

## **APPENDIX 3**

**HONG KONG ENVIRONMENTAL PROTECTION DEPARTMENT**

**STANDARD OPERATING PROCEDURES  
FOR  
PM<sub>2.5</sub> FIELD SAMPLING**

**Field Operating Procedures for Partisol-Plus Model 2025 Sequential Air Sampler  
for the 12-month Chemical Speciation Project (Version 1, Oct 2000)**

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<b><u>Section</u></b>	<b><u>Table of Content</u></b>	<b><u>Page</u></b>
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Sequential Particulate Sampler	
1.2	Flow Schematic	
<b>2</b>	<b>INSTALLATION</b>	<b>6</b>
2.1	Setting Up the Sampler	
2.2	Partisol Stand	
<b>3</b>	<b>PROCEDURES</b>	<b>9</b>
3.1	Ambient Air Temperature Calibration	
3.2	Filter Temperature Calibration	
3.3	Filter Compartment Temperature Calibration	
3.4	Ambient Pressure Calibration	
3.5	External Leak Check	
3.6	Actual Flow Calibration	
3.7	Internal Leak Check	
3.8	Timer Calibration	
<b>4</b>	<b>SAMPLING OPERATION PROCEDURES</b>	<b>14</b>
4.1	Turning On The Sampler	
4.2	Main Screen	
4.3	Time Base Filter Setup Screen	
4.4	Pre-Sampling	
4.5	Post-Sampling	
<b>5</b>	<b>QUALITY CONTROL AND MAINTENANCE</b>	<b>21</b>
5.1	Monthly One-Point Verification Check	
5.2	Cleaning the First Stage Inlet	
5.3	Cleaning the WINS Impactor	
5.4	Quality Control Activity and Frequency	
<b>6</b>	<b>REFERENCE</b>	<b>29</b>
 <b>APPENDIX</b>		
Appendix A-1	Dynamic Calibration Log Sheet	
Appendix A-2	Field Operation Log Sheet	
Appendix A-3	Monthly One-point Verification Check Log Sheet	
Appendix B	Status Codes of Partisol-Plus Model 2025 Sequential Air Sampler	

# 1 INTRODUCTION

## 1.1 SEQUENTIAL PARTICULATE SAMPLER

The R&P Partisol-Plus Model 2025 Sequential Air Sampler (Figure 1-1) is adopted in the chemical speciation project for PM<sub>2.5</sub> particulate sampling. It is a USEPA's designated equipment for PM<sub>2.5</sub> & PM<sub>10</sub> samplings and its associated facility allows for multi-sampling.

The USEPA prescribes the use of Teflon filter material for reference PM<sub>2.5</sub> measurement while PM<sub>10</sub> measurement is generally accomplished using TX40 (Teflon-coated glass fiber), quartz fiber, or Teflon materials. A range of other materials can be used in the 47 mm format for special applications. To obtain a comprehensive set of chemical species concentrations in this project, both Teflon and pre-fired quartz filters are used. Teflon filter is also used in this project for quality control checks, flow calibration and EDXRF analysis.



Figure 1-1 Partisol-Plus Model 2025 Sequential Air Sampler

The Partisol-Plus sampler can be configured with a WINS Impactor and a first-stage inlet for the USEPA's PM2.5 reference sampling. The filter storage and exchange system permits the operation of the device for more than 3 days of 24-hour sampling between site visits. The Partisol-Plus system allows field blank collection, and samples particulate matters on the 47 mm diameter filter. To minimize the possibility of contamination arising from cross-contamination of exposed filters and direct exposure to the operator, the following precautions shall be implemented :

- (i) Each exposed (i.e. post-sampling) filter and field blank shall be separated from the others by Teflon blank separators (here called dummy filters) to avoid cross-contamination;
- (ii) Field blank in the pre-sampling cassette magazine, i.e. supply magazine, shall be placed on top of the last dummy filter (at the bottom of magazine) so that in the post-sampling cassette magazine, i.e. storage magazine, the last dummy filter will be on top of the field blank and all other dummy & exposed filters after multi-samplings.
- (iii) The exposed filters shall ONLY be removed from the cassettes and storage magazine in the Balance Laboratory (here called the Laboratory). Laboratory operator (LS) shall always wear anti-static gloves, laboratory coat and mask during filter handling.

Besides, internal data storage and sophisticated data input and output features of the sampler will allow meteorological data and information from the other external sources to be averaged and stored, as well as logging atmospheric pressure, temperature, relative humidity & dynamic flow rate at the 5-minute interval for quality control recording. It can also record the total sampling volume in either volumetric or standard term for compliance of different measurement standards around the world.

## **1.2 Flow Schematic**

The flow schematic diagram as shown in Fig 1-2 provides an overview of the hardware's basic flow and electronic connections. The schematic shows an inlet system consisting of a first-stage inlet that is followed by a straight down tube and then a WINS PM-2.5 Impactor. For reference USEPA PM2.5 sampling, the WINS Impactor is located inside the sampler enclosure. For PM10 sampling, the first-stage inlet is replaced by a designated PM10 sampling inlet while the WINS Impactor is substituted with a straight internal down tube.

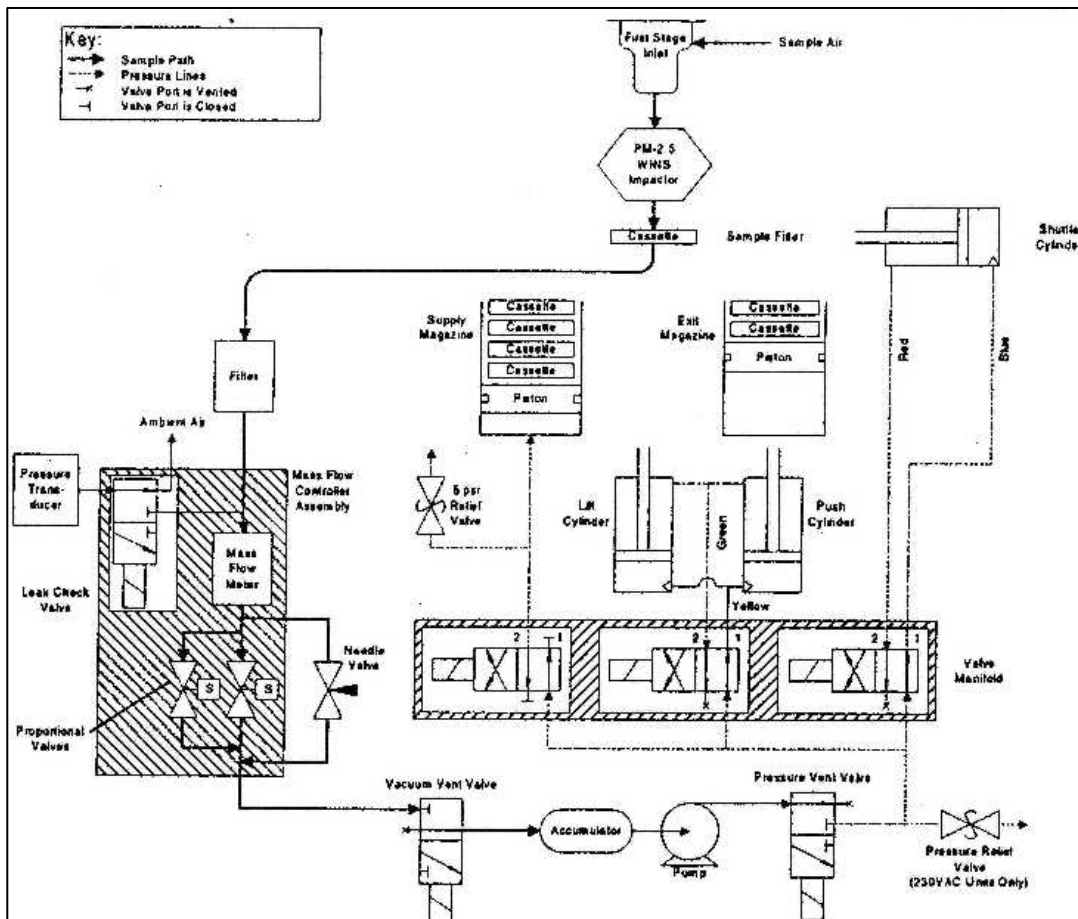


Figure 1-2 Partisol-Plus System Flow Schematic

A 47mm filter is housed in a filter cassette that the user installs with other cassettes in a supply cassette magazine, with a capacity of up to 16 filters. A storage magazine on another side will hold all exposed filters with clean dummy filters inserted in between any two exposed filters to avoid cross contamination.

The use of filter cassette magazines simplifies filter exchange and transport, and minimizes the risk of contamination during these procedures. Filter cassette magazines may be exchanged while the unit is sampling. The supply magazine contains pre-weighed, preconditioned filters to be used for collection, while the storage magazine receives exposed filters (Figure 1-3). During filter exchange, the sampler pushes filter cassettes contained in the supply magazine upward and to the right, while the already-exposed filter is shuttled rightward to the storage magazine. For sensitive speciation applications, every second loaded filter may be a dummy filter, forming a complete seal between filter cassettes contained in the storage magazine.

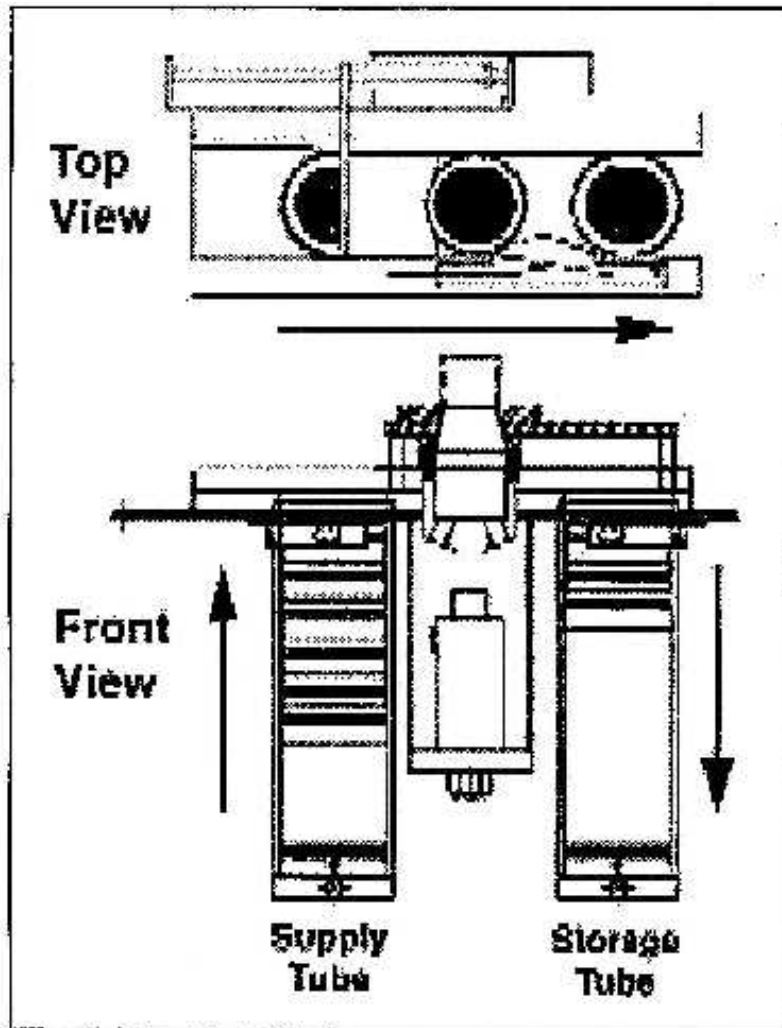


Figure 1-3

An in-line filter downstream of the sample filter protects the mass flow controller from any particles that may remain in the air flow. The mass flow controller operates under the control of the sampler's microprocessor, and maintains the sample stream at a constant volumetric flow rate (16.7 LPM default) through the use of ambient temperature and pressure sensors. The accumulator minimizes pulsation caused by the vacuum pump.

The Partisol-Plus Sampler maintains a constant volumetric flow rate at the set point entered by the user (usually 16.7 LPM), and reports the sampled volume ( $m^3$ ) in either volumetric or standard term. According to the USEPA requirement, the former should be adopted for the calculation of PM<sub>2.5</sub> mass concentration.

The sampling system determines the ambient temperature and pressure for flow rate calculations through the use of sensors that continually provide updated information to the microprocessor. The mass flow controller in the Partisol-Plus Sampler is calibrated at a temperature of 0 °C and pressure of 1 atmosphere (760 mm Hg). For the device to sample at the correct volumetric flow

rate, it makes use of the measured ambient temperature and pressure. Using this information, the microprocessor calculates the correct mass flow set point ( $Flow\_Rate_{STP}$ ) required to achieve the desired volumetric flow setting:

$$Flow\_Rate_{STP} = Flow\_Rate_{Vol} \times \frac{273.15}{Ave\_Temp + 273.15} \times \frac{Ave\_Pressure}{760}$$

where:

$Flow\_Rate_{STP}$  = Control set point of the mass flow meter (equivalent flow at 0 °C and 760 mm Hg).

$Flow\_Rate_{Vol}$  = Volumetric flow rate set point (L/min) as entered by the user in the Setup Screen. This value is 16.7L/min (equivalent to 1m<sup>3</sup>/h) for most applications.

$Ave\_Temp$  = The current ambient temperature (°C) as measured by the temperature sensor mounted on the down tube of the sampler.

$Ave\_Pressure$  = The current ambient pressure (mm Hg) as measured by the pressure transducer in the sampler's enclosure.

Mass concentration data must be in volumetric m<sup>3</sup>, which simply involves the integration of the above volumetric flow rate over the sampling period, without any further adjustment.

The Partisol-Plus Sequential Sampler automatically determines the sampled volume in volumetric or standard m<sup>3</sup> for each filter exposed, and stores this information internally for later viewing or downloading. In this project, volumetric m<sup>3</sup> is used for the determination of PM2.5 concentrations.

## **2. INSTALLATION**

### **2.1 Setting Up the Sampler**

2.1.1 Cut any tie wraps and remove any transport restraints from inside the sampler enclosure.

2.1.2 Install the large rain hood on the right side of the enclosure. The rain hood should cover both air filters.

- i) Peel back the paper facing of the larger gasket and apply it to the larger rain hood.
- ii) Place the large rain hood with its gasket attached hood on the enclosure.
- iii) Secure the rain hood to the unit using four (4) #10-32 x 1/2" slot bind head screws.

2.1.3 Install the two small rain hoods. Both rain hoods are installed on the back panel of the enclosure

- i) Peel back the paper facing of one of the smaller gaskets and apply it to one of the smaller rain hoods.
- ii) Place the small rain hood with its gasket attached hood on the enclosure.

- iii) Secure the rain hood to the unit using four (4) #10-32 x 1/2" slot bind head screws.
- iv) Repeat this procedure for another rain hood.

2.1.4 Install the external sample tube and the 1st Stage Inlet.

- i) Insert the end of the external sample tube with the 5 cm (2 inches) machined section into the bulkhead of the sampler. Ensure that the tube is pushed into the enclosure through the final O-ring until it hits a stop.
- ii) Turn the dome connector on the bulkhead to ensure a tight grip.
- iii) Place the 1st stage inlet on another end with 3 cm (1.25 inches) of machining. Ensure that the tube is pushed past the inlet's two O-rings, which provide some resistance, and hits a stop.

In its final sampling configuration, the entrance to the inlet must be approximately 2m ( $\pm 0.2m$ ) above the ground (6 to 7 feet). A stand (57-004644) described in Section 2.2 provides a convenient means of installing the sampler to the height requirements.

2.1.5 Connect the unit to the electric supply in a manner that meets all safety and regulatory requirements for the hardware's intended Use. The wires inside the power cord are defined by the following colors:

For 200VAC configuration of Partisol-Plus System

Line	Brown
Neutral	Blue
Common Ground	Green/Yellow

2.1.6 Install the ambient temperature sensor.

- i) Locate the two screws installed on the left side of the enclosure.
- ii) Remove the two screws, being careful not to lose the washers. This will expose two holes.
- iii) Locate the ambient temperature probe assembly in the compilation package.
- iv) Place the ambient temperature probe assembly over the two holes in the left side of the sampler enclosure.
- v) Secure the assembly to the enclosure using the screws and washers previously removed. Place the washers between the ambient temperature bracket and the enclosure - not under the head of the screw - to prevent leakage of water into the electronics compartment.
- vi) Plug the ambient temperature probe into the connector on the back panel of the sampler labeled "Ambient Temperature".

2.1.7 Prepare the WINS PM2.5 Impactor for use, as described in Section 5.2.2.

2.1.8 Install a 47mm filter in the manner described in Section 3, but without turning on the sampler.



## 2.2 Partisol Stand

The Partisol Stand (R&P part number 57-004644) aids in the installation of the Partisol-2025 Sampler, and ensures that the inlet is at the appropriate height. Figure 2-1 shows the mounting of the unit on the stand. **WARNING:** The Partisol-Plus / Stand could present a tipping hazard in high wind conditions if the stand is not properly anchored.

Figure 2-1 contains a listing of parts, as well as other assembly information for the stand. Put this hardware together in accordance with the diagram shown in this figure.

- i) Assemble the bottom of the stand by attaching the front, back and sides with the hardware G, H and I.
- ii) Place one leg on each inside corner, fasten with hardware G, H and I.
- iii) Attach the top front and back to the outside of the legs with hardware G, H and I do not tighten.
- iv) Attach the top left and right rails to the legs and to the top front and back rails with hardware G, H and I.
- v) Tighten all Hardware.
- vi) Place the Partisol-Plus Sampler onto the stand and secure using hardware G and H.

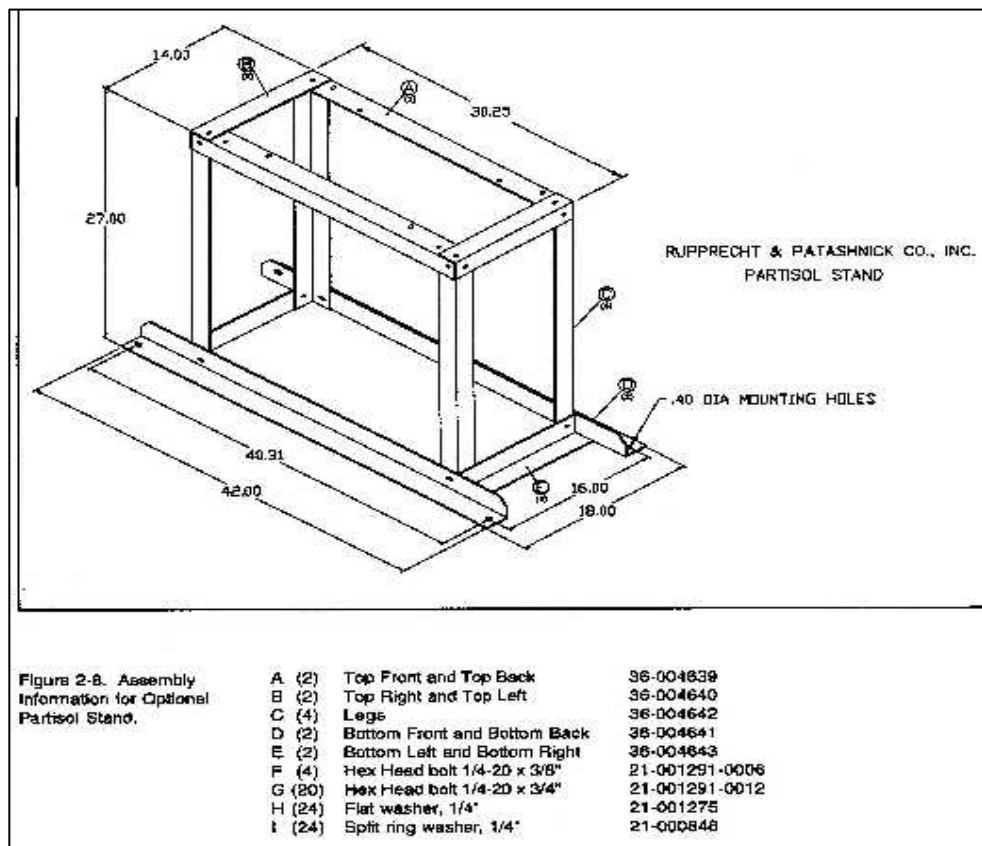


Figure 2-1

### 3. CALIBRATION PROCEDURES

This Section describes the procedures involved in calibrating the timer and sensors of temperature, pressure and volumetric flow. All working standards shall be traceable to the recognized standards :

Parameter	Working Standard	Traceable to the Primary Standard
Actual flow rate (10-20 L/min)	Volumetric dry-cell flowmeter	Bubble tube glass flowmeter certified by SCL* or equivalent
Time	Digital watch/timer	RTHK# or equivalent
Temperature	Liquid-in-glass thermometer (transfer standard)	CRM@ Liquid-in-glass thermometer certified by SCL or equivalent
Pressure	Portable barometer	Fortin barometer certified by SCL or equivalent

\*: SCL = Standards and Calibration Laboratory of the Innovation and Technology Commission, Hong Kong

#: RTHK = Radio Television Hong Kong

@: CRM = Certified Reference Material

The screens that support calibration activities are located in the Service Mode of the Partisol-Plus sampler. Calibration should only be done in the Stop Operation Mode.

Calibrations and leak checks should be carried out in the following order. Results must be filled in “PM2.5 Sampler Half-Yearly Dynamic Calibration Log Sheet” (Appendix A-1).

#### 3.1 Ambient Air Temperature Calibration

3.1.1 Press <MENU> to enter the “Service Menu”. With the cursor pointing to “Calibration/Audit”, press <F3: SensCal> to enter the Sensor Calibration Screen.

3.1.2 If the calibration will be done at ambient condition, the reference temperature measurement can be taken with the probe installed in the radiation sensor.

3.1.3 After the reference thermometer and sampler probe are equilibrated at temperature for at least 5 minutes, press <Edit> then enter the measured reference temperature in °C in the Actual column of “Amb Temp” row of the Sensor Calibration Screen, press <Enter>. The sampler automatically adjusts the corresponding offset based upon this input.

#### 3.2 Filter Temperature Calibration

3.2.1 Insert a filter cassette without screen in the topmost position of the filter cassette supply tube. Insert supply magazine into the sampler.

3.2.2 Press <MENU> to display the Master Menu. Scroll to the Service Menu, then press

**<Enter>**.

- 3.2.3 Press **<F2: Audit>** to display the Audit screen.
- 3.2.4 Press **<F4:FiltAdv>**. Wait for filter change to complete.
- 3.2.5 Press **<Esc>** to enter the Service Menu. With the cursor pointing to “Calibration/Audit”, press **<F4: FiltCal>** to enter the Filter Temperature Calibration Screen.
- 3.2.6 Note the location of the filter temperature probe in the sampling platform of the ventilated filter compartment.
- 3.2.7 Unlatch and open the top cover of the sampler.
- 3.2.8 Remove the WINS Impactor.
- 3.2.9 Put a reference thermometer through the hole into the sampling platform.
- 3.2.10 After the reference thermometer and sampler probe are equilibrated at temperature for at least 5 minutes, press **<Edit>** enter the measured reference temperature in °C in the Actual column of “Filter” row of the Filter Temperature Calibration Screen, press **<Enter>**. The sampler automatically adjusts the corresponding offset based upon this input.
- 3.2.11 Reinstall the WINS Impactor.
- 3.2.12 Close and latch the top cover of the sampler.

### **3.3 Filter Compartment Temperature Calibration**

- 3.3.1 Press **<MENU>** to display the Master Menu. Scroll to the Service Menu, then press **<Enter>**.
- 3.3.2 With the cursor pointing to “Calibration/Audit”, press **<F4: FiltCal>** to enter the Filter Temperature Calibration Screen.
- 3.3.3 Determine the current temperature (°C) at the location of the filter compartment probe in the ventilated filter compartment of the sampler using the reference thermometer.
- 3.3.4 After the reference thermometer and sampler probe are equilibrated at temperature for at least 5 minutes, press **<Edit>** Enter the measured reference temperature in °C in the Actual column of “Filt Comp” row of the Filter Temperature Calibration Screen, press **<Enter>**. The sampler automatically adjusts the corresponding offset based upon this input.

### **3.4 Ambient Pressure Calibration**

- 3.4.1 Press **<MENU>** to enter the Service Menu. With the cursor pointing to “Calibration/Audit”, press **<F3: SensCal>** to enter the Sensor Calibration Screen.
- 3.4.2 Determine the current ambient station pressure in mmHg (absolute pressure, not corrected to sea level).
  - i) To convert from Atmospheres at 0 °C to mmHg, multiply by 760.
  - ii) To convert from millibars to mm Hg, multiply by 0.75012.

- 3.4.3 Press <Edit> enter the measured ambient pressure in the Actual column of the “Amb Pres” row of the Sensor Calibration Screen, press <Enter>. The sampler automatically adjusts the corresponding offset based upon this input.

### 3.5 External Leak Check

- 3.5.1 Press <MENU> to display the Master Menu. Scroll to the Service Menu, then press <Enter>.
- 3.5.2 Press <F1: LeakChk> to display the Leak Check screen.
- 3.5.3 Insert a filter cassette containing a new 47mm Teflon filter in the topmost position of the filter cassette supply tube.
- 3.5.4 Press <F4:FiltAdv>. Wait for filter change to complete.
- 3.5.5 Remove the sample inlet from the external sample tube.
- 3.5.6 Install a flow audit adapter on the open end of the external sample tube.
- 3.5.7 Close the valve on the flow audit adapter.
- 3.5.8 Press <F2: Start>. After the prompt, press <F1: Externl> to select the external leak check. Follow the instructions displayed on screen.
- 3.5.9 The sampler will automatically pull a vacuum and check for flow. A pass or a fail message will display at the end of the leak check cycle. A pressure drop of 25 mmHg/min or less is the sampler’s leak check pass criteria.
- 3.5.10 Upon the completion of leak check cycle, record the pressure drop rate and slowly open the valve on the flow audit adapter.
- Warning :** If the valve is opened quickly, filter in the compartment will be easily damaged.
- 3.5.11 If a leak check fail message is displayed on the screen, insert a filter cassette containing a new 47mm Teflon filter in the topmost position of the filter cassette supply tube and repeat the leak check procedure.
- 3.5.12 Repeat test or make repairs if necessary to achieve minimal leakage.
- 3.5.13 After a successful leak check, slowly open the valve on the flow audit adapter.
- Warning :** If the valve is opened quickly, filter in the compartment will be easily damaged.

### 3.6 Actual Flow Calibration

- 3.6.1 Make sure all calibrations and the external leak check as described in Procedures 3.1-3.5 have been performed with satisfactory results before the actual flow calibration is carried out.
- 3.6.2 Press <MENU> to enter the Service Menu. With the cursor pointing to “Calibration/Audit”, press <F5: FlowCal> to enter the Flow 1 Calibration Screen.
- 3.6.3 Remove the inlet from the external sample tube of the sampler. Install the Flow Audit

Adapter on the end of the tube with its valve open.

3.6.4 Connect the soft tube between the Flow Audit Adapter and Bios Flow Calibrator Transfer Standard.

3.6.5 Press **<Edit>** enter the desired minimum and maximum calibration flow rate (Range: Min Actual Flow to Max Actual Flow), as well as the number of calibration points desired (Num Points) in the Flow 1 Calibration Screen, press **<Enter>**.

**Note:** For a three-point calibration of 16.7 L/min flow rate set point, the setting should be as follows:

*Min Flow: 15.0 L/min (10% below the actual 16.7 L/min set point)*

*Med Flow : 16.7 L/min (set point)*

*Max Flow: 18.4 L/min (10% above the actual 16.7 L/min set point)*

*Num Points : 3*

During the calibration procedure, the sampler begins with the minimum actual flow rate (Min Flow), and performs measurements at equal flow rate interval until it reaches the maximum actual flow rate (Max Flow).

3.6.6 Press **<F5: More>** followed by **<F4: Start>** to initiate the flow calibration.

3.6.7 Wait for the flow to stabilize at each flow rate plateau, then press **<Edit>** and enter the actual flow (actual volumetric l/min) from a NIST/HK SCL-traceable flow meter in the Act Flow Field. Press **<Enter>**. The sampler proceeds to the next flow rate plateau after the user presses **<Enter>** for each measured value.

3.6.8 The sampler automatically adjusts the Offset and Span values in the Flow 1 Calibration Screen once it performs measurements at all flow rate plateaus.

3.6.9 Press **<MENU>** to display the Master Menu.

3.6.10 Press **<F2: Audit>** to display the Audit screen.

3.6.11 Press **<F1: Pump>** then press **<F2: Valve>**.

3.6.12 Wait for the flow to stabilize, then record the readings of the sampler and flowmeter, e.g. BIOS, in the Calibration Log Sheet.

3.6.13 Verify that the current actual flow is within  $\pm 2\%$  of the measured actual flow. If this is not the case, perform the actual flow calibration procedures again.

3.6.14 Restore the sampling hardware to its original state by removing the flow metering hardware and reinstalling the inlet onto the external sample tube.

### **3.7 Internal Leak Check**

3.7.1 Press **<MENU>** to display the Master Menu. Scroll to the Service Menu, then press **<Enter>**.

3.7.2 Press **<F1: LeakChk>** to display the Leak Check screen.

3.7.3 Insert a filter cassette containing leak check disk (the screen should be removed before installing the leak check disk) in the topmost position of the filter cassette supply tube. Insert supply magazine into the sampler.

- 3.7.4 In the Leak Check Screen, press <**F4: FiltAdv**> to move the leak check cassette into the sampling position. Wait for filter change to complete.
- 3.7.5 Press <**F2: Start**>. Press <**F2: Internal**> to select internal leak check. Follow instructions in the display to complete leak check.
- 3.7.6 The Partisol-Plus sampler will run an automatic leak check, and report either a pass or fail message. A pressure drop of 140 mmHg/min or less is the sampler's leak check pass criteria.
- 3.7.7 Upon the completion of leak check cycle, record the pressure drop rate.
- 3.7.8 If a failure message has displayed, clean the cassette and leak check disk carefully. Examine the cassette and disk for any external nicks or scratches. Discard any damaged cassette or disks, and re-run the test with a clean, undamaged cassette and leak check disk.
- 3.7.9 When a pass message is displayed, remove the flow audit adapter from the external sample tube and reinstall the sample inlet previously removed.
- 3.7.10 Press <**F4: FiltAdv**> to move the leak check cassette to the storage magazine and the dummy cassette into the sampling position.
- 3.7.11 Press <**MENU**> to display the Master Menu. Scroll to the "Exit Service Mode", then press <**Enter**>.

### 3.8 **Timer Calibration**

- 3.8.1 Press <**F5: Setup**> when in the Main Screen to enter the System Setup Screen. All of the fields in the System Setup Screen are editable when the sampler is in the Stop Operation Mode.
- 3.8.2 The Curr Time parameter is the current local time expressed by default as hh:mm:ss. When editing this parameter, treat each part of the time as a separate field.
- 3.8.3 Press <**Edit**> to enter the time from the reference watch / clock, then press <**Enter**>.
- 3.8.4 Press <**ESC**> to return the Main Screen.

## 4. SAMPLING OPERATION PROCEDURES

### 4.1 Turning On The Sampler

Once the sampling system has been wired to a main electrical source of 200 VAC, power can be applied to the unit.

The following steps are to turn on the sampler:

- i) Install a loaded supply and empty storage filter cassette magazine into the sampler.
- ii) Press the power switch on the main panel (lower left) to its “on” (1) position to activate the sampler.
- iii) If necessary, turn the adjustment knob to the right of the keypad/display to adjust the contrast of the liquid crystal display (LCD).

Once the power switch is pressed, the pump in the sampler may turn on momentarily. This is the default setting of the unit in case it is being turned on under extreme cold conditions where additional heat is necessary to warm the electronics.

The Title Screen appears on the display of the sampler for a few seconds to identify the model number of the hardware and the version number of the installed software. During the time that the sampler displays this screen, the user has a chance to reset the hardware by pressing the appropriate keys on the keypad.

### 4.2 Main Screen

After a few seconds, the Title Screen is automatically replaced by the Main Screen (Figure 4-1). This shows summary information regarding the sampling program currently defined by the user, the current operation mode, the existence of any status conditions, as well as certain operational information. The sampler displays the following fields on the Main Screen:

Stat: OK	Partisol 2025	Mode: STOP		
Current Time:	16:20 99/08/26			
Start Time:	00:00 99/08/24			
Stop Time:	00:00 99/08/25			
Filter ID:	Q 0000101			
Flow:	0.0 l/min			
Volume:	24 m <sup>3</sup>			
Help	Status	Filtset	Data	Setup

Figure 4-1

Status Code	The value of the status code in the upper left-hand corner of the Main Screen (next to Stat) indicates whether or not the hardware is operating properly (Appendix B). A value of “OK” indicates that all functions are proceeding normally.
Operating Mode	The sampler displays the current operating mode in the upper right-hand corner of the Main Screen (next to Mode). Press RUN/STOP to switch among the Stop, Wait, Sampling, Audit and Done Operating Modes.
Current Time/Date	The local time and date are displayed on the second line of the Main Screen. These variables should be set to their proper values in the Setup Screen before initiating a sampling program. The sampler express time as “hh:mm:ss” and dates as “yy/mm/dd” by default.
Start Time	The start time and date are displayed on the third line of the Main Screen, at which the sampler is currently programmed to begin sample collection (hh:mm yy/mm/dd by default).
Stop Time	The stop time and date are displayed on the fourth line of the Main Screen, at which the sampler is currently programmed to stop sample collection (hh:mm yy/mm/dd by default).
Filter ID	This field displays the Filter ID’s for the currently installed filter. The Filter number displayed at the top of the screen will automatically track the Filter ID’s in the sequence entered in the Filter List Screen. Filter ID can also be entered for each sampling and blank filter in this screen.
Flow	The flow rate is displayed on the sixth line of the Main Screen. It shows the current flow rate (L/min).
Volume	The total volume sampled is displayed on the seventh line of the Main Screen. It shows the current sampled volume (m <sup>3</sup> ).

### 4.3 Time Base Filter Setup Screen

The Time Base Filter Setup Screen (Figure 4-2) will display if the Sample Definition Method in the Sample Setup Screen was entered as Time. The Time Base Sequential Sampling program allows the user to set a time interval for sequential sampling. For example if the user selected



00:00 99/08/23 for Sample Start and 00:00 99/08/24 as Sample End times for filter #1, the sampler would start sampling at midnight and stop at next day midnight (i.e. 24-hour sampled). The sampler would exchange a filter and enter the Wait Mode, and then sample sequentially according to the program entered for the remaining filters in the supply magazine. Each filter in the supply magazine will use the default program set in the Sample Setup Screen *unless the user enters a different program in the Time Base Sequential Sampling Screen.*

The Time Base Filter Setup Screen contains the following fields to define the Time Base sampling program of the Partisol-Plus Sampler:

- |              |   |
|--------------|---|
| Filter       | The Filter field identifies the currently installed sampling filter by default. Pressing <F3: Next> will allow the user to program each filter in the magazine with a unique Time Base start and end time.  |
| Current Time | The current time is displayed in this field.  |
| Start Sample | The Start Time parameter defines the time and date that the Partisol-Plus will begin sampling for the filter number displayed in the Filter field at the top of the screen. When editing, treat each part of the time and date as a separate field.   |
| Stop Sample  | The Stop Time parameter defines the time and date that the unit will stop sampling for the filter number displayed in the Filter field. When editing, treat each part of the time and date as a separate field.   |
| Filter ID    | This field displays the Filter ID's for the currently installed filter. The Filter number displayed at the top of the screen will automatically track the Filter ID's in the sequence entered in the Filter List Screen. Filter ID# can also be entered for each sampling and blank filter in this screen.  |
| Cassette ID  | This field displays the Cassette ID's for the currently installed filter. The Filter number displayed at the top of the screen will automatically track the Cassette ID's in the sequence entered in the Filter List Screen. The Cassette ID# can also be entered for each sampling and blank filter in this screen.  |
| Blank        | This parameter is either yes or no, defining whether the Filter number at the top of the screen is intended as a sampling filter or a blank filter. The sequence for sampling filter and blank filter cassettes can be most conveniently set in the Filter List Screen, or can be selected in this screen by pressing +List in the edit mode to change from no to yes. Setting this |

parameter to Yes in the Time Base Sequential Sampling Screen, the first filter will be a blank filter and the next filter advanced by the sampler will be the sampling filter.

In the **Browse Mode**, the soft function keys <F2: Prev> and <F3: Next> are used to move to the previous or next filter number. <F4: FiltLst> displays the Filter List Screen (Section 5.3.6). Pressing <F5: More> will access the <F6 to F10> function keys. <F7: Reset> will reset current settings for all Filters to the defaults as defined in the Sample Setup Screen. The <F3: +Hour> and <F4: +Day> keys are used to increment the Start Sample or Stop Sample times by one hour or one day respectively. Pressing <F5: Back> will restore the original <F1> to <F5> functions.

In the **Edit Mode** +List, -List and Backspace are accessed by <F1> to <F3> respectively.

**Note:** If the Partisol-Plus has been programmed for fewer sampling cycles than available filter cassettes in the supply magazine, the instrument will sample using the entered program(s), *then revert to the default sampling program*. Sampling will continue with any additional filter cassettes using the default program settings as entered in the Sample Setup Screen.

Stat: OK	Filter: 01	Mode: STOP
Current Time:	16:20 99/08/23	
Start Sample:	00:00 99/08/24	
Stop Sample:	00:00 99/08/25	
Filter ID:	Q 0000101	
Cassette ID:	RP 003025	
Blank:	No	
Help	Prev	Next
FiltLst	*More*	

Figure 4-2 Time Base Filter Setup Screen

Function Keys in Browse Mode:

Help	Prev	Next	FiltLst	*More*
	Reset	+ Hour	+ Day	*Back*

Function Keys in Edit Mode:

- List	+ List	Bksp		
--------	--------	------	--	--

## 4.4 Pre-Sampling

EPD will have been completed parts of Field Operation Log Sheet (Appendix A-2), including sampling time schedule, filter IDs and filter sequence in the supply magazine, during the filter preparation in laboratory. The Field Operation Log Sheet will be attached to the supply magazine for collection. Details of the field operations must be recorded in the log sheet at site.

- 4.4.1 Follow Section 4.5 to retrieve all post-sampling filters, if any.
- 4.4.2 Follow Section 5.2 to clean up the sampler and its inlet monthly.
- 4.4.3 Follow Section 5.3 to clean up the WINS impactor and replace the 37mm fiber-glass filter in the impactor well at least once every 120 hours (i.e. five 24 hours) operation.
- 4.4.4 According to the time schedule, perform half-yearly dynamic calibration as described in Section 3.
- 4.4.5 According to the time schedule, perform monthly one-point verification check as described in Section 5.
- 4.4.6 Perform external leak check following the procedures in Section 3.5.
- 4.4.7 Perform internal leak check following the procedures in Section 3.7.
- 4.4.8 Remove the caps from the supply and storage magazines. Then install the supply magazine, in which sampling filters are stored, on the left-hand side magazine holder of the sampler and the clean empty storage magazine on the right-hand side holder for the following sampling run.
- 4.4.9 Program the sampler for sampling run.
  - i) Press **<RUN/STOP>** to switch to the Stop Mode (if display shows “Stop” Mode, jump this step).
  - ii) Press **<F3: Filtset>** to enter the Time Base Filter Setup Screen from the Main Screen.
  - iii) The Filter field identifies the currently installed sampling filter. Press **<Edit>** to enter the Edit Mode for modifying the filter’s current setting.
  - iv) Scroll the cursor to Start Sample field to edit the starting date (yy/mm/dd) of the currently installed sampling filter according to the Field Operation Log Sheet. The starting time should be 00:00 by default.
  - v) Scroll the cursor to Stop Sample field to edit the stop date (yy/mm/dd) of the currently installed sampling filter according to the schedule. The stop time should be 00:00 by default.
  - vi) Scroll the cursor to the Filter ID field to enter the filter ID as provided by EPD in Field Operation Log Sheet. Note that press **<F1: -List>** or **<F2: +List>** to change an alphabet.
  - vii) Scroll the cursor to the Cassette ID field to enter the cassette ID according to the pre-set sequence in Field Operation Log Sheet.
  - viii) Scroll the cursor to the Blank field to indicate this filter as a sampling filter or

blank filter. A dummy filter can be treated as a blank. Press <F2: +List> to change from “No” to “Yes”. “Yes” is a blank filter; “NO” is a sampling filter. (Remark : valid field blank will always be the second last filter counting from the bottom of supply magazine. The last one at the bottom of magazine will be treated as a dummy)

- ix) Press <Enter> to return to Filter Setup Screen from Edit Mode.
- x) If you continue to program another filter, press <F3: Next> to enter the next Filter Setup Screen and repeat the above Step (iii) to Step (x).
- xi) Press <F2: Prev> or <F3: Next> to check the information and sequence of the samples.
- xii) Press <ESC> to return to the Main Screen.
- xiii) Press <RUN/STOP> to run the program. Note that the Mode should show “WAIT” until the user-defined sampling conditions are met for next filter to be exposed.
- xiv) Record any abnormal events or problems in the log sheet (Appendix A-2).

## 4.5 Post-Sampling

Details of the post-sampling field operation must be recorded in the Field Operation Log Sheet (Appendix A-2).

- 4.5.1 Remove the storage magazine containing the sampled filters. Put a clean dummy filter gently on topmost of the storage magazine (Remark :DO NOT press it hard into the magazine) before the magazine is capped in order to reduce the clearance between the cap and the magazine. It helps minimize the movement of sampled filters inside the magazine during transportation.
- 4.5.2 Place the capped magazine in a metal transport container. Then properly seal the container in an air-sealed plastic bag before placing it into an ice box with frozen blue ice inside. Return the magazine to the laboratory within eight hours after retrieving from sampler.  
**Note** : “Blue Ice” packs must be separated from the samples by keeping it inside separate air-sealed Zip-lock bags to avoid accidental leakage.
- 4.5.3 Remove the cap of a clean empty magazine and then put this magazine into the cassette storage position of the sampler to facilitate a new sample collection.
- 4.5.4 Press <RUN/STOP> to Stop Mode.
- 4.5.5 Press <F4: Data> to Filter Data Times Screen.
- 4.5.6 Record the average flow rate, CV, actual sampled air volume, valid elapsed time and status code of each filter. You should press <F3: Moredat>, <F1: - Rec> or <F2: +Rec> to find out the above data.
- 4.5.7 Press <F4: Intvdat> to enter the Interval Data Screen.

- 4.5.8 Record the initial flow rate (at the time 00:10) and final flow rate (at the time 24:00) of each filter by pressing <F1: -Rec> or <F2: +Rec> to find out.
- 4.5.9 Press <ESC> to return the Main Screen.
- 4.5.10 Connect a portable computer (PC) to the sampler with the 9-pin to 9-pin RS232 cable. Use AKCOMM or any other data transfer program to transfer data from sampler to PC.
- 4.5.11 Press <F4: Data> to the Filter Data Times Screen.
- 4.5.12 Press <F5: DwnLoad> to Download Data Screen.
- 4.5.13 Run the AKCOMM program in the PC.
- 4.5.14 Set storage pointer at the beginning in the PC.
- 4.5.15 Select Download Storage, and then press <Enter>.
- 4.5.16 Enter number of data to be downloaded. Type “A” for download all data, and then press <Enter>.
- 4.5.17 Input storage file name (e.g. F1001023.fil; F1-equipment no., 00-year, 10-month, 23-day, .fil-filter data), and then press <Enter>.
- 4.5.18 Download the data in progress.
- 4.5.19 When the filter data was downloaded, press <ESC> of the sampler to return Filter Data Times Screen.
- 4.5.20 Press <F4: IntvDat> to the Interval Data Screen.
- 4.5.21 Press <F5: DwnLoad> to Download Data Screen.
- 4.5.22 Set storage pointer at the beginning in the PC.
- 4.5.23 Select Download Storage, and then press <Enter>.
- 4.5.24 Enter number of data to be downloaded. Type “A” for download all data, and then press <Enter>.
- 4.5.25 Input storage file name (e.g. F1001023.int; F1-equipment no., 00-year, 10-month, 23-day, .int-interval data), and then press <Enter>.
- 4.5.26 Download the data in progress.
- 4.5.27 When the filter data was downloaded, press <ESC> of the sampler to return Interval Data Screen.
- 4.5.28 Press <F4: InptDat> to the Input Data Screen.
- 4.5.29 Press <F5: DwnLoad> to Download Data Screen.
- 4.5.30 Set storage pointer at the beginning in the PC.
- 4.5.31 Select Download Storage, and then press <Enter>.
- 4.5.32 Enter number of data to be downloaded. Type “A” for download all data, and then press <Enter>.
- 4.5.33 Input storage file name (e.g. F1001023.inp where F1 = equipment no.; 00 = year; 10 = month; 23 = day; .inp = input data), and then press <Enter>.
- 4.5.34 Download the data in progress.
- 4.5.35 When the filter data was downloaded, press <ESC> twice to return to the Main Screen.
- 4.5.36 Verify your downloaded data files.
- 4.5.37 Record any abnormal events or problems in the log sheet.

## **5. QUALITY CONTROL/ASSURANCE AND MAINTENANCE**

All quality checks must be carried out by a competent field staff with traceable standards/ equipment certified by an accredited laboratory. Failure in anyone of the following checks must be verified immediately. No sampling will be allowed until the problems are solved satisfactorily. Checks must be repeated to bring home the satisfaction. If the problem cannot be fixed before the next sampling day, the sampler shall be replaced by a new one at least one day before the next sampling day.

### **5.1 Monthly One-Point Verification Check**

Monthly one-point verification check for various sensors should be performed and recorded in the “PM2.5 Sampler Monthly One Point Verification Check Log Sheet” (Appendix A-3).

#### **5.1.1 Ambient Air Temperature Verification**

- i) Press <Stats> to enter the “Temp/Pressure” screen from Main Screen.
- ii) If the verification will be done at ambient condition, the reference temperature measurement can be taken with the probe installed in the radiation sensor.
- iii) After the reference thermometer and sampler probe are equilibrated at temperature for at least 5 minutes, record the data into log sheet.
- iv) Verify that the value of Ambient Temp displayed in Temp/Pressure Screen is within  $\pm 2^{\circ}\text{C}$  of the measured temperature. If this is not the case, perform the filter temperature calibration procedure described in Section 3.1.

#### **5.1.2 Filter Compartment Temperature Verification**

- i) Press <Stats> to enter the “Temp/Pressure” screen from Main Screen.
- ii) Determine the current temperature ( $^{\circ}\text{C}$ ) at the location of the filter compartment probe in the ventilated filter compartment of the sampler using an external thermometer.
- iii) After the reference thermometer and sampler probe are equilibrated at temperature for at least 5 minutes, record the data into log sheet.
- iv) Verify that the value of Filter Comp Temp displayed in Temp/Pressure Screen is within  $\pm 2^{\circ}\text{C}$  of the measured temperature. If this is not the case, perform the filter temperature calibration procedure described in Section 3.3.

#### **5.1.3 Filter Temperature Verification**

- i) Insert a filter cassette without screen in the topmost position of the filter cassette

- supply tube. Insert supply magazine into the sampler.
- ii) Press <MENU> to display the Master Menu. Scroll to the Service Menu, then press <Enter>.
  - iii) Press <F2: Audit> to display the Audit screen.
  - iv) Press <F4:FiltAdv>. Wait for filter change to complete.
  - v) Note the location of the filter temperature probe in the sampling platform of the ventilated filter compartment.
  - vi) Unlatch and open the top cover of the sampler.
  - vii) Remove the WINS Impactor.
  - viii) Put a reference thermometer through the hole into the sampling platform.
  - ix) After the reference thermometer and sampler probe are equilibrated at temperature for at least 5 minutes, record the data into log sheet.
  - x) Verify that the value of Filt Temp displayed in Audit Screen is within  $\pm 2^{\circ}\text{C}$  of the measured temperature. If this is not the case, perform the filter temperature calibration procedure described in Section 3.2.
  - xi) Reinstall the WINS Impactor.
  - xii) Close and latch the top cover of the sampler.

#### 5.1.4 Ambient Pressure Verification

- i) Determine the current ambient station pressure in mmHg (absolute pressure, do not correct to sea level) by reference barometer.
 

**Hint :** To convert from atmospheric pressure at 0 °C to mmHg, multiply by 760.  
To convert from millibars to mmHg, multiply by 0.75012.
- ii) Record the readings of the sampler in the Audit Screen and the reference barometer in the log sheet.
- iii) Verify that the value for “AmbPres” in the Audit Screen is within  $\pm 10\text{mmHg}$  of the measured ambient pressure. If this is not the case, perform the ambient pressure calibration procedure described in Section 3.4.

#### 5.1.5 External Leak Check

- i) Press <F5: LeakChk> to display the Leak Check screen.
- ii) Insert a filter cassette containing a new 47mm filter in the topmost position of the filter cassette supply tube.
- iii) Press <F4:FiltAdv>. Wait for filter change to complete.
- iv) Remove the sample inlet from the external sample tube.
- v) Install the flow audit adapter on the end of the tube.
- vi) Close the valve on the flow audit adapter.
- vii) Press <F2: Start>. After the prompt, press <F1: External> to select the external

leak check.

- viii) Follow instructions displayed on screen.
- ix) Sampler will automatically pull vacuum and check for flow.
- x) A pass or a fail message will display at the end of the leak check cycle.  
Remark : Pressure drop of 25mmHg/min or less is the “Pass” criteria of leak check.
- xi) Upon the completion of leak check cycle, record the pressure drop rate and slowly open the valve on the flow audit adapter.
- xii) If a leak check fail message is displayed on the screen, insert a filter cassette containing a new 47mm filter in the topmost position of the filter cassette supply tube and repeat the leak check procedure.
- xiii) Repeat test or make repairs if necessary to achieve minimal leakage.
- xiv) After a successful leak check, slowly open the valve on the flow audit adapter.

### 5.1.6 Flow Rate Verification

- i) Press <**F5: Audit**> to display the Audit screen.
- ii) Connect the soft tube between the Flow Audit Adapter and Bios Flow Calibrator Transfer Standard.
- iii) Press <**F1: Pump**> then press <**F2: Valve**>.
- iv) Wait for the flow to stabilize, then record the readings of the sampler and flowmeter, e.g. BIOS, in the “Monthly One Point Verification Check Log Sheet”.
- v) Verify that the current flow is within  $\pm 4\%$  of the measured flow. If this is not the case, perform the flow calibration procedures following procedures in Section 3.6.

### 5.1.7 Internal Leak Check

- i) Press <**F5: LeakChk**> to display the Leak Check screen.
- ii) Insert a filter cassette containing leak check disk (the screen should be removed before installing the leak check disk) in the topmost position of the filter cassette supply tube. Insert supply magazine into the sampler.
- iii) In the Leak Check Screen, press <**F4: FiltAdv**> to move the leak check cassette into the sampling position. Wait for filter change to complete.
- iv) Press <**F2: Start**>. Press <**F2: Internl**> to select internal leak check. Follow instructions in the display to complete leak check.
- v) The Partisol-Plus sampler will run an automatic leak check, and report either a pass or fail message. A pressure drop of 140mmHg/min or less is the sampler’s leak check pass criteria.
- vi) If a failure message has displayed, clean the cassette and leak check disk carefully. Examine the cassette and disk for any external nicks or scratches. Discard any damaged cassette or disks, and re-run the test with a clean, undamaged cassette and



leak check disk.

- vii) When a pass message is displayed, remove the flow audit adapter from the external sample tube and reinstall the sample inlet previously removed.
- viii) Press <F4: FiltAdv> to move the leak check cassette to the storage magazine and the dummy cassette into the sampling position.
- ix) Press <MENU> to display the Master Menu. Scroll to the “Exit Service Mode”, then press <Enter>.

## 5.2 Cleaning the First Stage Inlet

### 5.2.1 Supplies and tools recommended for maintenance :

ammonia-based general purpose cleaner	cotton swabs
small soft-bristle brush	paper towels
distilled water	silicone-based stopcock grease
small screwdriver	small crescent wench
pocket knife	

A cleaning and maintenance interval should be one month of continuous operation for PM2.5, involving its removal, cleaning, and an O-ring check.

### 5.2.2 Removing and Disassembling the Inlet

- i) Remove the First Stage inlet, gently lift the complete inlet upward off the 1.25" OD sample tube.
- ii) Disassemble the upper and lower inlet halves by unscrewing counterclockwise the top acceleration assembly from the lower collector assembly (Figure 5-1).

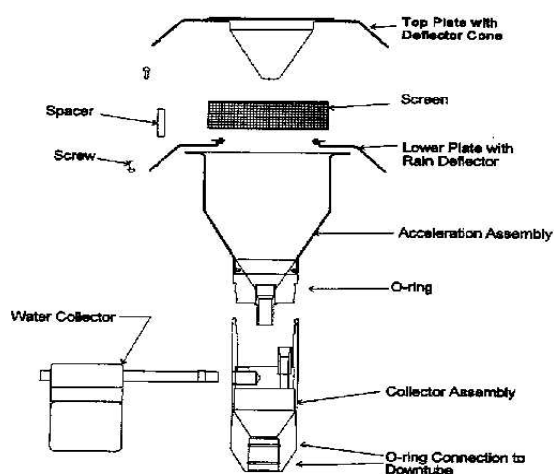


Figure 5-1 First Stage Inlet

### 5.2.3 Maintenance of the Top Acceleration Assembly

- i) Mark the top plate deflector cone and lower plate with a pencil scribe to facilitate proper orientation for easier reassembly after cleaning and maintenance.
- ii) Using a phillips-blade screwdriver, remove the four pan head screws from the top of the top plate, and lift the top plate off the four threaded spacer standoffs and set aside.
- iii) Inspect the insect screen for contamination and clean by lifting the screen off the lower plate rain deflector and brush or rinse with water until clean. Dry and reinstall.
- iv) Using a general-purpose cleaner and paper towel, clean the top plate deflector cone and internal wall surface of the acceleration assembly.  
**Note :** Be sure that after cleaning the acceleration nozzle is clean. If not, use a cotton swab and cleaner to remove contamination.
- v) Inspect the large diameter impactor nozzle O-ring for wear. Replace, if necessary, or using a light coating of silicone grease, apply a thin film on the O-ring itself, and likewise a small light coating on the aluminum threads of the acceleration assembly.
- vi) After reinstalling the bug screen, align the top plate markings with the lower plate markings. The four holes in the top plate should align with the four spacer standoffs. Insert and tighten securely the four pan-head screws.

### 5.2.4 Maintenance of the Lower Collector Assembly

Most of the contamination in the inlet is found on the collector plate. The threads should be cleaned to facilitate a tight seal when the two halves are reassembled.

- i) Using a general-purpose cleaner with a paper towel, clean the collector assembly walls and three vent tubes. A cotton swab may be necessary to clean these vent tubes. Likewise, clean the bottom side of the collector assembly.
- ii) Using a cotton swab, also clean the weep hole in the collector plate where the moisture runs out to the moisture trap. Remove the rain jar and clean. Inspect the brass nipple fitting to ensure tightness and non-blockage. When reinstalling the rain jar, place a light coating of silicone grease on the gasket inside the cap of the rain jar. This will ensure a leak-free fit.
- iii) Inspect the two inlet-to-inlet tube sealing O-rings for wear. Replace, if necessary. Use a light coating of silicone grease on these O-rings to ensure that a seal is made when reinstalled on the 1 1/4" OD sample tube.

### 5.2.5 Re-Assembly and Re-Installation

- i) Reassemble the top and bottom inlet assemblies until the threads tighten. Hand-tighten only.
- ii) Carefully place the inlet back on top of the 1 1/4" OD sample tube. Take care not to damage the internal O-rings.

### 5.3 Cleaning the WINS Impactor

The procedures below describe the removal, cleaning and reinstallation of the WINS PM-2.5 Impactor (Figure 5-2).

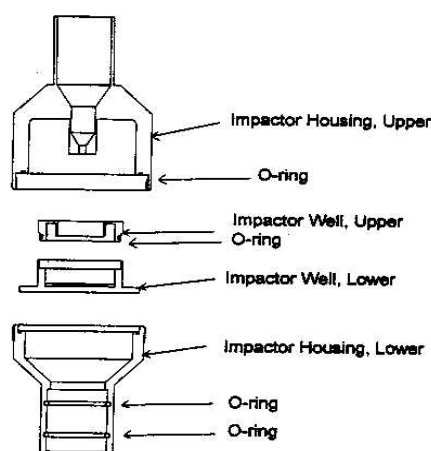


Figure 5-2 PM2.5 WINS Impactor

5.3.1 If the sampler is currently in the Wait or Done Operating Modes, press <RUN/STOP> and select STOP to enter the Stop Operating Mode. This suspends normal system operations for the exchange of the WINS impactor.

**Note :** No action is required if the sampler is in the Stop or Error Operating Modes.

5.3.2 Unlatch and open the top cover of the Partisol-Plus Sampler with the down tube and first-stage inlet attached to gain access to the WINS impactor.

5.3.3 Lift the WINS impactor out of the upper part of the sampler enclosure. The WINS impactor is connected to an adapter that makes contact with the external down tube.

5.3.4 The WINS impactor is connected on its top side to an adapter that makes contact with the external down tube. Separate the WINS impactor from its adapter.

5.3.5 Unscrew the middle Section of the WINS impactor to remove its top piece from the bottom. This exposes the impactor well. Remove the impactor well from the bottom Section of the WINS impactor (Figure 5-3).

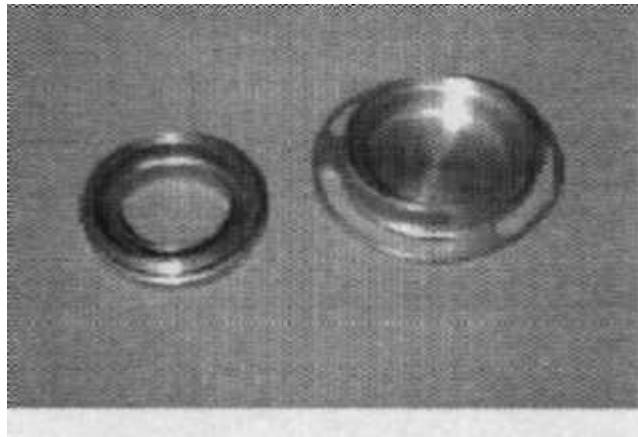


Figure 5-3 Impactor Well

- 5.3.6 With a dry lint-free paper towel, wipe off the Inside surfaces of the WINS impactor. A general purpose cleaner can be used, if necessary.
- 5.3.7 Inspect all O-rings in the top and bottom Sections of the WINS impactor for damage and replace, if necessary. Place a thin coating of O-ring lubricant onto the O-rings, if necessary.
- 5.3.8 Remove the top of the impactor well by lifting upward.
- 5.3.9 Remove any filter previously Installed, and clean the top and bottom of the impactor well using a dry lint-free paper towel. A general purpose cleaner can be used, if necessary.
- 5.3.10 Inspect the O-ring in the top Section of the impactor well for damage and replace, if necessary. Place a thin coating of O-ring lubricant onto the O-ring, if necessary.
- 5.3.11 Place a new 37 mm borosilicate glass fiber filter (R&P part number 32-004294) onto the bottom of the impactor well.
- 5.3.12 Place 42 to 44 drops of impactor oil (tetramethyl tetraphenyltri-siloxane or R&P part number 59-004292) onto the glass-fibre filter (Figure 5-4).

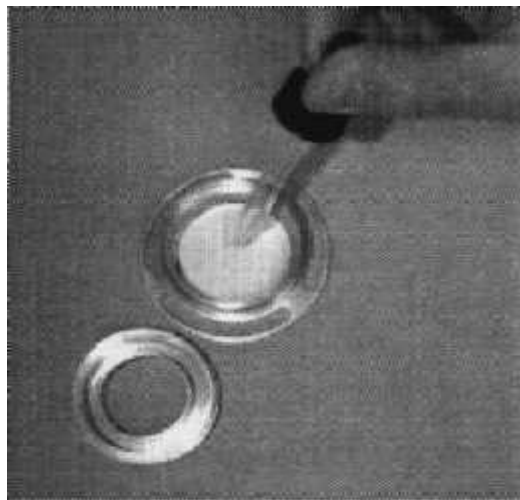


Figure 5-4 : Coating the 37mm glass-fibre filter with oil (tetramethyl tetraphenyltri-siloxane)

- 5.3.13 Place the top onto the bottom of the impactor well.
- 5.3.14 Place the impactor well into the bottom Section of the WINS impactor.
- 5.3.15 Screw the top of the WINS impactor back onto the bottom Section. Ensure that the WINS impactor remains in the upright orientation so that the oil in the impactor assembly does not spill.
- 5.3.16 Reinstall WINS impactor to the sampler and close the top cover of sample.

#### 5.4 Quality Control Activity and Frequency

	Quality Control Activity	Frequency
1	Competence of operators : i) Examine the competence on filter handling and equipment operation ii) Reassessment	i) Before start of the project ii) Yearly
2	General inspection on siting environment, equipment installation & safety	Every site visit
3	Overhaul cleaning of sampler, down-tube and the 1st stage sampling inlet	Monthly
4	Clean/change the filters of ventilation fans	Monthly
5	Clean the WINS impactor and replace the 37mm glass-fiber filter in its well	Every sampling cycle (i.e. three 24-hour samplings in six days) or Every five 24-hour samplings
6	Dynamic Calibration : - Flow rates at 15.0, 16.7 & 18.4 L/min - Internal and external temperatures - Ambient pressure - Time - Subsequent leak checks after calibration : Internal check : pressure drop $\leq 25$ mmHg/min External check : pressure drop $\leq 140$ mmHg/min - Subsequent flow check after calibration : Flow rate audit at 16.7 L/min : $\leq \pm 2\%$ of HKSCS-traceable standard; & $\leq \pm 5\%$ of design flow 16.67 L/min	i) Half-yearly, or ii) Upon installation, or iii) After pump replacement or major repair, or iv) After major maintenance on flow control device, or iv) After sampler relocation, or v) Flow rate, temperature or pressure found to be out of acceptable limit in the monthly one-point verification check
7	One-point verification check : - Internal leak check : pressure drop $\leq 25$ mmHg/min - External leak check : pressure drop $\leq 140$ mmHg/min - Temperatures audit : $\leq \pm 2^\circ\text{C}$ - Pressure audit : $\leq \pm 10$ mmHg - Flow rate audit at 16.7 L/min : $\leq \pm 4\%$ of HKSCS-traceable standard; & $\leq \pm 5\%$ of design flow 16.67 L/min - Time audit : $\leq \pm 1$ min	Monthly
8	Large in-line filter	Every six months

	<b>Quality Control Activity</b>	<b>Frequency</b>
9	External/internal leak check : - Internal leak check : pressure drop $\leq$ 25 mmHg/min - External leak check : pressure drop $\leq$ 140 mmHg/min	After cleaning the WINS impactor
10	Pump replacement	Every 18 months
11	Filter holding time : - Pre-sampling : less than 30 calendar days since the pre-sampling filter weighing - Post-sampling : collect samples within 4 calendar days after end of the last sampling	Every sampling cycle
12	Field blank collection	Every sampling cycle : One per sampler per site (either quartz or Teflon according to schedule)
13	Precision check by collocated sampling : - CV of mass concentration $\leq$ 10%	Two out of every three samplings per site (Either quartz vs quartz or Teflon vs Teflon according to the sampling schedule)
14	Re-certify the working standards i) Flowmeter ii) Glass thermometer iii) Portable barometer iv) Digital timer/watch	i) Yearly ii) Half-yearly iii) Half-yearly iv) Quarterly
15	Performance audit by an independent audit team using independent standards traceable to the primary reference standards or at least the certified reference material (CRM) standards.	Quarterly

Details for the above refer to the USPEA Quality Assurance Handbook 2.12 and the manufacturer's Operating Manual.

## 6. REFERENCE

- (1) USEPA Quality Assurance Guidance Document 2.12: Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference of Class I Equivalent Methods
- (2) Federal Register / USEPA Appendix L of 40 CFR Part 50 (EPA 1997a)
- (3) Rupprecht & Patashnick's Operating Manual for Partisol-Plus Model 2025 Sequential Air Sampler
- (4) USEPA Quality Assurance Document: Quality Assurance Project Plan for the PM<sub>2.5</sub> Performance Evaluation Program

**Environmental Protection Department**  
**Air Services Group**  
**PM2.5 Sampler Half-Yearly Dynamic Calibration Log Sheet**

Site ID: TW / MK / RU / \_\_\_\_\_ \* Site Name: Tsuen Wan ./ Mong Kok / Hok Tsui / \_\_\_\_\_ \*

Sampler Model: Partisol-Plus Model 2025 Equipment No.: \_\_\_\_\_ Date of Visit: \_\_\_\_\_

**Transfer Standard Instruments:**

Volumetric Flow meter: \_\_\_\_\_ S/N \_\_\_\_\_ Expiration Date \_\_\_\_\_

Thermometer: \_\_\_\_\_ S/N \_\_\_\_\_ Expiration Date \_\_\_\_\_

Barometer: \_\_\_\_\_ S/N \_\_\_\_\_ Expiration Date \_\_\_\_\_

**Temperature Calibration:**

Starting Time: \_\_\_\_\_

Sampler's Indicated Temperature, °C ( $T_{ind}$ )			Measured Temperature, °C ( $T_{ref}$ )		
Ambient	Filter	Filter Compartment	Ambient	Filter	Filter Compartment
1.					
2.					
3.					
Avg	Avg	Avg	Avg	Avg	Avg

Have you entered the measured reference temperature ( $T_{ref}$ ) to the sampler for adjustment? Yes / No\*

**Pressure Calibration:**

Starting Time : \_\_\_\_\_

Sampler's Indicated Pressure, mmHg ( $P_{ind}$ )	Measured Pressure, mmHg ( $P_{ref}$ )
1.	
2.	
3.	
Avg.:	Avg.:

Have you entered the measured reference pressure ( $P_{ref}$ ) to the sampler for adjustment? Yes / No\*

**Leak Check:**

Starting Time: \_\_\_\_\_

External Leak Check		Internal Leak Check	
Trial	Indicated Pressure Drop Rate, (mm Hg/min)	Trial	Indicated Pressure Drop Rate, (mm Hg/min)
1		1	
2		2	
3		3	

Remarks: 1 mbar= 0.75012 mmHg

A pressure drop of 25mmHg/min or less for external leak check is pass criteria.

A pressure drop of 140mmHg/min or less for internal leak check is pass criteria.

Repeat test or make repairs, if necessary, to pass the leak check.

Does the sampler pass the leak check? Yes / No\*

\*Delete as appropriate

D:\CKWONG\PM25-2000\Forms\Half-Yearly Calibration.DOC, Rev(2)

**Environmental Protection Department**  
**Air Services Group**  
**PM2.5 Sampler Half-Yearly Dynamic Calibration Log Sheet**

**Flow Calibration:** Starting Time: \_\_\_\_\_  
 Flow Check Device Calibration Relationship: Slope \_\_\_\_\_ Intercept \_\_\_\_\_ r: \_\_\_\_\_

3-Point Calibration (range: 15.0 ~ 18.4 L/min)	Sampler's Indicated Actual Flow Rate, L/min ( $Q_{ind}$ )	Measured Actual Flow Rate, L/min ( $Q_{ref}$ ) <sup>@</sup>
Min Flow: 15.0		
Med Flow: 16.7		
Max Flow: 18.4		

<sup>@</sup> 10 consecutive measurements should be taken and averaged for a reading

Have you entered the measured reference flow rate ( $Q_{ref}$ ) to the sampler for adjustment? Yes / No\*  
 After calibration, please perform one-point check (16.7L/min) to verify the actual flow rate.

1-Point Check	Sampler's Indicated Actual Flow Rate, L/min ( $Q_{ind}$ )	Measured Actual Flow Rate, L/min ( $Q_{ref}$ ) <sup>@</sup>
16.7 L/min		

<sup>@</sup> 10 consecutive measurements should be taken and averaged for a reading

Percent Difference from Reference Measured Flow Rate (a): \_\_\_\_\_ (Limit : +/- 2%)

(a) Percent Difference =  $[(Q_{ind} - \text{Average } Q_{ref}) / \text{Average } Q_{ref}] \times 100$

Percent Difference from Design Flow Rate (b): \_\_\_\_\_ (Limit : +/- 5%)

(b) Percent Difference =  $[(Q_{ind} - 16.67) / 16.67] \times 100$

Is the Sampler within the limits? Yes / No\* (if No, verify again after calibration)

**Time Calibration:**

Sampler's Indicated Time: \_\_\_\_\_ Reference Time: \_\_\_\_\_

Have you entered the reference time to the sampler for adjustment? Yes / No\*

**Remarks:**

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Completed by: \_\_\_\_\_  
 ( \_\_\_\_\_ )

Date: \_\_\_\_\_

Supervised by: \_\_\_\_\_  
 ( \_\_\_\_\_ )

Date: \_\_\_\_\_



\*Delete as appropriate

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**Field Operation Log Sheet**

Site ID: TW / MK / RU / \* Site Name: Tsuen Wan / Mong Kok / Hok Tsui / \*  
 Sampler Model: Partisol-Plus Model 2025 Equipment No.: \_\_\_\_\_ Batch No.: \_\_\_\_\_

**A) Pre-Sampling:**

Pre-Sampling Worked By: \_\_\_\_\_

Date of Visit: \_\_\_\_\_ Arrival Time: \_\_\_\_\_ Departure Time: \_\_\_\_\_

**Operation Procedures:**

Completed (mark ✓ as appropriate)

1. Retrieve all post-sampling filters.
2. Clean the sampler and its head as scheduled.
3. Clean WINS Impactor and renew its filter.
4. Perform leak check.

External Leak Check		Internal Leak Check	
Trial	Indicated Pressure Drop Rate, (mmHg/min)	Trial	Indicated Pressure Drop Rate, (mmHg/min)
1		1	
2		2	
3		3	

Remarks: 1 mbar= 0.75012 mmHg

A pressure drop of 25mmHg/min or less for external leak check is pass criteria.

A pressure drop of 140mmHg/min or less for internal leak check is pass criteria.

Repeat test or make repairs, if necessary, to pass the leak check.

5. Perform half-yearly dynamic calibration as scheduled.
6. Perform monthly one-point verification check as scheduled.
7. Install a supply magazine in the left side and a clean empty storage magazine on the right side.
8. Program the sampler for sampling runs according to the following sequence.

**Programming:**

Supply Magazine ID: \_\_\_\_\_

Sequence of samples is as follows:

	Description (Sample ID)	Filter ID	Cassette ID	Sampling Date (yyyy/mm/dd)	Field Blank / Dummy
1.	Sample1:		RP	/ /	No
2.	Sample2:		RP	/ /	No
3.	Sample3:		RP	/ /	No
4.	Field Blank/ Dummy*:		RP	/ /	Yes
5.	Dummy	--	RP	/ /	Yes

9. Press <RUN/STOP> to "RUN" Mode or "WAIT" Mode.

**Remarks:**


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**Field Operation Log Sheet**

**B) Post-Sampling:**

Post-Sampling Worked By: \_\_\_\_\_

Date: \_\_\_\_\_ Arrival Time: \_\_\_\_\_

Departure Time: \_\_\_\_\_

**Operation Procedures:**

Completed (mark ✓ as appropriate)

- 1. Retrieve all post-sampling filters and store into transport container.
- 2. Press <RUN/STOP> to Stop Mode.
- 3. Record the data into the following table.

Storage Magazine ID: \_\_\_\_\_

	Cassette Description (Sample ID)	Filter ID	Cassette ID	Initial Flow (L/min) [00:10]	Final Flow (L/min) [24:00]	Ave. Flow (L/min)	CV (%)	Actual Sampled Air Volume (m <sup>3</sup> )	Valid Elapsed Time (hh:mm)	Status Code
1.	Sample1:		RP							
2.	Sample2:		RP							
3.	Sample3:		RP							
4.	Field Blank/ Dummy*:		RP	--	--	--	--	--	--	
5.	Dummy	--	RP	--	--	--	--	--	--	

- 4. Download the data into Notebook computer, handheld personal computer or personal digital assistant (PDA).  
 Filter Data filename: \_\_\_\_\_ (e.g. F1001108.fil)  
 Interval Data filename: \_\_\_\_\_ (e.g. F1001108.int)  
 Input Data filename: \_\_\_\_\_ (e.g. F1001108.inp)   
 #(F1-equipment no, 00-year, 11-month, 08-day, .fil-filter data, .int-interval data, .inp-input data)

**Remarks:**

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**PM2.5 Sampler Monthly One Point Verification Check Log Sheet**

Site ID: \_\_\_\_\_ Site Name: \_\_\_\_\_  
 Sampler Model: Partisol-Plus Model 2025 Equipment No.: \_\_\_\_\_ Date of Visit: \_\_\_\_\_

**Transfer Standard Instruments:**

Volumetric Flow meter: \_\_\_\_\_ S/N \_\_\_\_\_ Expiration Date \_\_\_\_\_  
 Thermometer: \_\_\_\_\_ S/N \_\_\_\_\_ Expiration Date \_\_\_\_\_  
 Barometer: \_\_\_\_\_ S/N \_\_\_\_\_ Expiration Date \_\_\_\_\_

**Leak Check:**

Starting Time: \_\_\_\_\_

External Leak Check		Internal Leak Check	
Trial	Indicated Pressure Drop Rate, (mmHg/min)	Trial	Indicated Pressure Drop Rate, (mmHg/min)
1		1	
2		2	
3		3	

Remarks: 1 mbar= 0.75012 mmHg

A pressure drop of 25mmHg/min or less for external leak check is pass criteria.

A pressure drop of 140mmHg/min or less for internal leak check is pass criteria.

Repeat test or make repairs, if necessary, to pass leak check.

Does the sampler pass the leak check? Yes / No\***Temperature Verification:**

Starting Time: \_\_\_\_\_

Sampler's Indicated Temperature, °C (T <sub>ind</sub> )			Measured Temperature, °C (T <sub>ref</sub> )			Difference (T <sub>ind</sub> - T <sub>ref</sub> ), °C		
Ambient	Filter	Filter Compartment	Ambient	Filter	Filter Compartment	Ambient	Filter	Filter Compartment
1.						(Limit: +/-2°C)		
2.								
3.								
Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg

Does the Sampler pass the test? Yes / No\* (if No, verify again after calibration)**Pressure Verification:**

Starting Time: \_\_\_\_\_

Sampler's Indicated Pressure, mmHg (P <sub>ind</sub> )	Measured Pressure, mmHg (P <sub>ref</sub> )	Difference (P <sub>ind</sub> - P <sub>ref</sub> ), mmHg
1.		(Limit: +/- 10mmHg)
2.		
3.		
Avg.:	Avg.:	Avg.:

Does the Sampler pass the test? Yes / No\* (if No, verify again after calibration)**Flow Rate Verification:**

Starting Time: \_\_\_\_\_

Flow Check Device Calibration Relationship: Slope \_\_\_\_\_ Intercept \_\_\_\_\_ r: \_\_\_\_\_

Sampler's Indicated Actual Flow Rate, L/min (Q <sub>ind</sub> )	Measured Actual Flow Rate, L/min (Q <sub>ref</sub> )
1.	
2.	
3.	
Avg.:	Avg.:

**PM2.5 Sampler Monthly One Point Verification Check Log Sheet**

Percent Difference from Reference Measured Flow Rate (a): \_\_\_\_\_ (Limit : +/- 4%)

(a) Percent Difference =  $[(\text{Average } Q_{\text{ind}} - \text{Average } Q_{\text{ref}}) / \text{Average } Q_{\text{ref}}] \times 100$

Percent Difference from Design Flow Rate (b): \_\_\_\_\_ (Limit : +/- 5%)

(b) Percent Difference =  $[(\text{Average } Q_{\text{ind}} - 16.67) / 16.67] \times 100$

Does the Sampler pass the test? Yes / No\* (if No, verify again after calibration)

**Time Check:**

Sampler's Indicated Time: \_\_\_\_\_

Reference Time: \_\_\_\_\_

(Limit: +/- 1 minute)

Does the Sampler pass the test? Yes / No\* (if No, verify again after calibration)

**Remarks:**

\_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_

Operator's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Supervisor's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

\*Delete as appropriate

## Status Codes of Partisol-Plus Model 2025 Sequential Air Sampler

<u>Code</u>	<u>Definition</u>
OK	<i>No current status conditions.</i>
M	<i>Flash Memory.</i> The sampler detected an error in its flash memory.
C	<i>Calibration.</i> A failure occurred in the sampler's automatic analog in its calibration routine.
Y	<i>System Reset.</i> The system performed an unanticipated reset.
Z	<i>Power Failure.</i> A power outage occurred during sampling on the current filter. Power outage events of less than 60 seconds are not logged by the sampler.
F	<i>Flow Out of Range.</i> The measured sample flow rate through the flow channel deviated by $\geq 5\%$ from its set point for more than 5 minutes.
S	<i>Flow Stop.</i> The measured sample flow rate through the flow channel deviated by $\geq 10\%$ from its set point for more than 60 seconds. This is a critical status condition, causing the sampler to enter the Error or Wait Operating Mode and the status lights inside and outside of the enclosure to blink.
A	<i>Ambient Sensors.</i> The ambient temperature sensor was not installed correctly or indicated an invalid value. For ambient temperature, this corresponds to a reading of less than $-60\text{ }^{\circ}\text{C}$ or greater than $70\text{ }^{\circ}\text{C}$ .
T	<i>Filter Temperature.</i> One of the filter compartment temperature sensors was not installed correctly or was out of range, i.e., less than $-60\text{ }^{\circ}\text{C}$ or greater than $70\text{ }^{\circ}\text{C}$ .
E	<i>Electronics Temperature.</i> The temperature of the instrument electronics compartment was outside of its usual operating range, i.e., less than $0\text{ }^{\circ}\text{C}$ or greater than $70\text{ }^{\circ}\text{C}$ .
R	<i>Filter Temperature Range.</i> The measured temperature of the filter exceeded the measured ambient temperature by more than $5\text{ }^{\circ}\text{C}$ for more than ten consecutive minutes.
X	<i>Filter Exchange Failed.</i> The sampler encountered a mechanical problem in attempting to exchange a filter cassette. This is a critical status condition, causing the sampler to enter the Error Operating Mode and the status lights inside and outside of the enclosure to blink.
O	<i>Coefficient of Variation 1.</i> The coefficient of variation of the sample flow rate, expressed as a percentage, was greater than 2 (2%) during the exposure of a filter.
P	<i>Elapsed Sample Period.</i> For sampling programs of $>12$ hour duration without conditional sampling, the sampler issues this status code if the elapsed time of a sample differed by $\pm 1$ hour from the selected duration. Sampling programs of less than 12 hours will not indicate an elapsed time error.
L	<i>Leak Check Failed.</i> This error code will appear if the leak check failed. A leak check fails if the vacuum created in the sampling system leaks at a rate of 25 mmHg or greater.
D	<i>Audit Performed.</i> This status condition indicates to the user that an audit was performed during sampling. It does not indicate an error. It is for information purposes only. This status code appears only in the filter data screen.
N	<i>No filters.</i> This status condition indicates that there are no filters left in the supply magazine.

In the case of multiple status conditions, the sampler displays the single or double letter abbreviation of all applicable flags in the status field of the Main Screen and other screen with a status condition field. For example, the sampler would display “ZR1” in the case of a power outage and filter temperature being out of range.