

Monitoring Parameter: Various Compounds	Title: Standard Operating Procedure for the Passive/Diffusive Method of Air Sample Collection
Revision No: Draft Revision Date: 09 April, 2018	Reference No: SOP-07 Parent Document: Part B1 – B.C. Field Sampling Manual
<p>1. Introduction and Scope</p> <p>This Standard Operating Procedure (SOP) provides operating guidelines and instructions for the passive (diffusive) measurement of air compounds within the provincial jurisdiction of British Columbia (B.C.).</p> <p>This SOP describes passive sample collection. Subsequent analysis of the sample by an analytical laboratory is required to complete the measurement of the target air compound. The laboratory analysis procedure is not covered in detail within this SOP.</p> <p>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. Passive sampling within the provincial jurisdiction of B.C. should be carried out with consideration to Part B of the BCFSM, and this document.</p> <p>Passive monitoring is a diffusive sampling method that is generally used to determine low level concentrations of air compounds over a sampling period that ranges between 24 hours to 30 days. This sampling method is suitable for remote locations as the method itself does not require electricity. A thirty day sampling period is recommended as a nominal passive sampling period. For monitoring objectives designed to consider concentrations measured at shorter time scales, or those designed to measure concentrations that are expected to exceed the high or low thresholds of the passive samplers, active monitoring of ambient air concentrations would provide a more appropriate sampling method.</p>	
<p>2. Principle of the Sampling Method</p> <p>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.</p> <p>This SOP and the B.C. Field Sampling Manual are available at: www2.gov.bc.ca.</p>	
<p>3. Principle of the Sampling Method</p> <p>Passive Samplers</p> <p>A passive sampler is a simple device capable of sampling gaseous compounds in ambient air via diffusion or permeation. Passive sampling does not require active movement of air through the sampler. Gaseous compounds, if present in the ambient air, diffuse through a static air layer or permeate a membrane. Samplers are generally specific to one target compound.</p> <p>Samplers for the following compounds are commercially available:</p>	

- speciated volatile organic compounds (VOCs) including benzene,
- aldehydes, ketones, and phenolics,
- chlorinated compounds,
- alcohols,
- sulphur dioxide (SO₂),
- hydrogen sulphide (H₂S),
- nitrogen dioxide/oxides of nitrogen (NO₂/NO_x),
- ozone (O₃),
- ammonia (NH₃), and;
- nitric acid (HNO₃).

Regardless of the target compound this method deploys a sampler body or sampling tube of known dimensions that is prepared by a laboratory. Sampler bodies and sampling tubes contain a diffusion barrier and a chemical-specific sampling media. At the sampling location, the sampler housing is set up on a stand and the sampler bodies or tubes are taken out of their protective containers and installed in the housing. The passive samplers are normally exposed for a period of 30 days although this may vary depending on the requirements of the sampling program. Sample trip blanks (unopened samplers) and duplicate samples are deployed and returned to the laboratory as part of the same batch. A duplicate sample should be deployed for every 10 samples. Where possible one passive station in a network should be co-located with a reference method or equivalent.

At the end of the sampling period, the sampler bodies or tubes are placed within their protective containers and sealed plastic bags and returned to the laboratory for analysis. The laboratory analysis determines the average concentration of the compound over the sampling period. Average regional or local meteorological conditions (temperature, relative humidity, and wind speed) for the sampling period are generally required for accurate analysis of the passive concentrations. Common measurement units are parts per billion (ppb).

4. Interferences

Potential interferences include precipitation, particulate matter contamination, physical damage to the sampler body or membrane, siting exposure that differs from the meteorological data representing station conditions, and contamination by incidental exposure to the target compound that was not part of the ambient environment.

Precipitation

Wetting can damage the passive sampler media, or may introduce dissolved gases to the sampler media resulting in inaccurate measurements. To prevent precipitation interference passive samplers should be installed facing downwards and within a housing equipped with a rain shelter; or deployed in a similar manner which will prevent wetting of the media.

Particulate Matter

Air compounds may be absorbed by particulate matter, resulting in inaccurate measurements if particulate matter is allowed to settle on the sampler media. To prevent this, passive samplers should be installed facing downwards in a housing or deployed in a similar manner which will prevent the precipitation of suspended particulate matter on the media.

Physical Damage

The diffusion barrier on passive samplers is delicate and can be easily damaged if handled improperly. Proper care must be taken to avoid touching the diffusion barrier during deployment or retrieval of the samplers. Samplers should be positioned in a location where they are unlikely to be damaged by wildlife.

Siting Exposure

Passive samplers must be deployed in a setting which has similar meteorological characteristics to the meteorological station data used to determine the concentrations of target compounds. A white housing will generally be appropriate to minimize the effects of solar radiant heating. Excessive winds can interfere with sampling. This can be minimized by using a sample housing.

Contamination

Passive samplers must be left in their protective containers and stored according to laboratory specifications to prevent the uptake of compounds when not deployed, e.g., in transit. Contact with the diffusion barrier when handling must be prevented to avoid contamination of the samplers. Sample blanks must not be opened, and should remain in their protective containers throughout the sampling period. Sample blanks must be treated similarly to the deployed samplers throughout the sampling program, and placed in a similar temperature environment as the deployed samplers during the sampling period.

5. Precision and Accuracy

Passive sampling measurements are affected by factors during the sample collection period (such as measurement height and meteorological conditions) as well as the laboratory's analysis method.

The precision of a measurement is generally considered to be the 'repeatability of the measurement'. The accuracy of the measurement is generally considered to be a measure of the 'deviation from true'. Determination of precision and bias should be completed by the analytical laboratory as per their quality assurance/quality control (QA/QC) procedures. In the field, one duplicate passive sample and one method blank should be deployed for every batch of 1 to 10 passive samplers, and all samplers should be deployed as per Section 9 'Installation Requirements'.

6. Recommended Apparatus

For passive sampling, a sampler body with a diffusion barrier and stand are required. A sampler housing and rain shield are recommended unless the sampler body can be mounted in a configuration that effectively mitigates or eliminates the potential for interference. Passive sampler housings provided by laboratories often double as a rain shield.

To prevent contamination, the samplers should be stored and transported in protective cases which are themselves kept within a sealable plastic bag. It is important to use samplers when shipped from the laboratory and then return them to the laboratory soon after retrieval for the following reasons:

- The samplers have a pre-exposure storage life ranging from a few weeks to a few months
- The samplers have a post-exposure storage life ranging from a few weeks to a few months

For a given network and monitoring period, it is important to use samplers, including blanks and

duplicates, from the same laboratory batch to eliminate variability from sampler manufacture.

The stand can be fabricated from wood or metal, or could be an existing structure that does not prevent the proper sampling of air compounds (i.e. an existing fence post).

7. Measurement Range and Sensitivity

Analysis range and sensitivity depend on the method employed by the laboratory and by the compound being monitored. The lower range of passive detection limits reported by a commercial laboratory is typically on the order of 1 ppb to 10 ppb for a 24-hour exposure, to 0.01 ppb to 0.1 ppb for a 30-day exposure. Maximum sample concentrations are in the order of 20 ppb to 100 ppb. The sampling rate is moderately sensitive to meteorological conditions, and these must be taken into account.

8. Site Requirements

Monitoring site specifications should be developed to ensure that the data obtained from the site satisfies the requirements of intended or established monitoring objectives. It is recommended that monitoring site requirements be established in consultation with the B.C. Ministry of Environment and Climate Change Strategy (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 location.

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

9. Installation Requirements

The passive sampling station installation should conform to the following:

- The sampler housing shall be mounted to a supporting structure in accordance with the manufacturer's specifications and in a configuration that ensures that there is no restriction to airflow.
- The sampler must be deployed in a manner that prevents the diffusion barrier from becoming wet, protects the diffusion barrier from the precipitation of suspended particulates, and protects the diffusion barrier from high wind speeds (i.e. use a housing/rain shield).
- The sampler housing shall be placed so that the diffusion barrier of the sampler body is at a height of 2 m to 4 m above ground surface.
- Co-located samplers should be within a 4 m horizontal distance of each other.
- Passive samplers within a monitoring network should be positioned at the same sampling height.
- Higher objects such as trees and buildings should not exceed 30 degrees from the horizontal plane of the sampler body as illustrated in the following figure.



Figure reference: Blair R. Irwin, ENV 2018

10. Sampling Requirements

The following activities should be performed by the operator of a passive sampling program:

Action	Time/Frequency	Description	Record Keeping
Sampler Storage	Prior to or after installation	Store in a cool location out of direct light. Store samplers and method blanks together. Do not open storage containers outside of the deployment period.	n/a
Sampler Deployment	At installation	Record the date, time, location, measurement height, and sample identification and batch number; record sample identification on the sampler body.	<ul style="list-style-type: none"> Record in logbook; record sample ID on sampler body Complete Chain of Custody (COC) information required by the analytical laboratory.
Sampler Retrieval	At the end of the sampling period (30 days \pm 4 days after deployment, unless otherwise determined)	<p>Check for signs of damage/tampering. Check integrity of samplers.</p> <p>Place the protective cap on the sampler, return the sampler to its protective container, place in a sealable bag, and record the date, time, and sample identification number at the time of sample collection.</p> <p>Send to laboratory for analysis. Minimize storage period.</p>	<ul style="list-style-type: none"> Record in logbook Complete COC information required by the analytical laboratory.

11. Zero and Span Checks

This section is not applicable to this measurement method.

12. Calibration

This section is not applicable to this measurement method.

13. References

Alberta Government. 2016. *Air Monitoring Directive, Chapter 3: Ambient Monitoring Site Selection*,

Siting Criteria and Sampling System Requirements. Version Dec 16, 2016.

Revision History: 0.0 (New document)

Approval

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