| Monitoring Parameters: **Benzene, Toluene, Ethylbenzene & Xylene (BTEX)** | Title: **Standard Operating Procedure for the Semi-Continuous Measurement of Ambient BTEX DRAFT** |
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| **Revision No: Draft**<br>**Revision Date: 4 July, 2017** | **Reference No: SOP-11**<br>**Parent Document: Part B1 – B.C. Field Sampling Manual** |

## 1. Introduction and Scope

This Standard Operating Procedure (SOP) provides operating guidelines and instructions for the semi-continuous ambient monitoring of hydrocarbons including Benzene, Toluene, Ethylbenzene and Xylene (BTEX) within the provincial jurisdiction of British Columbia (B.C.).

This SOP forms part of the B.C. Field Sampling Manual (BCFSM). Part B - Air and Air Emissions Testing, of the BCFSM provides additional information on Air Quality Monitoring that must be used in conjunction with the information provided in this SOP. Installation and maintenance of a BTEX analyzer within the provincial jurisdiction of B.C. should be carried out with consideration to Part B of the B.C. Field Sampling Manual, the analyzer manufacturer's manual, and this document.

## 2. Document Control

This Standard Operating Procedure is a controlled document. Document control provides a measure of assurance that the specifications and guidance it provides are based on current information that has been scrutinized by a qualified reviewer/s. Controlled documents are reviewed within a five year life cycle. Please ensure that the revision date listed in the header of this document does not exceed five years.

This SOP and the B.C. Field Sampling Manual are available at: www2.gov.bc.ca.

## 3. Principle of the Measurement Method

Gas Chromatography (GC) with a Photoionization Detector (PID) or Flame Ionization (FID) Detector

The principle detection and quantification method deployed for ambient concentrations of BTEX is gas chromatography (GC).

The analyzers used in the semi-continuous measurement of BTEX repeatedly collect and analyze small volumes of ambient air (the 'sample') that are drawn into the analyzer using a vacuum pump. Each sample enters a separation column which consists of two sequential columns; a stripper column and an analysis column. The two columns are identical but have different lengths. In these columns the gas components (compounds) of a sample differentiate based on their specific physical properties (e.g. molecular mass) and chemical properties (e.g. volatility). The specific properties of a gas compound determine the speed at which they travel through the columns. For example, compounds with the lowest molecular weight and highest volatility travel the fastest through the separation column. These compounds have the lowest column retention times and as such, are the first to emerge from the separation column. Based on these principles, compounds are identified using retention times.

The concentration of compounds emerging from the column are quantified by a detector; commonly a photoionization detector (PID). Photoionization detectors use ultraviolet radiation to ionize gas components. The resulting ions produce an electrical current that elicits a response commensurate

with the concentration of the ionized gas. Photoionization detectors are capable of achieving a high resolution at low concentration ranges; typically in the parts per trillion (ppt) to parts per million (ppm) range.

Following each sample cycle, the sample path is flushed with clean air in preparation for the next sample.

## 4. Interferences

***Particluate Matter***

The presence of particulate matter in an air sample may interfere with a BTEX analyzer's response. Interference by particulate matter can be minimized using a particle filter at the sample inlet. The particle filter must have a 2 µm diameter pore size and be made of an inert material such as Teflon.

***Water Vapour***

The presence of water vapour may result in an inconsistent detector response. This potential interference can be mitigated by using a dryer and ultra-pure carrier gas. The sample cycle should be sufficient to clear all compounds from the column before proceeding to the next sample cycle.

## 5. Precision and Accuracy

The precision of an analysis is generally considered to be the 'repeatability of the measurement'. This can be confirmed through zero and span checks, and calibrations.

The accuracy of the sensor is generally considered to be a measure of the 'deviation from true'. The accuracy of a sensor can be checked by performing calibrations against a certified calibration standard mixture (See Sections 11 and 12 of this SOP). Accuracy can also be confirmed through periodic span checks and multipoint checks/calibrations.

## 6. Recommended Equipment and Apparatus

The following is a commercially available BTEX analyzer suitable for use within the provincial jurisdiction of B.C.:

- Syntech Spectras Analyser GC 955

This list does not necessarily exclude other commercially available BTEX analyzers, and analyzers recognized by United States (US) Environmental Protection Agency's (EPA) Federal Reference and Equivalent Methods. In deed as technology advances, new analyzers will enter the market which may be suitable for use within the provincial jurisdiction of B.C. It is highly recommended however that you consult with the B.C. ENV if you intend to deploy BTEX analyzers that are not listed above. Regardless of the instrument deployed, all analyzers should meet the specifications described within this document.

## 7. Measurement Range and Sensitivity

Typical commercially available BTEX analyzers operate at a user selectable range of ppt to % range, depending on customizable detection options. For B.C. ENV monitoring purposes analyzers should be set to the ppt to ppm range.

## 8. Site Requirements

Monitoring site specifications should be developed to ensure that the data obtained from the site satisifies the requirements of intended or established monitoring objectives. It is recommended that monitoring site requirements be established in consultation with the B.C. ENV to ensure that siting requirements are commensurate with monitoring objectives.

As a preliminary guideline site selection should consider and address: monitoring objectives, representativeness of the region, interference from the surrounding area, and zone type (residential, commercial, industrial) of the monitoring location.

Refer to Section XX of the BCFSM for further information on site selection.

## 9. Installation Requirements

Follow analyzer specific installation requirements discussed in the analyzer manufacturer's manual. The installation should also conform to the following:

- The monitoring station's sampling inlet and manifold shall meet the requirements of the most recent version of the National Air Pollution Surveillance (NAPS) Program's *Monitoring and Quality Assurance/Quality Control Guidelines* Section 8.2 and Section 8.3.
- The ¼ inch diameter connection tubing from the manifold to the analyzer inlet must be made of Teflon or an equivalent material for chemical inertness.
- A Teflon particulate filter capable of removing at least 99% of 1 µm diameter and larger particles must be placed in the sampling line upstream of the analyzer, unless the analyzer is equipped with a similar internal filter. The filter holder should be constructed of an inert material (e.g. Teflon, stainless steel, aluminum).
- A data acquisition system ('DAS' or 'data logger') should be connected to the analyzer to record or download the measurement data from the analyzer. If an analog data logger is used, it must be set to match the voltage range of the analyzer, typically at 1 V or 10 V full scale. It must be ensured that the analog output matches the digital output displayed on the analyzer. The datalogger must also record and monitor any alarm conditions of the analyzer.
- The analyzer must be placed in a weather resistant enclosure that is vented, heated and cooled to maintain a stable temperature preferably in the range of 20°C to 30°C but must be capable of maintaining the operating temperature range specified by the manufacturer. Enclosure temperatures should not deviate by more than 2°C over a one hour period.
- A permeation dryer should be placed in the sampling line upstream of the analyzer.

## 10. Operational Requirements

The following activities should be performed by the operator of a semi-continuous automated BTEX analyzer.

| Action | Time/Frequency | Description | Record Keeping |
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| Analyzer Range Set Up | After installation | As per manufacturers operation manual. Monitoring range should be 0 ppb to 1000 ppb. | Record in logbook, see example station installation record (BCFSM, Appendix XX) |
| Multipoint Verification | • After installation (or relocation) following a 24 h to 72 h warm up period; | As per Section 11 of this SOP | Record in logbook, see example gas calibration activity record (BCFSM, |

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| | • After analyzer repairs/maintenance that may affect performance of the instrument;<br>• When zero check exceeds ± 0.1 ppm;<br>• When span drift is ≥ ± 10% of reference value;<br>• For new analyzers after the first 3 months of operation;<br>• Bi-annually if span checks are conducted daily – or when any threshold above is reached (whichever happens first);<br>• Quarterly if span checks are conducted less than daily – or when any of the threshold above is reached (whichever happens first). | | Appendix XX) |
| Zero and Span Verification | Daily preferred, weekly minimum | As per manufacturers operation manual | Record in logbook, see example routine maintenance record (BCFSM, Appendix XX) |
| Verify Operational Parameters | Each monitor station visit | As per manufacturers operation manual | |
| Check Support Gas Pressures | Each monitor station visit | Check gas cylinder pressures and replace if they drop below 500 psi | |
| Inlet Filter Change | Inspect monthly, change as required | As per manufacturers operation manual. A filter change can affect flow and pressure so a verification or full calibration is required. | |
| Analyzer Maintenance | As recommended by manufacturer or as required | As per manufacturers operation manual | Record in logbook |
| Sample Path Inspection (Probe to Analyzer) | Each monitor station visit | Where necessary replace with new lines, tighten loose connections, clean manifold if required. Any alteration to the sample pathway should be accompanied by verification or full calibration. | Record in logbook |

**11. Zero and Span Checks**

Zero and span checks are required to verify the analyzers performance between calibrations. These checks should be performed in accordance with Section XX of the B.C. Field Sampling Manual.

## 12. Calibration

Calibration should be performed in accordance with Section XX of the B.C. Field Sampling Manual and the manufacturer's manual.

## 13. References

National Air Pollution Surveillance (NAPS) Program. Monitoring and Quality Assurance/Quality Control Guidelines.

Government of Alberta 2015. *Ambient Air Monitoring Performance Specification Standards – Continuous Analyzers VOCs (BTEX and Styrene).*

Syntech 2011. *Syntech Spectras Analyser GC 955 – Manual for the Syntech Spectras GC955-series.*

United States Environmental Protection Agency (US EPA) 2013. *QA handbook for Air Pollution Measurement Systems Volume II Ambient Air Quality Monitoring Program*. US EPA Office of Air Quality Planning and Standards Air Quality Assessment Division.

US EPA 2013. *Method 18 – Measurement of Gaseous Organic Compound Emissions by Gas Chromatography*.

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**Approval**