

Passive Sampling of **Mercury** in **Ambient Air** Methodology and Procedure



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This document has been prepared by:

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The document is adapted from the “Standard Operating Procedure for the MerPAS®”, originally developed by Alexandra Steffen at the Environment and Climate Change Canada (ECCC). The adaptation was carried out by the Chemicals Science and Policy Unit, Chemicals and Health Branch, Industry and Economy Division, United Nations Environment Programme (UNEP).

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ABBREVIATIONS

ECCC	Environment and Climate Change Canada
GCMP	Global Chemicals Monitoring Programme
GEF	Global Environment Facility
GEM	Gaseous Elemental Mercury
GMP	Global Monitoring Plan
ID	Identification
ISO	International Organization for Standardization
PAS	Passive Air Samplers
POPs	Persistent Organic Pollutants
QC	Quality Control
SOP	Standard Operating Procedure
UNEP	United Nations Environment Programme

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1. INTRODUCTION

This standard operating procedure (SOP) provides support to the Global Chemicals Monitoring Programme (GCMP) and its child projects in different UN regions. The GCMP includes six child projects in participating countries from Africa, Asia and Pacific Islands, and Latin America and the Caribbean, with financial support from the Global Environment Facility (GEF). It aims to provide scientifically robust evidence for evaluating the effectiveness of the Stockholm Convention on Persistent Organic Pollutants (POPs) and the Minamata Convention on Mercury thereby facilitating a comprehensive global understanding of the concentrations of POPs and mercury in humans and the environment.

The objective of this SOP is to describe the step-by-step installation and management of passive air samplers (PAS), namely MerPAS®, for sampling Mercury in air under the GCMP.

The SOP includes the main steps for assembling, disassembling, and maintaining the samplers. MerPAS® is designed to absorb mercury (mainly the gaseous elemental mercury (GEM)) on a carbon trap, enabling the determination of mercury concentrations in air. Subsequently by quantifying absorbed total Mercury in the MerPAS®, trends and patterns of mercury in air can be estimated, including whether concentrations are increasing or decreasing and how they vary across countries and regions.

This SOP is applicable for deploying MerPAS® at all kinds of sampling sites, including in urban, suburban, rural, and remote areas.

2. PASSIVE AIR SAMPLING OF MERCURY USING MERPAS®

2.1. Details about MerPAS®

The MerPAS® passive air sampler uses non-reusable sulfur-impregnated activated carbon (HGR-AC) as the sorbent for mercury. The carbon is held in a stainless-steel mesh tube (re-usable) that itself is placed inside a radial diffusive barrier (White Radiello®). This barrier, in turn, is attached to the inside of a compact PET blue container with a downward-facing mesh-screened lid which acts simultaneously as a shelter from strong wind and rain. Mercury undergoes diffusive uptake and accumulates on the sorbent, with sampling rate being tightly controlled by the diffusive barrier ([Figure 1](#)). This sampling device is characterised and is commercially produced by Tekran Instrument Corporation (Tekran Inc., Toronto, ON, Canada) and is sold under the MerPAS® name (Tekran n.d.).

Once collected, the samples are shipped to a laboratory for analysis using thermal decomposition, amalgamation, and atomic absorption spectrophotometry, or using commercially available automated total mercury analyzer (e.g. Milestone DMA-80). The volumetric concentration of mercury in air, averaged over the deployment period, is calculated using the amount of mercury quantified on the sorbent (the mean of the two samples collected minus the blank) and a previously calibrated sampling rate, which can be adjusted for temperature and wind speed. This method has been shown to have accuracy on a par with currently acceptable methodologies for measuring mercury in the atmosphere and demonstrates excellent precision (McLagan *et al.* 2015).

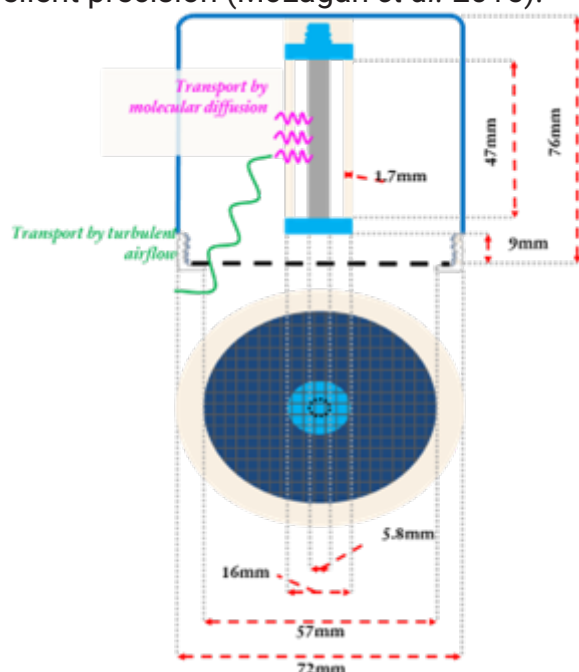


Figure 1. Technical drawing of a MerPAS® passive air sampler for monitoring gaseous mercury in ambient air.

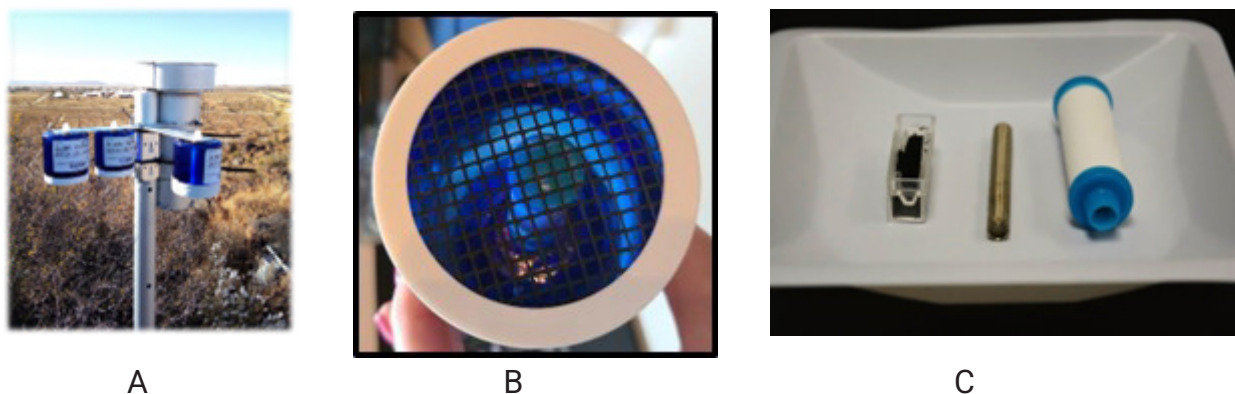


Figure 2. A demonstration of MerPAS® passive air sampler deployment and its various parts.

(A) External view of MerPAS® passive air samplers used for mercury monitoring in ambient air. (B) Downward facing side of the sampler. (C) HGR-AC, a stainless-steel mesh tube, and a radial diffusive barrier.

2.2. Sampling frequency

A white pail containing one set of three MerPAS® passive air samplers will be shipped to each sampling site. These samples will be exposed seasonally, i.e., for three months per exposure period, and one set of three MerPAS® will be used sequentially. From each set of three MerPAS®, two units of PAS will be deployed as **Samples**, and one as a field **Blank** (Figure 2). A duplicate set of three MerPAS® samples will be installed at 20 sites for quality control (QC) and to help assess the analytical capacities and the identification of suitable regional laboratories. Mounting brackets and other relevant hardware are included in the package for the initial set up.

To cover seasonality, a proposed sample deployment schedule is given below:

Table 1. Proposed schedule for sample deployment.

Periods	First sampling year 2027	Second sampling year 2028
1 st Period	Early January to early April 2027	Early January to early April 2028
2 nd Period	Early April to early July 2027	Early April to early July 2028
3 rd Period	Early July to early October 2027	Early July to early October 2028
4 th Period	Early October 2027 to early January 2028	Early October 2028 to early January 2029

Note: Each MerPAS® will be seasonally deployed for four periods of three month each. Samples can be deployed during the first week of each scheduled deployment month, with a margin of a few days. Sample deployment and removal should occur on the same day.

3. SITE SELECTION AND SAMPLING

This section describes the requirements for the site selection and the sampling procedures for the installation and removal of MerPAS®.



Video tutorials developed by the Environment and Climate Change Canada (ECCC) with detailed explanations on site selection and sampling of mercury in ambient air using MerPAS® are recommended to be watched. These can be accessed on [Youtube channel: Atmospheric Mercury Research Lab Environment Canada](#).

Tutorial videos relevant for the installation and removal of MerPAS® can be watched using the following weblinks:

- For the installation: [Installation of Mercury Passive Sampler](#)
- For removing or replacing the MerPAS®: [Removing Mercury Passive Sampler](#)

3.1. Requirements for the sampling locations

Site characteristics can influence the mercury concentration in air as well as their uptake by deployed sampler. Therefore, site selection is critical to the design of any monitoring network and should be based on the goals of the monitoring programme. For example, to provide insights into changes in atmospheric mercury levels, to assess levels in sensitive or vulnerable ecosystems (e.g., the Arctic or areas near wetlands), to examine contributions from point sources, to assess background concentrations, or to help the evaluation of atmospheric models. A diversity of site locations should be considered depending on the use of the data.

Sites can be grouped as (a) background or remote, (b) rural, (c) urban, and (d) contaminated or industrial sites. It is important that mercury air monitoring sites prioritize co-location with other existing monitoring activities, including air quality sites where relevant air pollutants, such as ozone, sulfur dioxide, carbon monoxide, fine particulate matter (PM_{2.5}) and halogens, are regularly monitored. This allowed for the use of available infrastructure and co-measurements with relevant reactants. If no such infrastructure or measurements are available, check whether there is any nearby facility that records ambient temperature and wind speed, as these are critical factors to later calculate mercury in ambient air based on passive air sampling.

To meet the GCMP objectives of providing data to the Minamata Convention on Mercury and creating synergies with monitoring activities under the Stockholm Convention, sam-

pling locations for monitoring mercury in ambient air should preferably be background sites and, where possible, coincide with those used for passive air sampling of POPs.

Once an appropriate location has been identified, the next step is to arrange a post, fence, or railing on which to mount the sample brackets. It is important to choose a mounting location that is well above the ground and away from windows, doors, and building vents, so that any pollution point source and disturbances in natural air circulation can be avoided. Optimally, the location would be in a secure area with unobstructed air flow. Tools to mount the brackets will be required, including a screwdriver or a socket driver, and a pair of scissors or a box cutter.

3.2. Installing the MerPAS® brackets

The initial sampling kit will be provided with mounting brackets, hose clamps, and several zip ties, as well as the sampling kit described in [section 3.3](#).



Figure 3. Visualization of mounting brackets for installing MerPAS® samplers

1. Find a suitable post on which to mount the provided brackets. Find an area away from buildings, traffic, people, doors, and windows.
2. Try to mount the samplers around the same height, i.e. at least 2.0 m above the ground.
3. If mounting the brackets at the same height, use two hose clamps to secure the brackets in place.
4. The brackets will need to remain in place for at least two years, therefore, they should be securely fastened to withstand strong winds and weather conditions.

3.3. Preparing MerPAS® samples and blank

The sampling kit contains the following items:

- One set of three blue MerPAS® samplers in double Ziploc bags (two samples and one field blank)
- Six open caps and six screens (note only two are used, for the samples, and one set is a spare)
- One roll of vinyl tape
- Four pair of nitrile gloves
- One permanent (Sharpie) marker
- Instructions manual
- Two spare cap nuts

This sampling kit contains supplies for one set of MerPAS® for 3-month sampling periods (**Figure 4**).

The blue MerPAS® sample container acts as both a travel container and weather shield for the sampler. Inside the blue container is a white tube containing carbon (**Figure 5**); do not remove this tube from inside the blue container, rather simply replace the solid lid (**Figure 6**) with the mesh lid (**Figure 7**) and install with the lid down to begin sampling (**Figure 4**).



Figure 4. MerPAS® samplers mounted on a pole for field deployment



Figure 5. Sampling tube (red arrow): **do not remove!!!**

Figure 6. Solid transport lid used for storage prior to deployment (blue arrow)

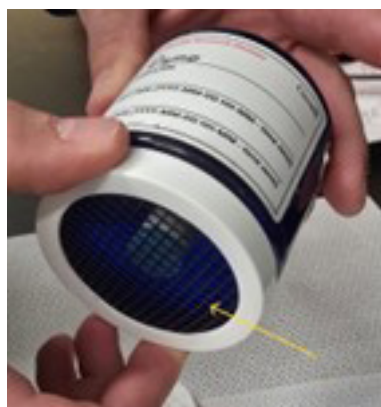
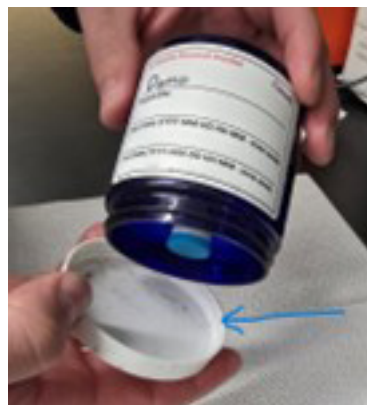


Figure 7. MerPAS® deployment setup with mesh lid (yellow arrow)

3.4. Procedure for sample deployment

- Put on the provided nitrile gloves.
- Remove all three MerPAS® from the Ziploc bags (keep Ziploc bags in the pail - and do not throw them as they will be used again).
- Label the **Project/Site** with the location and country names with permanent marker.
- Using a permanent marker, label the two MerPAS® units to be used as samples with the word “**SAMPLE**”. Whereas, label the remaining MerPAS® unit with the word “**BLANK**”.

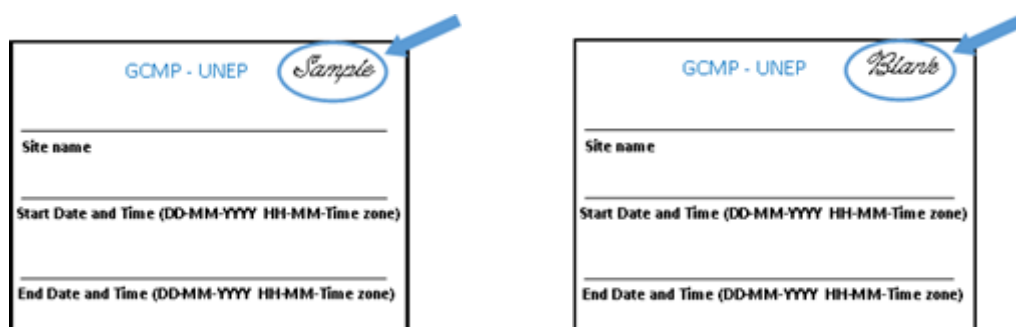


Figure 8. Example of labelling of Merpas® sample and blank units prior to deployment.

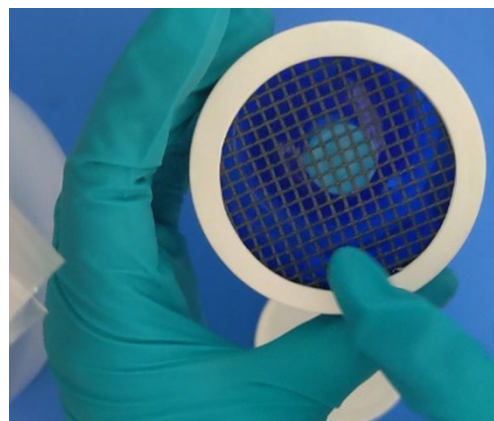
- Remove the tape from around the lids of two containers of the samples. (**Do not remove the tape from around the lid of the blank sample unit**).

Figure 9. Removal of tape and opening of lids before installing sampling screens.



- Remove the lids from the two MerPAS® samples.
- Replace the lids on both PAS sample units with the open lid fitted with black mesh (the curved side of the mesh should face into the sample container).

Figure 10. Installation of mesh lids on MerPAS® units at the start of the sampling period.



- Label the **samples** with the **start date and time** on the sticker on the outside of the sample housing using a permanent marker. Also, make note of this information in a filed logbook (as the information may fade under harsh weather conditions).

Figure 11. Labelling of the MerPAS® sample.

GCMP - UNEP	Sample
Geneva, Switzerland	
Site	01-06-2026 13:00
Start Date and Time (DD-MM-YYYY HH-MM-Time zone)	
End Date and Time (DD-MM-YYYY HH-MM-Time zone)	

- Similarly, label the **blank** PAS and fill in the **start date and time** on the sticker on the outside of the blank sample housing with the permanent marker. Ensure that the BLANK is clearly marked (Important to note that the Blank should retain the tape and the white lid on the sampler for the sampling period).

Figure 12. Labelling of the Blank MerPAS®.

GCMP - UNEP	Blank
Geneva, Switzerland	
Site name	01-06-2026 13:00
Start Date and Time (DD-MM-YYYY HH-MM-Time zone)	
End Date and Time (DD-MM-YYYY HH-MM-Time zone)	

3.5. Deploying MerPAS® samplers

Once the MerPAS® units are prepared, they are ready for installation. Please follow the below described steps to install the MerPAS® samplers.

- Take the prepared MerPAS® samplers to the sampling location.
- Install the prepared and labelled SAMPLE and BLANK MerPAS® units into the mounting brackets by inserting the male end of the fitting from the sample housing through the hole in the mounting bracket.
- Screw the cap into the male fitting and tighten securely (an extra cap nut can be found in the pail in case one is dropped and cannot be found).
- The samples and the blank are left in place after installation for a period of three months, after which they are replaced with a new set of samples and blank.

There will be a total of eight 3-month periods during the two years of sampling for this program.

Figure 13. Installation of MerPAS®.



3.6. Collecting and replacing the MerPAS®

A step-by-step guide for collecting and replacing the MerPAS® sample and blank units after the deployment period is provided below:

- Go to the sampler location with the sampling kit pail.
- Put on the nitrile provided gloves.
- Remove one sampler at a time. Start with removing the cap nut, and then detach the sampler from the bracket.



Figure 14. Removing the Merpas®.

- Note down the **END date and time** on the **Samples** and **Blank** with the marker as shown in **Figure 15**.

GCMP - UNEP <i>Sample</i>	GCMP - UNEP <i>Blank</i>
<i>Geneva, Switzerland</i>	<i>Geneva, Switzerland</i>
Site	Site name
<i>01-06-2026 13:00</i>	<i>01-06-2026 13:00</i>
Start Date and Time (DD-MM-YYYY HH-MM-Time zone)	Start Date and Time (DD-MM-YYYY HH-MM-Time zone)
<i>01-09-2026 13:00</i>	<i>01-09-2026 13:00</i>
End Date and Time (DD-MM-YYYY HH-MM-Time zone)	End Date and Time (DD-MM-YYYY HH-MM-Time zone)

Figure 15. Final labeling of the samples and blank units with start and end dates and times.

- Remove the open lid and screen from the **samples** and replace the screen end with the solid lid (as shown in **Figure 16**). **(Please ensure that the lid is tightened securely, as loose caps lead to contamination).**



Figure 16. Replacing of the open lid with the solid lid.

- Keep the remaining open lids and screens in the pail and return them with the samples.
- Repeat this process with both the sample units.
- Remove the Blank sample from the mounting bracket, note down the end date and time, and place it in double-layered ziplock bags as shown in **Figures 17** and **18**.

Figure 17. Placing the MerPAS® unit into double Ziplock bags after the sampling period ends.

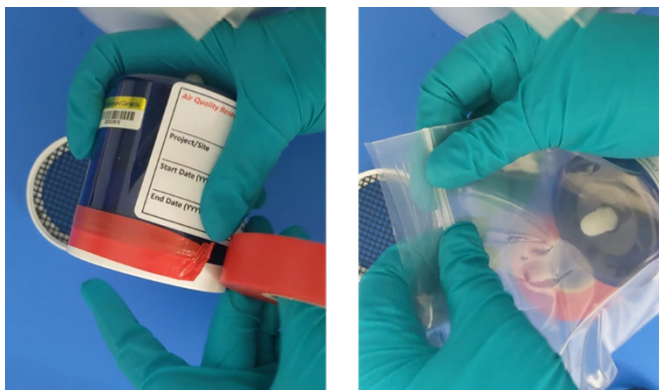


Figure 18. Placement of field blank and sample units in ziplock bags (double bagged).



- Install the two new samples and one new blank sample following the instructions described in **sections 3.3 and 3.4** for the three-month period deployment.

3.7. Storage and transport of the collected MerPAS® sample and blank units

The two samples and one blank MerPAS® units are stored and transported in double Ziplock bags and kept in the white pail to avoid contamination. The samplers may be stored in a dry cool place in the sealed pail for several months. Do not place the pail in a refrigerator or freezer and keep it away from known contaminated areas during storage.

Please ensure that all lids are tightly closed, as loose lids lead to contamination. Apply tape to seal around the two samples lids and place them in Ziploc bags (double-bagged in the same manner as received).

Please take pictures during each sampling event, including during the first deployment, the sample changes, and of the sampling sites.

The pail containing one set of MerPAS® samplers should be placed in the original box or another suitable cardboard box. The samples should then be shipped to the assigned regional or expert laboratory for analysis. This will be done every six months, covering two sampling periods. The shipment modalities shall be agreed upon in close cooperation between the sampling country and the international/regional expert laboratory.

4. DOCUMENTATION

Please, provide a summary of all information described below related to the location and conditions:

Country name:	Full name and ISO_3 code
Operator name:	Full name of all the operators performing the sampling.
Site/Location:	Short name assigned
Weather stations:	Please indicate if a weather station is located close to the site, if yes, please provide details of the weather station.
Address:	Physical address
Type of site:	Remote, Urban, Rural, Agricultural
GPS coordinates:	Degrees (latitude and longitude) and decimal values (latitude and longitude)
Narrative:	Brief narrative description of the location and its surroundings, and any other important observation about the site or sampling devices.
Institution responsible:	Please provide name of the institution undertaking the sampling.
Photo:	Please insert a photo of the sampling site.

5. REFERENCES

Naccarato, A., Tassone, A., Martino, M., Moretti, S., Macagnano, A., Zampetti, E. *et al.* (2021). A field intercomparison of three passive air samplers for gaseous mercury in ambient air. *Atmospheric Measurement Techniques* 14, 3657–3672. <https://doi.org/10.5194/amt-14-3657-2021>.

McLagan, D., Mitchell, C., Huang, H., Lei, Y., Cole, A., Steffen, A., *et al.* (2015). Guidance on PFAS analysis in water for the Global Monitoring Plan on A High-Precision Passive Air Sampler for Gaseous Mercury. *Environmental Science & Technology Letters* 3, 24–29. DOI: [10.1021/acs.estlett.5b00319](https://doi.org/10.1021/acs.estlett.5b00319).

Tekran Instrument Corporation, Inc. (n.d.). *MerPAS® Passive Air Sampler*. <https://www.tekran.com/products/merpas/overview/> Accessed 25 July 2025.

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