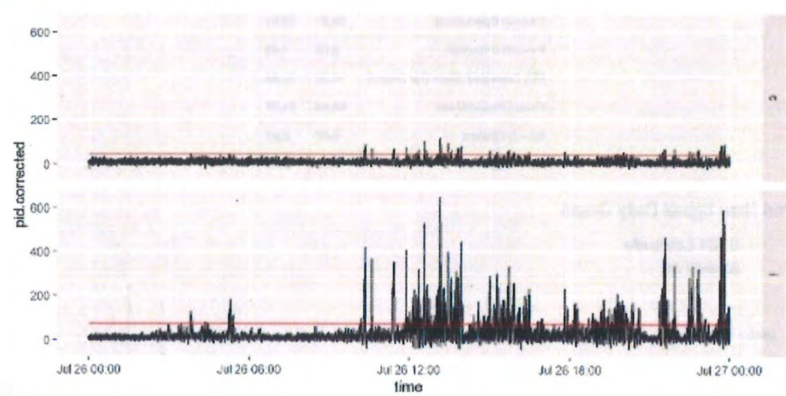
SPod Raw Signal Daily Graph



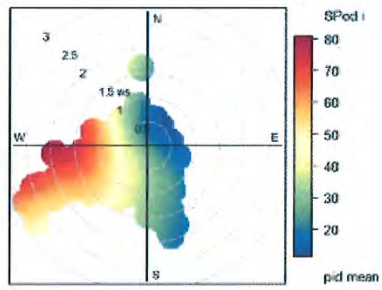
Detects

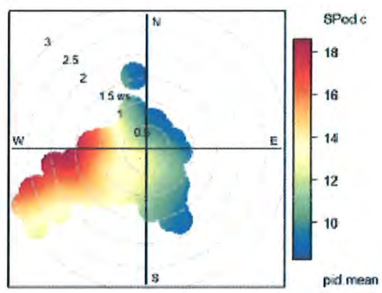


PID corrected with Threshhold



Polar Plots (5min)





Signature of Analysis: ______________________________

End.

Lab Can Trigger System Leak Check

procedure:

Part A - Place an evacuated summa cannister on the system by connecting to the quick connect. The pressure should be between 25-30 inHg. Let this set for 2 minutes. There should be zero pressure drop for this to pass.

Part B - Place the same evacuated summa cannister on the system by connecting to the quick connect. The pressure should be between 25-30 inHg. Let this set for 24 hours. There should be <1 inHg pressure drop for this to pass.

test:

A:

Date	Time	System ID	Starting Pressure	End Time	Pass(Y/N)

B:

Date	Time	System ID	Starting Pressure

Date	Time	Ending Pressure	Pass(Y/N)

Signature of tester: ______________________________

End.

8 Data Analysis Code

All codes and programs currently being used can be obtained by contacting Eben Thoma at Thoma.Eben@EPA.gov.

Appendix C: Remote Data Retrieval Procedure

1.0 Data Retrieval

1.1 Sensit SPod Data Retrieval

1.1.1 Connect the field laptop computer the internet and open a browser window. Log onto the Sensit SPod cloud data storage by accessing the following web address: http://18.222.146.48/SPOD/epa/data/raw/SPOD/1003/. The username is "epatestuser" and contact ERG Task Manager for the password.

1.1.2 Click on the day of the data file that needs to be downloaded. While on the screen with the data, click on the "File" header and choose the "Save as…" option.

1.1.3 Save the data file as a .txt file format in the prescribed folder that is set up just for the Sensit SPod data.

1.1.4 Continue this process for all data files needing to be downloaded.

1.1.5 Log off of the website by closing the browser window.

1.1.6 Open one of the recently downloaded .txt data files with Microsoft Excel. Choose the option for "Delimited" and click the "Next >" button. Select the "Tab", "Comma", and "Space" Delimiters and click the "Finish" button.

1.1.7 Save the data by clicking the "File" header and choosing the "Save as…" option. Make sure Excel is saving the file in the same folder as the original .txt file and as the same name of the original file. Just to the left of the "Save" button select the option to save the file as an Excel workbook (*.xlsx) file from the pull-down menu. Then click the "Save" button.

1.1.8 Repeat this process for all other downloaded Sensit SPod data.

1.1.9 Inspect the converted data files to ensure data was being recorded by all sensors, that there are no missing data or data gaps, and that it is reasonable (e.g. check wind direction by comparing the value to other co-deployed units or to known values [nearby airport, onsite observation]).

Appendix D: Certificates of Analysis

GASCO

GASCO AFFILIATES, LLC.

320 Scarlet Blvd.
Oldsmar, FL 34677
(800) 910-0051
fax: (866) 755-8920
www.gascogas.com

CERTIFICATE OF ANALYSIS

Date: March 8, 2019
Order Number: 4625257641
Lot Number: DBJ-248-0.5-1

Customer: Grainger

Use Before: 03/08/2023

Component	Specification (+/- 10%)	Analytical Result (+/- 2%)
Isobutylene	0.5 PPM	0.45 PPM
Air	Balance	Balance

Cylinder Size: 3.6 Cu. Ft.
Contents: 103 Liter

Valve: 5/8" -18UNF
Pressure: 1000 psig

The calibration gas prepared by Gasco is considered a certified standard. It is prepared by gravimetric, or partial pressure techniques. The calibration standard provided is certified against Gasco's G.M.I.S. (Gas Manufacturer's Intermediate Standard) which is either prepared by weights traceable to the National Institute of Standards and Technology (NIST) or by using NIST Standard Reference Materials where available.

Analyst:

Afton Briggs
Afton Briggs

ISO 9001:2008 Linde **SPECTRA** Environmental Gases, 80 Industrial Drive, Alpha, NJ 08865

THE LINDE GROUP Linde

SHIPPED TO: Eastern Research Group
601 Keystone Park Dr Ste 700
Morrisville, NC 27560-0348

PAGE: 1 of 1

CERTIFICATE OF ANALYSIS

Sales#:	117071196	**Cylinder Size:**	185 (3.2" X 9.4")
Production#:	1481899	**Cylinder # :**	AB-111640
Certification Date:	Feb-20-2019	**Cylinder Pressure:**	1700 psig
P.O.# :	PO66562	**Cylinder Valve:**	CGA 180 / Aluminum
Blend Type:	CERTIFIED	**Cylinder Volume:**	0.8 Liter
Material#:	24100940	**Cylinder Material:**	Aluminum
Traceability:	NIST by weight	**Gas Volume:**	98 Liters
Expiration Date:	Feb-20-2020	**Blend Tolerance:**	10% Relative
Do NOT use under:	150 psig	**Analytical Accuracy:**	5% Relative

COMPONENT	CAS NUMBER	REQUESTED CONC	CERTIFIED CONC
Chloroprene	126-99-8	0.50 ppm	0.50 ppm
Nitrogen	7727-37-9	Balance	Balance

ANALYST: Lou Lorenzetti

DATE: Feb-20-2019

Linde Gas North America LLC

(908) 329-9700 Main (908) 329-9740 Fax
www.Lindeus.com

Appendix E: Sensit SPOD Sensor Operational Manual

SENSIT SPOD Sensor Operation Manual and Configuration Guide

Version 1.0, August 12, 2019

For Questions Contact: jmelby@gasleaksensors.com

SPOD Sensor Overview

General

Overview	Parameter
Weight	Base unit: 6.75 lbs
Dimensions	Fully assembled with anemometer and antenna • D x W x H (6" x 8" x 16")
Mounting	Attached mounting flanges
Voltage Requirements	18V – 24V DC Charging (wired adapter or solar panel)
Current Requirements	2A max current draw when charging
Operating Runtime	3-5 days battery backup [1]
Operating Temp	-10°C to 50°C [2]
Data Outputs	• Digital wired output (3.3V TTL - USB) • Wireless (4G IoT Cellular Included) [2] • Optional analytics on server [4] • SD card data backup [5]

Notes:

1. Battery backup time depends on run mode and frequency of transmission.
2. Limited by lithium ion charging temperature. Lower temperature operation will require external or internal heating to maintain sufficient battery temperature for charge acceptance. Contact the manufacturer for more information.
3. Requires SIM card and suitable data plan on AT&T or T-mobile. Verizon service is pending
4. Cloud based analytics can be developed with additional contract
5. When removing SD card to obtain data, it is recommended to power off the sensor box prior to reinserting the SD card to avoid possible errors. If the system stops responding or any SD errors are observed after inserting an SD card, power down the sensor and turn back on.

Sensors

Overview	Parameter
Default PID Detection Range	10 ppb – 2 ppm[1]
Default PID Lamp Energy	10.6 eV[2]
Target PID Accuracy	+/- 20 ppb min or 10%[3,4]
Response Time	5-10 seconds[5,6]
Expected Lamp Life	1 year+

Notes:

1. VOC range reference to isobutylene. Additional PID sensors available with identical form factors if higher concentrations are necessary.

2. Additional PID sensors available with identical form factors if different lamp energies are required.

3. Factory calibration conducted with 1ppm isobutylene and ultra zero air

4. PID Sensors are sensitive to high amounts of humidity and may rail at the upper output if humidity is excessive. The SPOD contains an internal sensor heater to minimize humidity interference.

5. If the unit has been off for an extended period of time, it could take several minutes to an hour for the PID readings to drop to normal operating conditions depending on storage conditions. This stabilization may temporarily interfere with VOC detection.

6. Exposure to very high levels of VOCs may saturate the detector for several minutes to an hour

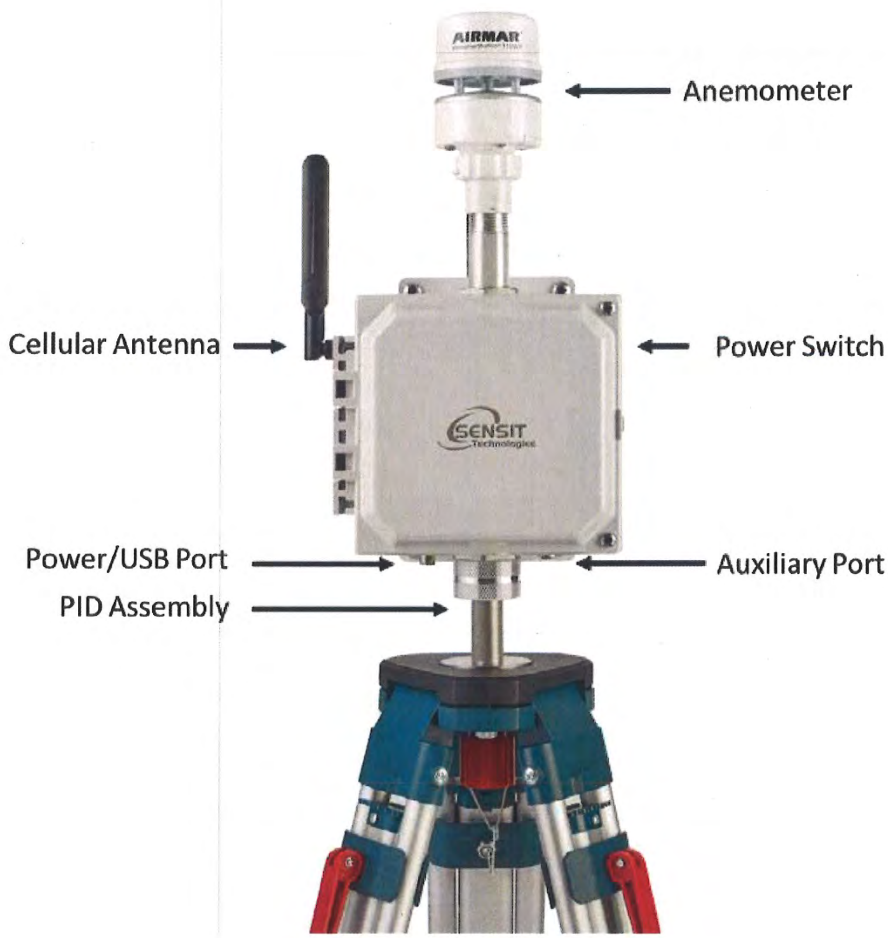
Cellular Specifications

Overview	Parameter
Network Technology	4G/2G[1]
Carrier	AT&T and T-mobile[2]
Transport Layer	TCP
Internet Layer	IP
Application Layer	HTTP and MQTT
Data Transfer Method	HTTP POST or MQTT Topics
HTTP Content Type	application/x-www-form-urlencoded
HTTP Body Field Identifiers	&ID, &MODULE, &STAT, &DATA
MQTT Content Type	JSON
MQTT Tags	"deviceld", "time", "iodb"
Post Location	Adjustable in Menu
APN	Adjustable in Menu
TLS/SSL	HTTPS and MQTTS with server authentication[3]

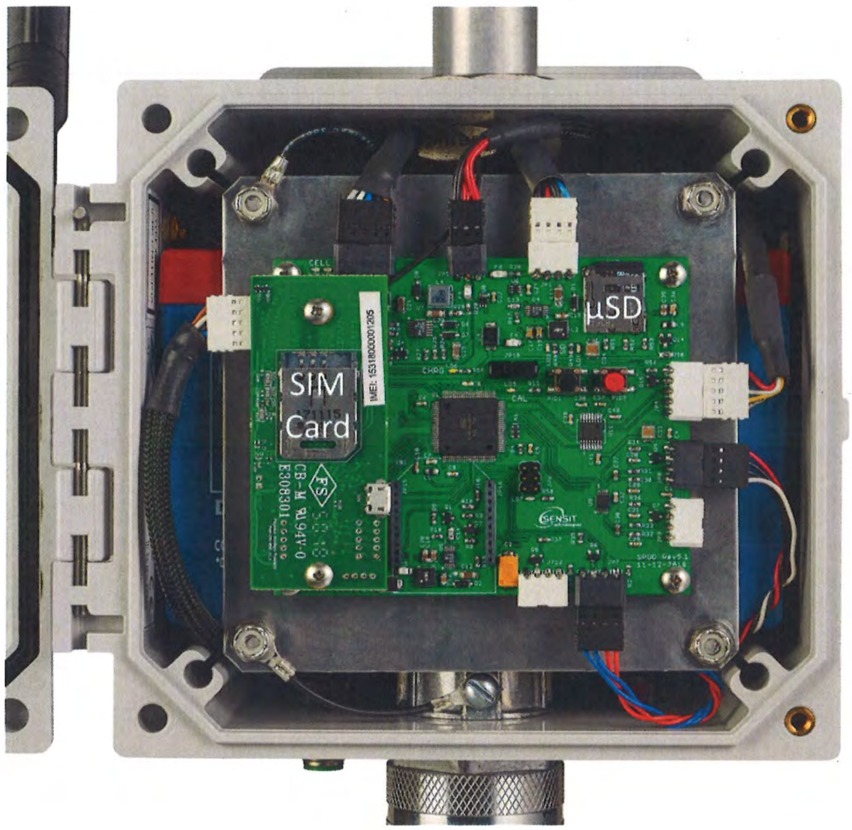
Notes:

1. 4G CAT M1 and NB-IoT
2. Modem is pending Verizon certification
3. Client authentication possible with additional development.

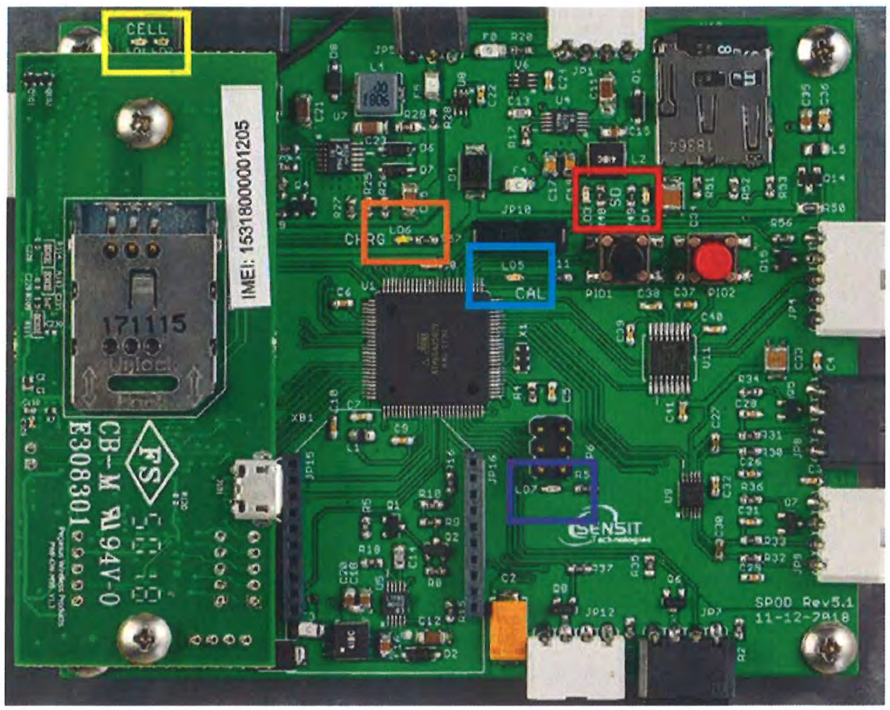
Sensor Exterior Features (Front Exterior)



Sensor Interior Features (Front Interior)



Sensor Interior LED Indication



Cellular Status	Charging Status	Calibration Mode	Sensor Status	SD Card Status

Cellular Status: Red LED if failure, Green LED if successful

Charging Status: Green LED if Charging

Calibration Mode: Solid/Flashing Blue LED in Calibration

Sensor Status: Red LED if initialization failure (PID or Weather Station)

SD Card Status: Red LED if failure, Green LED if successful

Quick Start Deployment Guide (USB Cable & Computer)

It is recommended to use a computer and the supplied USB cable when setting up the sensor unit to verify the operation of the sensors, system output, and cellular data connectivity (if applicable). If no cable and computer are available, please see the next page.

Unpack the sensor unit and check for any physical damage or obstructions at the sensor openings. Open enclosure cover and check for any loose or damaged components. Make sure all wires are securely fastened as shown in the internal sensor view on page 7.

1) Hook up USB cable sensor and initialize terminal connection. Power on unit and verify that the SD card was detected and initialized.

2) Verify the sensor outputs are reasonable or trending toward reasonable values keeping in mind the stabilization time for sensors that have been powered off or exposed to high VOC concentrations. Additionally, it may take up to 30 seconds for the ultrasonic anemometer to report valid environmental data. For information on USB headings and field identification, please see page 10.

3) When installing orient the weather sensor such that it is pointing North. Failure to do this will result in arbitrary wind direction. The North direction is indicated with a notch on the ultrasonic anemometer base. See page 11 for anemometer instructions. Never rotate the anemometer from the top or severe damage will occur.

4) After verifying functionality remove the USB cable. If planning to run in USB mode, install a power adapter or a solar panel for long term deployment applications. Otherwise, power cycle the SPOD, then install a power adapter or a solar panel for long term deployment applications.

Quick Start Deployment Guide (No Computer)

Unpack the sensor unit and check for any physical damage or obstructions at the sensor openings. Open enclosure cover and check for any loose or damaged components. Make sure all wires are securely fastened as shown in the internal sensor view on page 7 and refer to the LEDs indicated on page 8.

1) Power on unit. The illuminated switch should turn on. If the switch does not illuminate, inspect all wiring connections and charge battery.

2) Verify that the SD card was detected and initialized with the SD status LEDs

3) Verify the absence of sensor errors with sensor status LED.

4) If HTTP or MQTT protocol is selected verify successful initialization after startup with Cellular status. If PERIODIC protocol is used wait for required amount of time before cellular post.

5) If power is hooked up, wait for 1 minute after power up to verify the charging status LED is illuminated. Please note that if the battery is completely full the charging status LED will not illuminate.

6) When installing orient the weather sensor such that it is pointing North. Failure to do this will result in arbitrary wind direction. The North direction is indicated with a notch on the ultrasonic anemometer base. See page 11 for anemometer instructions. Never rotate the anemometer from the top or severe damage will occur.

7) After initialization is complete the illuminated switch will flash once per second to indicate normal operation

USB Output Headings and Description

USB Heading	*Description*	*Units/Format*
DATE	Local Date and Time	MM/DD/YY HH:MM:SS (24H)
PID1	Field 1, Sensor 1 VOC	PPB
	Field 2, Sensor 1 Raw	mV
PID2[1]	Field 1, Sensor 2 VOC	PPB
	Field 2, Sensor 2 Raw	mV
T	Temperature	°C
RH	Relative Humidity	%
P	Pressure	mBar
WS	Wind Speed	mph
WD	Wind Direction	Degrees
TC	Field 1, Sensor 1 Temp	Arb Units
	Field 2, Heater 1 Output	Arb Units
	Field 3, Sensor 2 Temp[1]	Arb Units
	Field 4, Heater 2 Output[1]	Arb Units
BATT	Battery Voltage	Volt
CHRG	Charging Current	mA
RUN	Operating Current	mA
TRIG	Field 1, Trigger Flag	0 or 1 if threshold exceeded
	Field 2, Trigger Counter	Adjustable
	Field 3, Sample Flag	0 or 1 if sample acquired
LAT[2]	GPS Latitude	Degrees
LON[2]	GPS Longitude	Degrees

Notes:

1. The control circuit board is designed to support a second sensor. Additional parameters will show up in the output if a dual sensor unit is configured by the factory.
2. GPS is not enabled on all units. Please contact Sensit to enable GPS.

Ultrasonic Anemometer Mounting Instructions

Installing (Figure 3)

CAUTION: The reflector plate and the waterproof film found in the wind channel of the WeatherStation Instrument are essential to its operation. Be careful not to scratch the plate, puncture the film, or damage them in any way.

CAUTION: The WeatherStation Instrument must be installed upright and vertical, *not* tilted to one side. It must be level and plumb. If the WeatherStation Instrument is tilted from the horizontal plane, it may introduce errors in the compass and wind readings.

CAUTION: To accurately measure the wind direction and heading, the alignment notch on the WeatherStation Instrument must be pointed correctly.

- Moving vehicle/boat—The alignment notch must point forward and be parallel to the centerline of the vehicle/boat.
- Stationary surface—It is recommended that the alignment notch point toward true north.

CAUTION: Tighten or align the WeatherStation Instrument by grasping the lower housing below the reflector plate. Hand tighten only.

- Do not rotate the cap. Turning it may sever internal connections and void the warranty.
- 110WXS, 150WXRS, 150WXS—Do not grasp the solar-radiation shield. The louvers may break.

CAUTION: If you use a thread lock, use Teflon pipe-thread tape. Do not use a liquid thread lock as it may weaken the plastic, causing it to swell and crack.

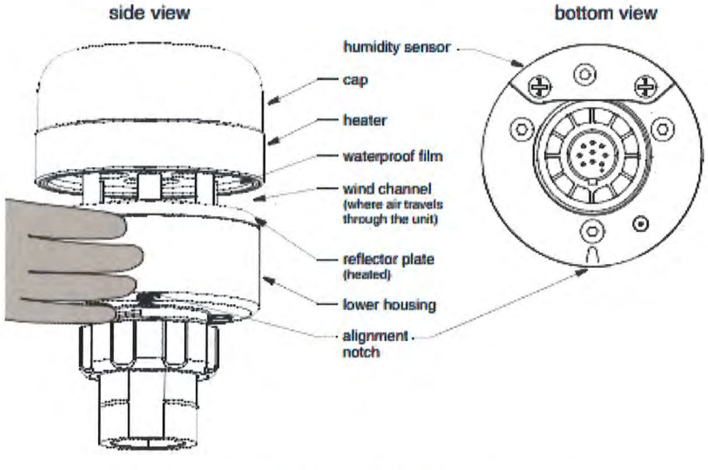


Figure 3. WeatherStation Instrument with heater (120/220WXH shown)

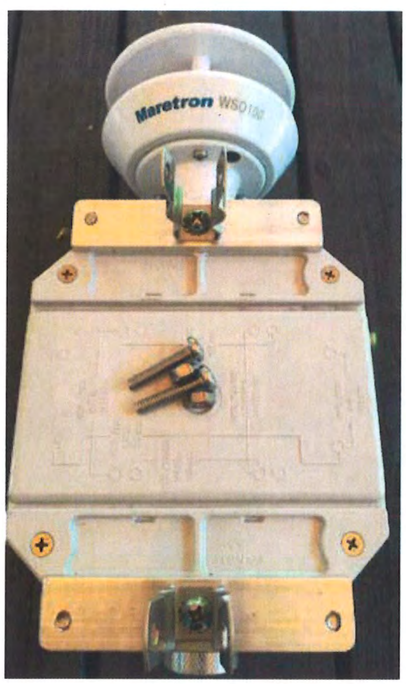
Tripod Setup and Installation (Optional)

1) Remove protective rubber feet if installing outdoors
2) Install pole on tripod. *Pole mounting attachment may differ from image below*.
3) Set leg height of tripod and spread legs with a minimum of 30° from perpendicular
4) For added stability in high wind or long-term deployments place sandbags against all legs

Catch tab with bag to hold down

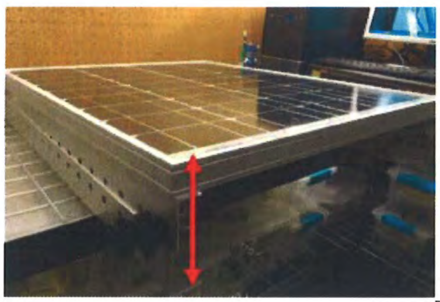
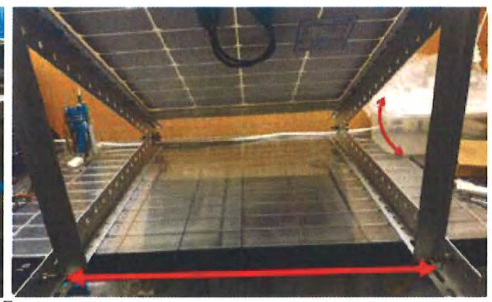
5) Use the shorter ¼" long screw to attach pole mount to back of SPOD
6) Use the longer 1 ¼" long screw + nut to tighten on pole
7) Tighten sufficiently to prevent rotation
8) Place SPOD as far up as possible on pole to avoid blocking anemometer

Note: The images below are used for reference. SPOD appearance will differ from image below.

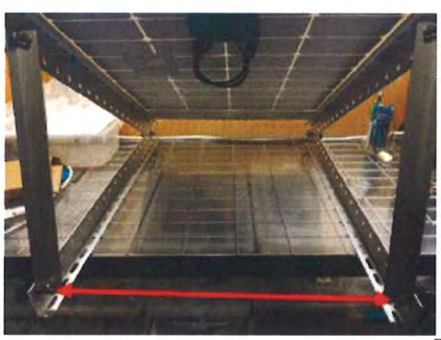
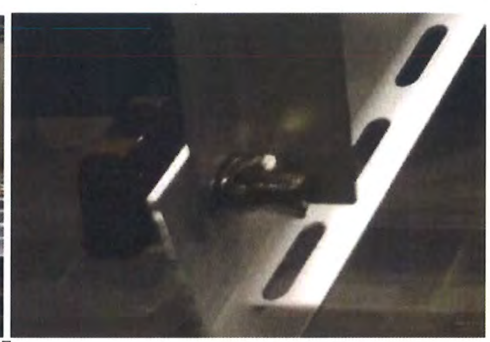


Solar Panel Setup and Installation (Optional)

1) Lift up on side with 2 knobs to unfold panel
2) Fold down angular supports on both sides and remove 2 knobs on bottom

3) Reattach knobs vertical angular supports on both sides (flat washer, lock washer, wing nut)

4) Place solar panel on ground and fasten to ground or add ballast if possible (recommended to avoid wind damage and theft)

5) Avoid shadowing on panel as much as possible as this will drastically reduce panel output power and efficiency

6) Route cable to SPOD unit

7) Plug cable into SPOD "Power/USB" connection

8) Power on SPOD unit

Note: Alternative solar mounts and solar panel extension cables can be purchased from Sensit. Please contact Sensit for more information if your application requires an alternative solar mounting setup.

USB Communication & Configuration Mode (Sensor)

The SPOD units allow for the reconfiguration of several parameters pertaining to the operation of system. Adjustment of these parameters is only accessible for a short period of time after powering on the sensor (~10s). These parameters are stored in non-volatile memory and are retained during subsequent power cycling. Documentation of these parameters is listed below.

Required Components:

- SPOD Unit
- USB data cable
- Computer with a serial port terminal software program (e.g. CoolTerm)

Sensor Quickstart Instructions

1) Connect the USB cable to the SPOD and computer and establish the communication link in the terminal software.

2) Turn on power switch and observe initialization process. After initializing the microcontroller and printing SPOD information, the system will system will prompt the user to:

   "Enter Configuration Mode? (YES)"

3) Configuration mode allows access to configuration settings and system settings. To enter configuration mode type **Yes** at the prompt and hit enter. The menus are all text-based and easy to follow. The following list contains all the adjustable within the menu:

Menu Item	*Description*	*Location*
CELLULAR	*Common settings*	*Root Menu*
DEFAULT	*System Default Settings*	*Root Menu*
DISPLAY	*Prints Current Settings*	*Root Menu*
GPS	*GPS Settings*	*Root Menu*
HEAT	*Sensor Heater Settings*	*Root Menu*
OFFSET	*Sensor Offset Setting*	*Root Menu*
POWER	*Power Settings*	*Root Menu*
SAMPLE	*Trigger Sample Settings*	*Root Menu*
TIME	*Time Settings*	*Root Menu*
EXIT	*Exit Menu*	*Root Menu*

Detailed Root Menu Information

Cellular: Contains all settings associated with the cellular modem. This is required for communication with any online servers.

Default: Resets all options to the factory default. Not recommended without consulting Sensit.

Display: Displays all current settings in the terminal window. An example print out is shown below. Please not that system settings may differ from device to device depending on the application.

System DATE,08/09/19 11:57:06
Sensor ID: SPOD00100
Battery Voltage: 13.74
Power Source: AC Power
Output Mode: Streaming
Communication Mode: Cellular
Network Selection: Automatic
Cellular Protocol: MQTT v3.1.1 with TLS
Publish Topic: "devices/SPOD00100/messages/events/"
Subscribe Topic:
Output Data Rate: 10
Cellular Output Ratio: 120

Server Address: sensit-test-hub.azure-devices.net
Access Point Name: zipitwireless.com.attz
GPS Mode: Interval
Sensor Heater: Enabled
Temp Set: 15
Dew Point Control: Disabled
Humidity Threshold: 80
Temp Set: 15
PID1 Offset Value (ppb): 0.00
Sample Trigger Value (ppb): 500
Trigger Average Time (sec): 10
Sample Collection Time (sec): 30

GPS: "ENABLE" or "DISABLE" the GPS. Depending on the cellular data protocol and output mode, the user may be presented with additional options. If cellular output is disabled or if PERIODIC protocol is selected the GPS mode will default to SINGLE (see below). If cellular output is enabled **and** MQTT or HTTP protocol are enabled the user can select between the following GPS settings:

"CONSTANT": GPS is always on and fixing position (Highest power draw)
"INTERVAL": GPS turns on at and interval determined by "RATIO"x"ODR"
"SINGLE": GPS turns on at power up and remains off until system is reset

HEAT: Adjust "CONSTANT" or "HUMID" heat settings. The "CONSTANT" setting means that the sensor heater is on at all times if enabled. The "HUMID" setting means that the sensor heater is on only if humidity exceeds a predefined threshold. If either option is enabled the user will be prompted to adjust the heater setpoints and for the "HUMID" option the user will be prompted to adjust the humidity set point. Both options could be enabled simultaneously to produce different heater setpoints depending on the humidity level. "CONSTANT" heat is enabled by default at 15°C above ambient.

OFFSET: Adjust the baseline of the PID sensor up or down by a constant value.

OUTPUT: This menu contains settings that modify the output characteristics of the sensor.

POWER: Select "SOLAR" and "AC" power. If "SOLAR" is selected the unit will try to charge the batteries whenever power is present. If "AC" is selected the system will maintain the battery voltage in the middle of its range to extend battery life. It is very important that "SOLAR" is selected for remote power application.

SAMPLE: Control the behavior of the auxiliary port. The port is configured to supply power to a valve to trigger sample collection if the PPB reading exceeds a predefined threshold for a predefined amount of time.

TIME: Set the system date and time. If cellular mode is enabled this will happen automatically when the device connects. Note that the initial data may have the wrong date and time until the clock adjusts.

EXIT: Leave the root menu and starts system operation

Detailed Cellular Menu Information

Menu Item	*Description*	*Location*
APN	*Carrier APN Setting*	*Cellular Menu*
CREDENTIALS	*MQTT Username and Password*	*Cellular Menu*
HOST	*Server Location Address*	*Cellular Menu*
NETWORK	*Cellular Network Configuration*	*Cellular Menu*
PROTOCOL	*Data Transfer Protocol*	*Cellular Menu*
RATIO	*Number of Samples to Buffer*	*Cellular Menu*
SIGNAL	*Apply settings and check signal*	*Cellular Menu*
TLS	*Activate TLS, Load Server Cert*	*Cellular Menu*
TOPICS	*MQTT Topics*	*Cellular Menu*
EXIT	*Exit Cellular Menu*	*Cellular Menu*

APN: Set the required APN for data access on the installed sim card. Please note that the APN text entry might be case sensitive

CREDENTIALS: Set the require USERNAME and PASSWORD require for MQTT data access.

HOST: Set the server address to send the data to. The target server must be configured to accept the data.

NETWORK: Define network behavior of the cellular module. AUTO mode is enabled by default and under most circumstances will work well. If required it is possible to force the modem to only look for "CAT M1", "NB IoT", or "2G" service instead of scanning for all network options. It is required to run "SIGNAL" option after adjusting network settings. Contact Sensit for more information.

PROTOCOL: Set the cellular data communication protocol to the following options:

"HTTP": Transfers data using HTTP Post protocol constantly at interval determined by the output data rate (ODR)

"MQTT": Transfers data using MQTT publish constantly at interval determined by the output data rate (ODR)

"PERIODIC": Buffers data according to the "RATIO" setting at the output data rate. After the required number of samples has been collected the modem will turn on, post all data, and then turn off. The interval of cellular cycles is determined by "ODR" x "RATIO"

RATIO: Set the number of required samples between cellular cycles for the "PERIODIC" cellular protocol. This value also influences GPS signal acquisition interval for certain modes. See information of GPS for more info.

SIGNAL: Acquire cellular signal strength and network registration status. This option also programs the modem with any changes to the NETWORK mode. After 10-15 seconds the serial terminal should display "CSQ: X,Y CREG Status: Z". A description of X,Y, and Z follow below.

X: (0-31,99) defines the signal strength
Y: (0-7, 99) defines the data error rate
Z: (0-5) defines the network registration status

X Value	dBm	Meaning
0	< -113	Absolutely no Signal
1	-111	Very Weak Signal
2-10	-109 to -93	Weak Signal
10-20	-81 to -73	Moderate Signal
21-30	-71 to -53	Strong Signal
31	> -51	Very Strong Signal
99	?	Unknown/Not Detected

Y Value	Meaning
0-3	Reliable Data Link
4-5	Occasional Dropped Posts
6-7	Unreliable Data Link
99	Unknown/Not Detected

Z Value	Meaning
0	Not registered, Not Searching
1	Registered Successfully
2	Not registered, Searching
3	Registration Denied
4	Unknown Status
5	Registered Successfully, Roaming

TLS: Enable or disable TLS encryption for HTTPS or MQTTS. For TLS authentication the user must load a root certificate file for the server on the microSD card. The certificate file **must** be named "CACERT.CER". If TLS is enabled the terminal should display:

```
TLS Eanbled...Waiting to Load Cert
Deleting Old Files
Loading New Cert From SD
Cert File Found
+QFUPL: 1311,3f41

OK
```

Please note that the values after "+QFUPL" are different for different certificate files. The first number is the number of bytes and the second number is a checksum. The same cert file should always generate the same number of bytes and checksum. If errors are observed verify that the certificate file is loaded on the microSD card and properly named.

TOPICS: Set the publish and subscribe topic used for MQTT cellular protocol.

EXIT: Leave the cellular configuration menu and enter the root menu

Detailed Output Menu Information

Menu Item	*Description*	*Location*
MODE	*Output Mode Settings*	*Output Menu*
ODR	*Data Rate Setting*	*Output Menu*
POLL	*Output When Polled (any char)*	*Output Menu*
STREAM	*Output Continuously*	*Output Menu*
EXIT	*Exit Output Menu*	*Output Menu*

MODE: Sets the communication mode of the SPOD. The following options are possible:

"Cellular": Sends data with cellular modem at ODR and USB/Power port at 1Hz
"USB": Sends data with USB/Power Port at 1Hz
"XBEE": Sends data with XBEE (optional) at ODR and USB/Power port at 1Hz

ODR: Sets the output data rate of the cellular modem or XBEE wireless device. The USB port will always show data output at 1Hz

POLL: Disable streaming over USB/Port and XBEE. SPOD will return data when receiving any character from control device.

STREAM: Continuous USB and XBEE data output at 1Hz.

EXIT: Leave the output configuration menu and enter the root menu

Detailed Sample Menu Information

Menu Item	*Description*	*Location*
SAMPLETEST	*Test Sample Trigger*	*Sample Menu*
SAMPLETIME	*Sample Acquisition Time*	*Sample Menu*
TRIGGERTIME	*Time Above Trigger Threshold*	*Sample Menu*
TRIGGERVAL	*Trigger Threshold Value (ppb)*	*Sample Menu*
EXIT	*Exit Sample Menu*	*Sample Menu*

SAMPLETEST: Manually toggles the sample collection device for testing the setup

SAMPLETIME: Sets the duration of the sample grab. Adjustable between 1-3600 seconds

STREAM: Continuous USB and XBEE data output at 1Hz.

EXIT: Leave the sample configuration menu and enter the root menu.

Sensor Maintenance and Calibration

Periodic Maintenance: The SPOD is a low maintenance device and is designed to operate remotely with no user intervention. Occasional inspections for damage and cleanliness are recommended to maintain optimum performance.

Sensor Calibration: Depending on application requirements and environmental conditions, periodic calibrations may be required to maintain target accuracy. Contact Sensit for ordering calibration gases, calibration hardware, and calibration instructions.

Sensor Replacement: The PID sensor assembly is designed to be field replaceable. Sensit recommends factory service when replacing the sensor to ensure overall sensor performance. Contact Sensit for more information.

Hardware and Software Installation Guide

1) Download drivers for FTDI Serial Adapter and install drivers

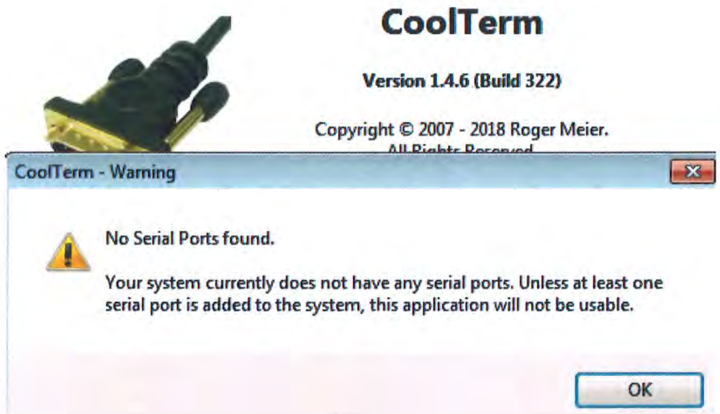
   http://www.ftdichip.com/Drivers/VCP.htm

2) Open serial terminal program of your choice. CoolTerm is recommended and instructions for using CoolTerm are found below. CoolTerm is available for Windows, Mac, and Linux. CoolTerm can be downloaded for free from here:

   http://freeware.the-meiers.org/

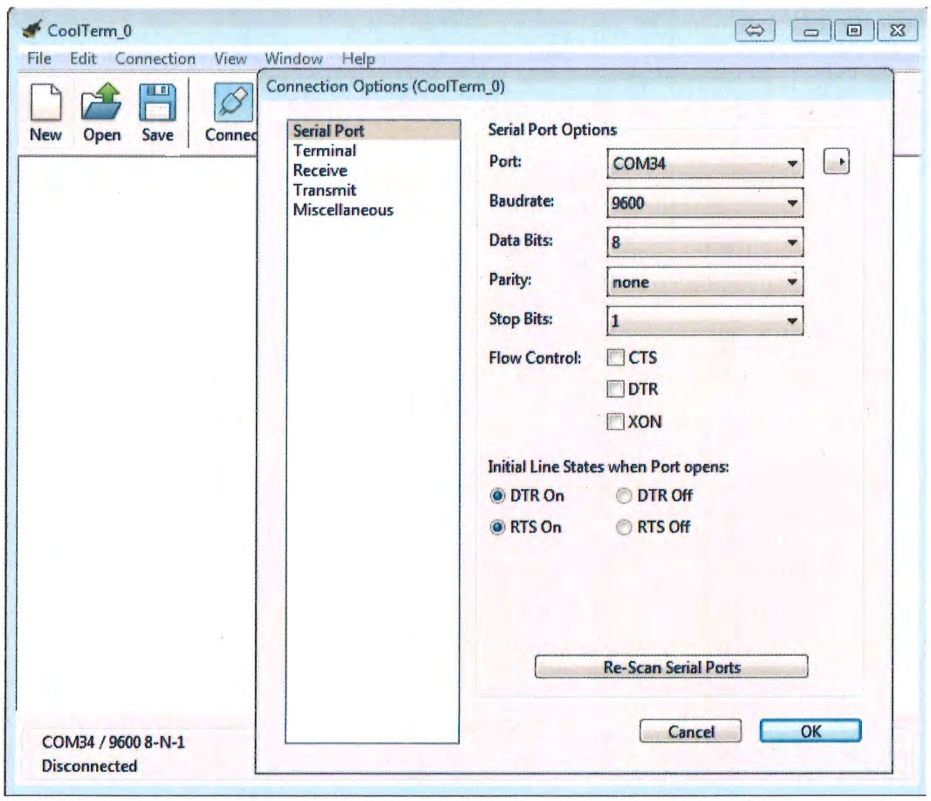
   1) Extract 'Software_CoolTerm' to the directory of your choosing. To avoid certain permissions issues do not extract into "Program Files". It is recommended to extract to the desktop if possible.

   2) Open the 'CoolTerm' application. You may receive an error indicating that no serial ports are found depending on what is hooked up to the computer. Click okay to continue.

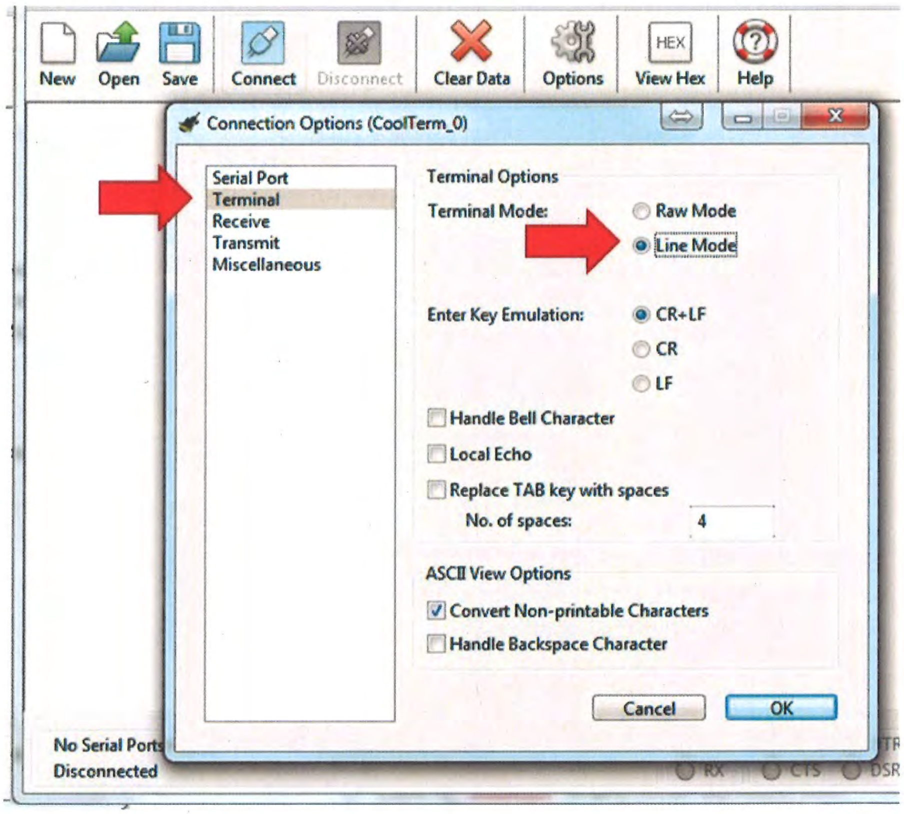


3) Click 'Options' as shown below

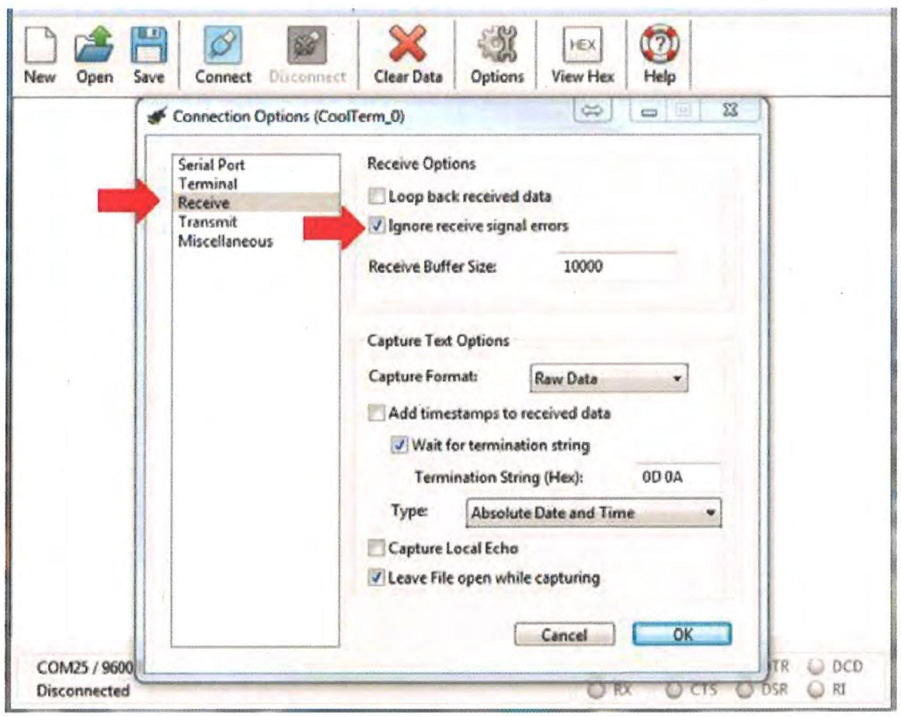
   a. 'Serial Port' options should open by default. If not, select Serial Port options from the list of available options as shown below. All default options should be correct but please verify. Click on 'Port' dropdown list and make note of any available ports. Plug in the USB cable and wait for hardware installation to finish. Click "Re-Scan Serial Ports". The newly added port is the USB cable. Select this port.



b. Select 'Terminal' options from list of available options and select 'Line Mode' as shown below. Line mode adds a text entry bar at the bottom of the screen that is useful for sending commands to the connectedsensor.



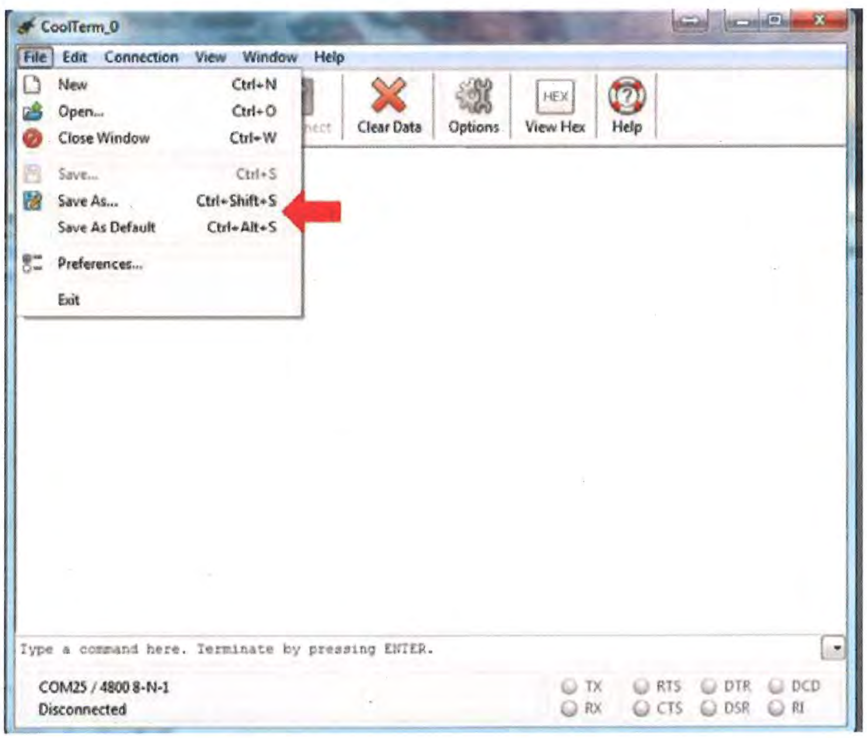
c. Select 'Receive' options from list of available options and check "Ignore Receive Signal Errors". Selecting this option reduces the possibility of the serial connection closing upon a received serial error such as connecting or disconnecting the cable or power cycling the unit.



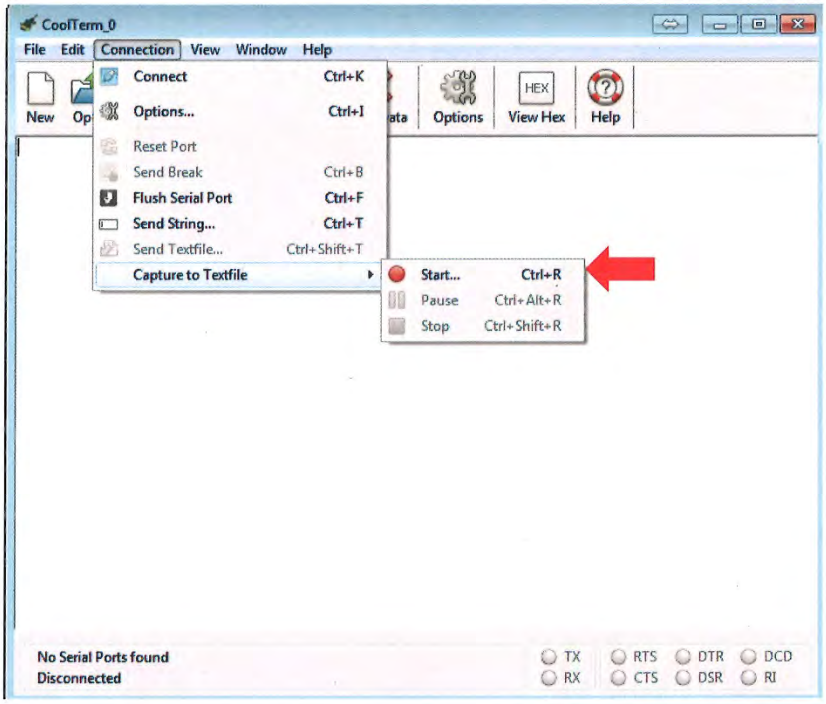
4) To avoid having to configure the terminal every time you open it, you have 2 options to save the configuration as shown in Figure 4.

    a. Click "Save As" and save the connection settings as a file that you can share or store on the computer

    b. Click "Save As Default" to change these settings to the default settings when starting the program. If you are running off the CD this option will give you an error as there is no default file.



5) Coolterm can be configured to record all data received over serial. This will be useful for evaluation purposes.
   a. To start a capture go to 'Connection' dropdown menu → Capture to Textfile → Start or hit Ctrl-R (⌘-R). Enter a file name and click save.
   b. To stop the capture navigate back to the menu entry and click stop or hit Ctrl-Shift-R (⌘-Shift-R)



Warranty

Your SENSIT SPOD is warranted to be free from defects in materials and workmanship for a period of one year after purchase. If within the warranty period the instrument should become inoperative from such defects the instrument will be repaired or replaced at our option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. Proof of purchase may be required before warranty is rendered. Units out of warranty will be repaired for a service charge. Internal repair or maintenance must be performed by a Sensit Technologies authorized technician. Violation will void the warranty. Units must be returned postpaid, insured and to the attention of the service department for warranty or repair.

This warranty gives you specific legal rights and you may have other rights which vary from state to state.

Sensit Technologies
851 Transport Drive
Valparaiso, Indiana
46383
USA

Tel: 219/465-2700
Fax: 219/465-2701

Email: info@gasleaksensors.com
Web: www.gasleaksensors.com

MADE IN THE USA
WITH GLOBALLY SOURCED COMPONENTS

Appendix F: Copy of ERG's current National Environmental Laboratory Certification for EPA Method TO-15 analysis.

Texas Commission on Environmental Quality

NELAP-Recognized Laboratory Accreditation is hereby awarded to

Eastern Research Group, Inc.
601 Keystone Park Drive, Suite 700
Morrisville, NC 27560-6363

in accordance with Texas Water Code Chapter 5, Subchapter R, Title 30 Texas Administrative Code Chapter 25, and the National Environmental Laboratory Accreditation Program.

The laboratory's scope of accreditation includes the fields of accreditation that accompany this certificate. Continued accreditation depends upon successful ongoing participation in the program. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current location(s) and accreditation status for particular methods and analyses (www.tceq.texas.gov/goto/lab). Accreditation does not imply that a product, process, system or person is approved by the Texas Commission on Environmental Quality.

Certificate Number: T104704426-19-10
Effective Date: 7/1/2019
Expiration Date: 6/30/2020

Executive Director Texas Commission on Environmental Quality

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate:	T104704426-19-10
Expiration Date:	6/30/2020
Issue Date:	7/1/2019

Eastern Research Group, Inc.

601 Keystone Park Drive, Suite 700
Morrisville, NC 27560-6363

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Air & Emissions***

Method EPA TO-15

Analyte	AB	Analyte ID	Method ID
1,1,1-Trichloroethane	FL	5160	10248803
1,1,2,2-Tetrachloroethane	FL	5110	10248803
1,1,2-Trichloroethane	FL	5165	10248803
1,1-Dichloroethane	FL	4630	10248803
1,1-Dichloroethylene	FL	4640	10248803
1,2,4-Trichlorobenzene	FL	5155	10248803
1,2-Dichlorobenzene	FL	4610	10248803
1,2-Dichloroethane (Ethylene dichloride)	FL	4635	10248803
1,3-Dichlorobenzene	FL	4615	10248803
1,4-Dichlorobenzene	FL	4620	10248803
Acetonitrile	FL	4320	10248803
Acrylonitrile	FL	4340	10248803
Benzene	FL	4375	10248803
Carbon tetrachloride	FL	4455	10248803
Chlorobenzene	FL	4475	10248803
Chloroethane (Ethyl chloride)	FL	4485	10248803
Chloroform	FL	4505	10248803
Chloroprene (2-Chloro-1,3-butadiene)	FL	4525	10248803
cis-1,2-Dichloroethylene	FL	4645	10248803
cis-1,3-Dichloropropene	FL	4680	10248803
Ethylbenzene	FL	4765	10248803
Methyl bromide (Bromomethane)	FL	4950	10248803
Methyl chloride (Chloromethane)	FL	4960	10248803
Methyl isobutyl ketone (Hexone) (MIBK)	FL	4985	10248803
Methyl methacrylate	FL	4990	10248803
Methyl tert-butyl ether (MTBE)	FL	5000	10248803
Methylene chloride (Dichloromethane)	FL	4975	10248803
Styrene	FL	5100	10248803

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Eastern Research Group, Inc.
601 Keystone Park Drive, Suite 700
Morrisville, NC 27560-6363

Certificate: T104704426-19-10
Expiration Date: 6/30/2020
Issue Date: 7/1/2019

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Air & Emissions***

Toluene	FL	5140	10248803
trans-1,3-Dichloropropylene	FL	4685	10248803
Trichloroethene (Trichloroethylene)	FL	5170	10248803
Vinyl chloride	FL	5235	10248803
Xylene (total)	FL	5260	10248803

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 20, 2019

9489 0090 0027 6002 9522 75

Ms. Donna Tedder
Eastern Research Group, Inc.
601 Keystone Park Drive, Suite 700
Morrisville, NC 27560-6363

Subject: Accreditation renewal

Ms. Tedder:

I am writing to congratulate you and the staff of *Eastern Research Group, Inc.* Based on your application and primary NELAP accreditation from the state of Florida, pursuant to authorization from the Executive Director of the Texas Commission on Environmental Quality, the Program Manager of the Quality Assurance Section has renewed your laboratory's secondary NELAP accreditation.

I am enclosing the new accreditation certificate and fields of accreditation listing. Please review the enclosures for accuracy and completeness. Your laboratory's accreditation is valid until the expiration date on the certificate and scope, contingent on continued compliance with the requirements of the state of Texas as well as those of your primary accreditation body.

Please contact me by electronic-mail at frank.jamison@tceq.texas.gov or telephone at (512) 239-3754 if I can provide any additional information or assistance.

Sincerely,

Frank Jamison
Data and Records Specialist

Enclosures

Appendix G: Sampling Plan.

Denka Performance Elastomer Facility SPod Monitoring Sampling Plan Eastern Research Group

Project Information	
Project Name:	SPod Monitoring at the Denka Performance Elastomer Facility
Location:	LaPlace, Louisiana
Project Number:	
Project Leader:	Dan Hoyt, EPA OECA
Preparation Date:	January 31, 2020

Project Implementation	
Sampling:	Scott Sholar (ERG), David Bordelon (Weston Solutions)
Analysis:	SPod monitoring and VOCs by EPA Compendium Method TO-15

Introduction/Background
This sampling plan outlines the field work and monitoring requirements necessary to support an EPA Headquarters and EPA Region 6 monitoring of the Denka Performance Elastomer facility in LaPlace, Louisiana. This sampling plan is included as Appendix G of the QAPP for SPod Monitoring at the Denka Performance Elastomer Facility in LaPlace, Louisiana. Denka Performance Elastomer LLC (“Denka”) owns and operates a neoprene manufacturing facility (the only neoprene production facility in the U.S.) at the Pontchartrain Works Site in Laplace, Louisiana (the “Facility”). Denka acquired the Facility from E.I. du Pont de Nemours and Company (DuPont) on November 1, 2015. On December 17, 2015, EPA released the results of the 2011 National Air Toxics Assessment (NATA). These results indicated the highest modeled cancer risks in the country were associated with an area in St. John the Baptist Parish, Louisiana, attributable to chloroprene (a likely human carcinogen) emissions from Denka’s Facility. EPA Region 6 began monitoring the air at six locations in the surrounding community in May 2016 (see Figure 1-1), conducted a Clean Air Act (CAA) inspection of the Facility in June 2016, and subsequently referred CAA violations to the Department of Justice (DOJ) for civil enforcement. Pursuant to a January 2017 Louisiana Department of Environmental Quality (LDEQ) Administrative Order on Consent (“State AOC”), Denka installed a Regenerative Thermal

Oxidizer (RTO) and other controls, designed to achieve an 85% reduction in Denka-reported chloroprene emissions. While the RTO's operation has decreased ambient concentrations of chloroprene in the community, ongoing monitoring results, presented in Table 2-3, indicate that ambient chloroprene concentrations remain higher than 0.2 microgram per cubic meter (µg/m3), the inhalation exposure concentration associated with an estimated 100-in-1 million lifetime cancer risk (based on the current inhalation unit risk value from EPA's Integrated Risk Information System). A 100-in-1 million lifetime cancer risk is generally described as the upper limit of acceptability for purposes of risk-based decisions at EPA.

Project/Task Description

Work for this project will be accomplished in phases. Information gathered from each phase will inform the next phase. This sampling plan was written for SPod Monitoring to detect SIS emissions in conjunction with canister sampling to measure SIS emissions surrounding the Denka Facility. The first phase will be the field demonstration using Sensit Technologies' SPod systems for continuous monitoring and collecting canister samples. Once the monitoring systems are operating, the data obtained from the SPod monitoring will be used in conjunction with data obtained from SPod triggered canister sampling to identify potential emissions.

Proximity to source from sampling locations for SIS detection will be evaluated throughout monitoring. If it is determined that certain sampling locations are not suitable, alternative sampling locations may be identified.

The effectiveness of an SPod-type sensor to detect SIS emissions is impacted by the proximity of potential emission sources. In this project, the SPod sensors will be deployed at a variety of distances around the Denka Facility, at the locations of the ambient air sampling sites. In order to employ the SPod systems, a field demonstration is essential to verify the effectiveness of the sensors at the identified locations.

The project involves installation of six Sensit SPods. These units are equipped with photoionization detectors (PID) and with event-triggered evacuated canister systems. The SPods will be installed at the current community sampling sites surrounding the Facility, with the intent to detect elevated concentrations of total VOCs in the air, which may include chloroprene. The SPod PIDs are capable of detecting VOCs with ionization energies of 10.6 eV or below. The SPods will not be used in potentially flammable areas. Following the pre-deployment QA testing, field testing near the Denka plant will include two phases:

The Initial phase consists of six SPods deployed separately at the six current community sampling sites surrounding the Facility for approximately two months. The data gathered in this phase will be processed and used to assess the sampling equipment performance and develop a trigger concentration for canister samples and averaging period for that concentration. A seventh SPod may be added as a collocate at one of the sites.

The Sampling phase consists of six SPods deployed separately at the six current community sampling sites surrounding the Facility for at least four months. The purpose of this phase is to collect data and determine if SIS can be measured. During this phase, the plan is to collect continuous SPod data and collect event triggered 24-hour canister samples at the previously determined trigger concentration for at least four months. The determined trigger concentration is subject to change as more data becomes available. The entire project will be evaluated at four months to determine if it should continue for a longer duration and how much more sample collection time will be required. A seventh SPod may be added as a collocate at one of the sites.

In addition to the commencement of this monitoring project, EPA will seek additional detailed operational and maintenance information from Denka to assist assessment.

Data Quality Criteria/Data Review/Assessment

Overall measurement quality objectives (MQOs) for this project can be defined in terms of the following data quality indicators:

- Precision - a measure of mutual agreement between individual measurements performed according to identical protocols and procedures. This is the random component of error.

- Accuracy – in terms of bias is the systematic or persistent distortion of a measurement process that causes error in one direction. Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

- Detectability - the determination of the low range critical value of a characteristic that a method-specific procedure can reliably discern.

- Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

- Comparability - a measure of the level of confidence with which one data set can be compared to another.

Due to some known limitations in the SPod sensor's capability/environmental factors, the SPod is not expected to provide 100% data completeness; 70% is the anticipated completeness target. There is a potential for project MQOs to change based on data collected in the Initial Phase.

Sampling and Measurements Design/Methods

Six SPods will be deployed at the six community sites surrounding the Facility to collect continuous SPod data. Weston Solutions field personnel will visit each site, initially once every six days. During the site visits the sampling equipment will be checked.

A seventh Sensit SPod will be a spare that could be used as a replacement, should any SPod needed replacement. Any changes made to SPod set-up must be recorded on a SPod Field Deployment Form from MOP 3010. A copy of all forms completed on-site must be sent to the ERG Task Manager. The procedures for the SPod preparation, initial evaluation, deployment, and use are described in MOP 3010. The Field Deployment Form is located in Section 7 of MOP 3010.

In the Initial phase sampling, six SPods will be deployed at all of the six current community sampling sites. The field contractor will visit each monitoring location site every six days initially for a potential of up to four triggered canister samples per site every six days. The data collected in the initial phase will allow potential plume measurements to be compared between the SPods and compared with associated triggered canister samples. A seventh SPod unit will be a spare that can be used to replace one of the SPods, if one should need to be taken out of service.

During the two-month Initial phase, the triggered 24-hour canister samples will be analyzed as follows:

- For the first two weeks, the list of target compounds will increase from chloroprene-only to fifty-nine VOCs by EPA Method TO-15. Table 3-1 displays the full list of compounds and ERG's current MDLs.
- Thereafter,
    - when an SPod detects a plume (i.e. a predetermined concentration level has been exceeded), the automatically triggered canister sample will be analyzed for chloroprene-only. Other key VOCs may be analyzed for on

a case-by-case basis, if it is determined by the Project Lead to aid with detection of SIS.

- when no plume is detected by the SPods, no canister sample will be analyzed.

During the Initial phase, the following will be accomplished:

- Determine a trigger concentration at each monitoring location site and averaging period for the concentration,
- Assess the sampling equipment performance for determining chloroprene plumes,
- Update SPod data processing/analysis method, if needed, to aid characterization. Current data analysis method is in MOP 3010 (software upgrades may have to be implemented based on data analysis before Sampling phase).
- Demonstrate the automated canister sampling trigger and remote trigger adjustment capabilities are functioning correctly. As such, the initial canister sampling trigger level will be based on initial monitoring PID monitoring data, at a level a canister sample would be expected to be triggered during the first week of deployment. Each trigger level will be adjusted higher, after at least one canister sample has been collected at each monitoring location. Trigger levels will be assessed throughout the project, including during the initial phase.

For the Sampling phase, the SPods will continued to be deployed at the six current community sampling sites (see Figure 3-1 for overhead photograph of community sampling locations) to collect continuous data for at least four months. The basic purpose of the Sampling phase is to collect continuous SPod data, to collect event triggered canister samples, and to determine if SIS can be detected.

Sampling/Handling Custody

ERG and Weston will use the sampling/handling custody procedures described in the Denka Elastomer SPod Monitoring QAPP.

Analytical Methods

ERG will also use EPA Compendium Method TO-15 to analyze the canister samples for VOCs, more specifically chloroprene.

Quality Control Procedures

ERG and Weston will follow quality control procedures applicable to this monitoring program as discussed in the Denka Elastomer SPod Monitoring QAPP.

Instrument Maintenance/Calibration

The GC/MS instruments are calibrated with National Institute of Standards and Technology (NIST)-traceable TO-15 standards minimally every 3 months and use internal standards to monitor instrument performance. The TO-15 calibration gas stock cylinders are recertified annually by the vendor. The initial calibration is verified daily with a second source continuing calibration standard.

For the SPods, calibration will be performed by Sensit Technologies. The calibrations will be assessed by ERG and Weston via a series of "bump" tests conducted prior to, during, and after monitoring in LaPlace, LA. "Bump" tests conducted during monitoring will be on a monthly basis unless otherwise directed by EPA's OECA Project Leader.

Project Schedule

QA Testing January-February, 2020

Initial March – April, 2020

Sampling May- September, 2020

Safety Procedures

The safety hazards which may be encountered and the personnel protection requirements for field activities are described in the Site Health and Safety Plan of the Denka Elastomer SPod Monitoring QAPP. EPA, ERG and Weston will follow the safety procedures which are documented in the ERG Health and Safety Program and applicable provisions of the *EPA Safety, Health, and Environmental Management Guidelines* (1997 edition), the *NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (1985 edition) and the *EPA Standard Operating Safety Guides* (1992 edition)..

Prepared by:	Work Assignment Manager: J Scott Sholar
	Date: 03/06/2020
Reviewed by:	Program Manager: Shaun Burke
	Date: 03/06/2020
Approved by:	EPA Team Leader: Dan Hoyt
	Date: 03/06/2020

Appendix H: Health and Safety Plan.

SITE HEALTH AND SAFETY PLAN

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****** General Information

1.	Project Title:	SPod Monitoring at the Denka Performance Elastomer Facility	Project Number	
2.	Location	LaPlace, Louisiana		
3.	Description of Field Activities:	Monitor Fugitive Emissions with Continuous Monitor		
4.	Date of Field Activities:	February 2020 through August 2020		
5.	EPA Personnel	Dan Hoyt		Project Lead
	ERG Personnel	Scott Sholar		Task Manager / Team Leader
	Weston Solutions Personnel	David Bordelon		Task Manager / Team Leader
6.	All monitoring personnel must have undergone health and safety training.			

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Emergency Information for LaPlace, LA

7.	Ambulance:	Shepard Ambulance		Phone:	911/Not Listed
8.	Hospital:	Ochsner Medical Complex – River Parishes 1900 West Airline Highway, LaPlace, LA 70068	(Emergency Room)	Phone:	(985) 652-7000

9.	Emergency Route:	See attached directions		
10.	Fire Department:	LaPlace Volunteer Fire Department 803 Walnut St, LaPlace, LA 70068	Phone:	911 (985) 652- 1777
11.	Police:	Garyville-Reserve Police Department 1801 W Airline Hwy LaPlace, LA 70068	Phone:	911 (985) 536-2112
12.	Poison Control Center:	Poison Control Center	Phone:	1-800-222-1222
13.	Site Emergency Notification/Evacuation Method		Route identified by facility personnel	

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Hazard Evaluation

14.	Check all known or potential hazards:			Radiation	X	Toxics		Fire/Explosion
		Corrosives		O_2 Deficient		Noise	______	Biological
		Dusts	X	Heat/Cold Stress				
NOTE: DISCUSS HAZARDS AND PRECAUTIONS IN DETAIL IN WORK PLAN BELOW.								
15.	Specify unusual working conditions/limitations (excavations, confined spaces, lagoons, elevated surface, weather, darkness, etc.) *:							

Heat Stress

Heat stress is expected to be a hazard during this inspection trip. Monitoring team personnel will wear cotton clothing under coveralls or Tyvek® as required, will drink plenty of fluids, and will monitor each other for heat stress and the team leader will be responsible for ensuring that proper treatment is administered in case a team member develops any of the following heat stress-related disorders. The levels of heat stress and associated symptoms are:

Heat rash which may result from continuous exposure to heat or humid air. Signs and symptoms include:

-- Itching skin/skin eruptions
-- Reduced sweating

<u>Treatment</u>: Keep skin clean and dry. Reduce heat exposure.

Heat cramps which are caused by heavy sweating and inadequate electrolyte replacement. Many times, cramps may not occur until after work or until the worker is sleeping. Signs and symptoms include:

— Muscle spasms
— Pain in the hands, feet, and abdomen

<u>Treatment</u>: Gently stretch and massage muscles and replace fluids. Rest in a cool shaded area.

Heat exhaustion which occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

— Pale, cool, moist, clammy skin
— Heavy sweating
— Headache and dizziness
— Nausea
— Fainting or fatigue
— Elevated pulse rate (above 150)

<u>Treatment</u>: Replace fluids; pour cool water over face, neck, hands, arms, and legs. Place worker in cool air and seek medical care.

Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:

— Red, hot, usually dry skin, body core temperature 108°F (oral)
— Lack of or reduced perspiration
— Nausea
— Headache, dizziness, and confusion
— Strong, rapid pulse
— Coma

	Treatment: Remove worker to cool area, saturate clothes with cold water, wrap worker in wet cold sheets (if possible), monitor ABC (airway, breathing, circulation), treat for shock, and call emergency services for basic life support (BLS) or advanced life support (ALS). Falling Hazards Falls are expected to be a hazard during this inspection trip. Monitoring personnel may be monitoring from the top of tanks as tall as 20 feet high. ERG will use the attached stairways and catwalks for getting to the top of the tanks. Electrical. Prior to installing equipment in the field, field staff will verify that all electrical equipment and cords are in good working condition. Field personnel will be instructed to immediately report to their team leaders any signs of malfunctioning electrical equipment. Animals, Poisonous Insects, and Poisonous Plants. Field personnel should be alert for and stay clear of wild and unsupervised animals, poisonous insects, and poisonous plants (e.g., poison ivy, poison sumac). Particularly, team member should also be aware of poisonous spiders (e.g., black widow). Be aware of your surroundings, do not just blindly wander in the monitoring locations. Observation is critical to avoidance. Learn to check around with a sweeping glance for anything that seems out of place. Your subconscious may notice a camouflaged animal. Snakes and other animals have many sensing devices to warn them of your presence. Make plenty of noise and movements while entering the monitoring area to announce your presence. Treatment: If a field staff is bitten by a snake, rodent, or spider, they should be taken to a medical facility immediately for treatment. Give the medical staff as much detailed information about the animal as possible. Describe the size, shape, and color of the animal.
* Attach specific hazard management plans, if applicable.	
16.	Potential Hazards: Identified through process knowledge and review the company corporate website.

Chemical/ Physical Hazard	TLV/ IDLH/ OSHA PEL	Routes/ Conditions of Exposure	Acute Symptoms	Odor Level	Odor/Visual Description
chloroprene	OSHA TLV-TWA: 1ppm IDLH: 300 ppm OSHA PEL: 8-hr Time-Weighted Avg: 25 ppm (90 mg/cu m) NIOSH REL: 15 Min Ceiling Value: 1 ppm (3.6 mg/cu m)	Rapidly absorbed by skin. Can be inhaled as a vapor	The substance is severely irritating to the eyes. The substance is irritating to the skin and respiratory tract. Exposure at high levels could cause lung oedema. The substance may cause effects on several organs. This may result in impaired functions. Exposure above the OEL could cause death.	Odorless	Odorless/Clear Colorless liquid

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Work Plan

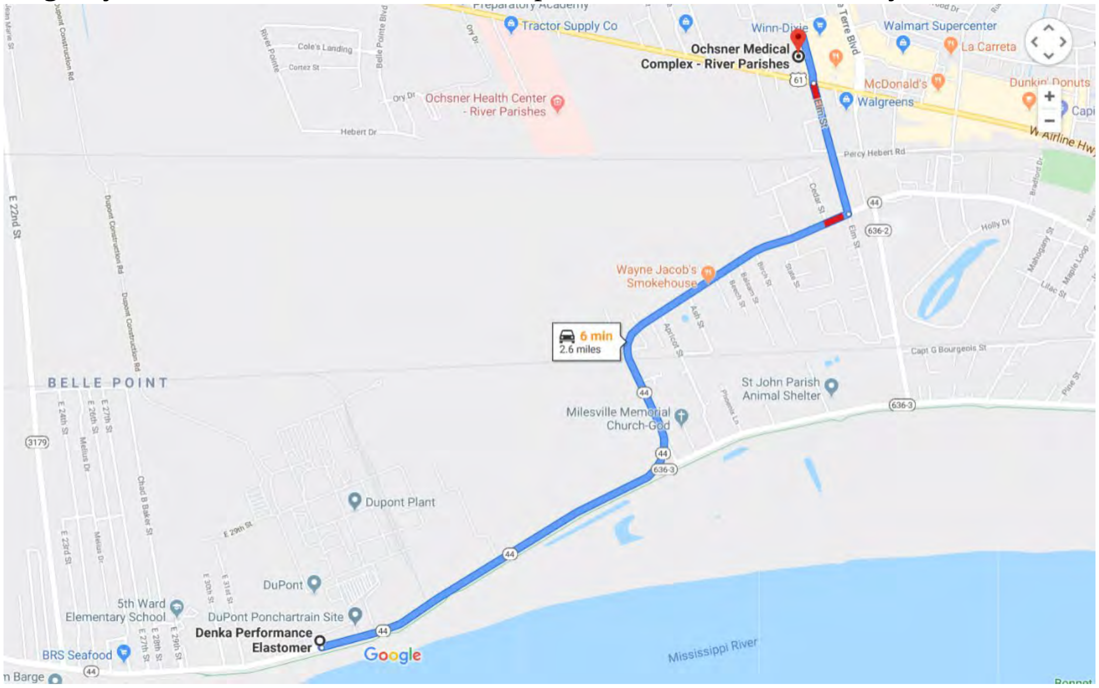
17.	The following table summarizes planned tasks, anticipated hazards, and control measures which will be taken, including levels of protection:

Task	Hazards	Level of Protection (A, B, C, D) and Control Measures
Setup and operate remote monitors for VOC detection	Slip trips falls, heat related injuries, flora/fauna related injuries	Long-sleeved clothing and close toed shoes will be worn when performing onsite activities.
Specific Personal Protective Equipment (PPE):		
Type of Protection	Hazard	Use of PPE
Foot Protection	Feet	Onsite personnel will wear closed toed shoes at all times while performing field work activities.
Safe Work Practices -		

Task		Hazards	Safe Work Practices
18.	Site Control/Security Measures:		Weston Solutions will visit the sites weekly and inspect them for any disturbance. All sites are on property owned by residents or other entities. Security will fall under landowner’s responsibility. No other site security control measures are planned at this time but will be considered if necessary.
19.	Decontamination Procedures (personnel hygiene, contaminated clothing, equipment, instruments, etc.):		
	Good personal hygiene will be practiced.		
20.	Disposal Procedures (contaminated equipment, supplies, decontamination solutions, etc.)		
	NA		

** Approvals	
This site HASP has been reviewed and constitutes the minimum anticipated safety requirements for personnel engaged in field activities at this project site. However, the Team Leader has the authority to change these requirements, based upon the conditions present at the site.	
Approved by:	
21.	EPA Project Leader: Date: Dan Hoyt 03/05/2020
22.	ERG Team Leader: Date: T Scott Sholar 03/05/2020
23.	Weston Solutions Team Leader: Date: David Bordelon 03-05-2020

Emergency Route to Ochsner Medical Complex from the Denka Facility in LaPlace, LA:



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