

**Compendium of Methods
for the Determination of
Inorganic Compounds
in Ambient Air**

Compendium Method IO-2.3

**SAMPLING OF AMBIENT AIR FOR PM₁₀
CONCENTRATION USING THE
RUPPRECHT AND PATASHNICK (R&P)
LOW VOLUME PARTISOL® SAMPLER**

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Method IO-2.3

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Method IO-2.3
Sampling of Ambient Air for PM₁₀ Concentration
Using the Rupprecht and Patashnick (R&P)
Low Volume Partisol® Sampler

Using Low Volume Partisol® Sampler

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Chapter IO-2
INTEGRATED SAMPLING OF SUSPENDED
PARTICULATE MATTER (SPM)

Method IO-2.3
Sampling of Ambient Air for PM₁₀ Concentration
Using the Rupprecht and Patashnick (R&P)
Low Volume Partisol® Sampler

1. Scope

1.1 The area of toxic air pollutants has been the subject of interest and concern for many years. Recently the use of receptor models has resolved the elemental composition of atmospheric aerosol into components related to emission sources. The assessment of human health impacts resulting in major decisions on control actions by federal, state and local governments is based on these data. Accurate measures of toxic air pollutants at trace levels is essential to proper assessment.

1.2 Suspended particulate matter (SPM) in air generally is a complex multi-phase system of all airborne solid and low-vapor pressure liquid particles having aerodynamic particle sizes from below 0.01-100 μm and larger. Historically, SPM measurement has concentrated on total suspended particulates (TSP), with no preference to size selection.

1.3 The U. S. Environmental Protection Agency (EPA) reference method for TSP is codified at 40 CFR 50, Appendix B. This method uses a high-volume sampler to collect particles with aerodynamic diameters of approximately 100 μm or less. The high-volume samples 40 and 60 ft^3/min of air with the sampling rate held constant over the sampling period. The high-volume design causes the TSP to be deposited uniformly across the surface of a filter located downstream of the sampler inlet. The TSP high-volume can be used to determine the average ambient TSP concentration over the sampling period, and the collected material subsequently can be analyzed to determine the identity and quantity of inorganic metals present in the TSP.

1.4 Research on the health effects of TSP in ambient air has focused increasingly on those particles that can be inhaled into the respiratory system, i.e., particles of aerodynamic diameter less than 10 μm . Researchers generally recognize that these particles may cause significant, adverse health effects.

1.5 On July 1, 1987, the U. S. Environmental Protection Agency (EPA) promulgated a new size-specific air quality standard for ambient particulate matter. This new primary standard applies only to particles with aerodynamic diameters ≤ 10 micrometers (PM₁₀) and replaces the original rules for TSP. To measure concentrations of these particles, the EPA also promulgated a new federal reference method (FRM). This method is based on the fractionation of non-PM₁₀ particles from their size distribution, followed by filtration and gravimetric analysis of PM₁₀ mass on the filter substrate.

1.6 The new primary standard (adopted to protect human health) limits PM₁₀ concentrations to 150 $\mu\text{g}/\text{m}^3$ during a 24-h period. These smaller particles are able to reach the lower regions of the human respiratory tract and, thus, are responsible for most of the adverse health effects associated with suspended particulate pollution. The secondary standard, used to assess the impact of pollution on public welfare, has also been established at 150 $\mu\text{g}/\text{m}^3$.

1.7 Monitoring methods for particulate matter are designated by the EPA as reference or equivalent methods under the provisions of 40 CFR Part 53, which was amended in 1987 to add specific requirements for PM₁₀ methods. Part 53 sets forth functional specifications and other requirements that reference and equivalent methods for each criteria pollutant must meet, along with explicit test procedures by which candidate methods or samplers are to be tested against those specifications. General requirements and provisions for reference and equivalent methods are also given in Part 53, as are the requirements for submitting an application to the EPA for a reference or equivalent method determination.

1.8 Under the Part 53 requirements, *reference methods* for PM₁₀ must use the measurement principle and meet other specifications set forth in 40 CFR 50, Appendix J. They must also include a PM₁₀ sampler that meets the requirements specified in Subpart D of 40 CFR 53. Appendix J specifies a measurement principle based on extracting an air sample from the atmosphere with a powered sampler that incorporates inertial separation of the PM₁₀ size range particles followed by collection of the PM₁₀ particles on a filter over a 24-h period. The average PM₁₀ concentration for the sample period is determined by dividing the net weight gain of the filter over the sample period by the total volume of air sampled. Other specifications are prescribed in Appendix J for flow rate control and measurement, flow rate measurement device calibration, filter media characteristics and performance, filter conditioning before and after sampling, filter weighing, sampler operation, and correction of sample volume to EPA reference temperature and pressure. In addition, sampler performance requirements in Subpart D of Part 53 include sampling effectiveness (the accuracy of the PM₁₀ particle size separation capability) at each of three wind speeds and "50 percent cutpoint" (the primary measure of 10-micron particle size separation). Field tests for sampling precision and flow rate stability are also specified. In spite of the instrumental nature of the sampler, this method is basically a manual procedure, and all designated reference methods for PM₁₀ are therefore defined as manual methods.

1.9 The procedures for sampling SPM in ambient air for PM₁₀ based upon active sampling using a low-volume (16.7 L/min flow rate) air sampler are described in this compendium method. The ambient particle are collected on Teflon®-coated glass or Teflon® filters. The sampler collects PM₁₀ ambient particles. The sampler can be adapted with a 2.5 µm size-select inlet for the determination of fine particulate concentration.

1.10 The Partisol® air sampler, fitted with either a PM₁₀ or PM_{2.5} inlet, can be used with other types of particulate collection hardware such as filter packs and polyurethane foam (PUF) samplers.

2. Applicable Documents

2.1 ASTM Documents

- D1356 *Definition of Terms Related to Atmospheric Sampling and Analysis.*
- D1357 *Practice for Planning the Sampling of the Ambient Atmosphere.*

2.2 Other Documents

- STP598 Calibration in Air Monitoring
- U. S. Environmental Protection Agency, *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I: A Field Guide for Environmental Quality Assurance*, EPA-600/R-94-038a.
- U. S. Environmental Protection Agency, *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition)*, EPA-600/R-94-038b.
- *Reference Method for the Determination of Particulate Matter in the Atmosphere*, Code of Federal Regulations, 40 CFR 50, Appendix J.
- *Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method)*, 40 CFR 50, Appendix B.
- *Operations Manual*, Partisol® Model 2000 Air Sampler, Ruppecht and Patashnick, Albany, NY.

3. Summary

3.1 The Ruppecht and Patashnick (R&P) Low-Volume Partisol® Air Sampler is a microprocessor-controlled manual sampler with a unique set of features that make it a suitable platform for measuring particulate concentration, acid aerosol, and other constituents found in the atmosphere. When equipped with a PM₁₀ inlet and operated in its most basic mode, the hardware performs the same function as traditional high-volume PM₁₀ samplers. For source apportionment or traffic studies, the device can be set up to sample by wind velocity and/or direction or by time of day.

3.2 Ambient air is drawn through a low flow (16.7 L/min) PM₁₀ or PM_{2.5} inlet where particle size selection takes place.

3.3 The particulate-laden air is then directed through a collection filter composed of either quartz, Teflon®-coated glass, or Teflon® where the particulate matter is collected.

3.4 A mass flow control system maintains the sample flow through the system at the prescribed volumetric flow using information from sensors that measure the ambient temperature (°C) and ambient pressure (atmospheres). A piston pump creates a vacuum to draw the sample stream through the inlet, filter, and mass flow controller.

3.5 A microelectronics system provides the user with menu-driven programming and diagnostic and data storage capabilities.

3.6 The sample filter is conditioned and weighed both before and after sample collection to determine the amount of mass collected during the sampling period, which is 24 h for EPA reporting purposes. As is the case with all filter-based manual samplers, proper filter handling is an important element in computing valid mass concentration results.

4. Significance

4.1 Particulate concentration is a criteria pollutant for which the EPA has set health-related standards. In addition, a number of recently published studies point to a link between the concentration of particulate matter and human health-related indicators. In attempting to lower the overall concentration of particulate matter, agencies and private organizations use the conditional sampling capabilities of the Partisol® Sampler to help identify sources.

4.2 The airborne particulate collected on the 47-mm filter in the Partisol® Sampler may be subjected to a number of post-collection chemical analytical techniques to ascertain the composition of the material caught by the filter. Such techniques include X-ray fluorescence (XRF) spectrometry, graphite furnace atomic absorption (GFAA), inductively coupled plasma/mass spectroscopy (ICP/MS), PIXE, and others. The type of filter media should be compatible with the analytical method used.

4.3 To determine the concentration levels of polynuclear aromatic hydrocarbons (PAHs), dioxins, polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs) and pesticides in ambient air, the standard 47-mm filter holder/exchange mechanism can be replaced with a PUF sampler. An optional, multi-stage filter pack can be used to collect particulate, nitric acid, and other airborne constituents. An optional annular denuder system can be used to collect acid aerosols.

4.4 The hub and satellite configuration of the Partisol® Sampler makes it possible to perform conditional particulate measurements by time of day, wind direction, analog input or serial input. These modes of operation are in addition to the sampler's basic 24-h, midnight-to-midnight sampling program. The added capabilities listed above are important to individuals who would like to determine the sources of ambient particulate.

5. Definitions

[Note: Definitions used in this document are consistent with ASTM Methods. All pertinent abbreviations and symbols are defined within this document at point of use.]

5.1 Absolute Filter. A filter or filter medium of ultra-high collection efficiency that collects very small particles (submicrometer size) with an efficiency of 99.95% or higher for a standard aerosol of 0.3 μm diameter.

5.2 Aerodynamic Diameter. The diameter of a unit density sphere having the same terminal settling velocity as the particle in question. Operationally, the size of a particle as measured by an inertial device.

5.3 Aerosol. A dispersion of solid or liquid particles in gaseous media.

5.4 Ambient. Surrounding on all sides.

5.5 Calibration. The process of comparing a standard or instrument with one of greater accuracy (smaller uncertainty) to obtain quantitative estimates of the actual values of the standard being calibrated, the deviation of the actual value from a nominal value, or the difference between the value indicated by an instrument and the actual value.

5.6 Differential Pressure Meter. Any flow measuring device that operates by restricting air flow and measuring the pressure drop across the restriction.

5.7 Filter. A porous medium for collecting particulate matter.

5.8 Flow Meter. An instrument for measuring the rate of a fluid moving through a pipe or duct system. The instrument is calibrated to give volume or mass of flow.

5.9 Impaction. A forcible contact of particles of matter. A term used synonymously with impingement.

5.10 Impactor. A sampling device that employs the principle of impaction (impingement).

5.11 Inhalable Particles. Particles with aerodynamic diameters of $< 10 \mu\text{m}$ that are capable of being inhaled into the human lung.

5.12 Interference. An undesired positive or negative output caused by a substance other than the one being measured.

5.13 Mass Flow Meter. A device that measures the flow rate of air passing a point, usually using the rate of cooling or heat transfer from a heated probe.

5.14 Matter. The substance of which a physical object is composed.

5.15 Particulate. Solids or liquids existing in the form of separate particles.

5.16 Precision. The degree of mutual agreement between individual measurements, namely repeatability and reproducibility.

5.17 Sampling. A process of withdrawing or isolating a fractional part of a whole. In air or gas analysis, the separation of a portion of an ambient atmosphere with or without the simultaneous isolation of selected components.

5.18 Standard. A concept established by authority, custom, or agreement to serve as a model or rule in the measurement of quantity or the establishment of a practice or procedure.

5.19 Traceability to NIST. A documented procedure by which a standard is related to a more reliable standard verified by the National Institute of Standards and Technology (NIST).

5.20 Uncertainty. Any allowance assigned to a measured value to take into account two major components of error: the systematic error and the random error attributed to the imprecision of the measurement process.

5.21 Virtual Impaction. Impaction of particles on stagnant air rather than a solid plate.

5.22 Virtual Impactor. Sampler in which particle size separation is accomplished by impaction into an air stream of differing velocity rather than onto an impaction surface.

6. Apparatus Description

6.1 General Description

6.1.1 The R&P Low-Volume Partisol® sampling system may be composed of either a hub unit operating alone or a hub unit connected to as many as three satellite units (see Figure 1). The hub unit contains not only the sample inlet (PM₁₀ or PM_{2.5}) and 47-mm filter exchange mechanism found in the satellite units, but also a microprocessor with internal data storage, an active flow control system, and a pump. The satellite units are connected to the hub by flow lines that are activated by solenoid valves contained in the hub. Only one unit (either hub or satellite) can be active at any particular time. The user programs the system using menu-driven software to determine the conditions under which the hub or satellite units are active.

6.1.2 In its simplest form, the Partisol® Sampler is set up to collect particulate matter (PM₁₀ or PM_{2.5}) on a standard 47-mm filter disk for 24-h periods stretching from midnight to midnight. As with other manual sampling devices, the filters used in this procedure are conditioned and weighed before exposure, and then conditioned and weighed again after use to determine the mass of particulate collected during the 24-h exposure time. The Partisol® hardware stores the data relevant to each 24-h collection period in its internal data logger for viewing and/or retrieval after the fact. Such information includes the total volume (in terms of standard temperature and pressure), total collection time, average temperature, and average pressure during the collection period.

6.1.3 In addition to the sampler's basic 24-h midnight-to-midnight operating cycle, the hardware can also be operated manually. If the system is purchased with an optional advanced EPROM (electrically programmable read only memory) module, four additional advanced programming modes are available: to indicate time, meteorology, analog input from a data logger, and digital input.

6.1.4 Internal diagnostics determine whether any status conditions are present. These conditions are displayed on the main screen of the sampler and are stored in the internal memory of the hardware for later retrieval.

6.1.5 An analog output channel (0-5 VDC) can be set up to operate in one of two different modes: (1) to indicate which flow channel is currently in use and whether any status conditions are present; and (2) to indicate output changes in relation to the flow rate currently passing through the sampler.

6.1.6 Ambient temperature and pressure sensors maintain the flow through the sample inlet at the proper volumetric flow rate. The total flow volume for each collection filter is reported in mass terms according to the standard temperature and pressure entered by the user in the Setup Screen.

6.1.7 RS-232 communication capabilities allow for data retrieval into a personal computer or remotely through a modem. The selection of which sampling station is currently active can be controlled optionally through a digital transmission through the RS-232 connection to the Partisol® Sampler.

6.2 Flow System

6.2.1 The system flow schematic (see Figure 2) provides an overview of the hardware's flow and electronic connections, and depicts a PM₁₀ inlet on the hub unit as well as on three satellite units. The satellite units are connected to the hub through 10 m (20 m available optionally) flow lines that are controlled by solenoid valves in the hub unit. Only one sampling station (hub or satellite) is active at any given time. The system's solenoid valves are controlled by the embedded microprocessor in accordance with the sampling program defined by the user.

6.2.2 After the sample flow passes through the 47-mm filter or other installed collection hardware, it passes through the solenoid valve and an in-line filter that protects the mass flow sensor. The sampler measures the current atmospheric pressure (atmospheres) and ambient temperature (EC) to adjust the reading from the mass flow sensor so that the proper volumetric flow rate is maintained. While the vacuum pump constantly operates at full capacity, a servo valve allows varying rates of flow to enter the system so that the sample flow is maintained at its volumetric set point. The accumulator minimizes pulsation caused by the vacuum pump, while the manual shut-off valves and vacuum gauge are used in audit and calibration procedures.

6.2.3 The Partisol® maintains a constant volumetric flow rate through the hub and satellite units at the set point entered by the user, while reporting flow volumes (m³) in mass terms based upon standard temperature and pressure. The flow rate used must be appropriate for the inlets being used in the Partisol® system. The PM₁₀, PM_{2.5} and TSP inlets available from R&P operate at a flow rate of 16.7 L/min (1 m³/h).

6.2.4 The sampling hardware determines the ambient temperature and pressure for flow rate calculations in one of two different ways: (1) the temperature and pressure transducers measure the current ambient temperature (EC) and ambient pressure (atmospheres); or (2) if the sampler is installed in an indoor location where outdoor air is being sampled, the user can override the automatic temperature and pressure measurements by entering seasonal averages for temperature and pressure in the software.

6.2.5 The Partisol® Sampler displays in its Setup Screen the standard temperature (EC) and standard pressure (atmospheres) in which flow volumes are computed for regulatory reporting purposes. These values may be changed by the user. By default, the standard temperature is 25EC and the standard pressure is 1 atmosphere.

6.2.6 The mass flow meter in the sampler is calibrated at a temperature of 0EC and a pressure of 1 atmosphere (1013.2 millibars or 760 mm Hg). For the device to sample at the correct volumetric flow rate, it uses the measured (or entered) average temperature and pressure. Using this information, the microprocessor calculates the correct mass flow set point (Flow Rate_{STP}) using the following formula:

$$\text{Flow Rate}_{\text{STP}} = \text{Flow Rate}_{\text{Vol}} \times \frac{273.15}{\text{Ave Temp} + 273.15} \times \frac{\text{Ave Pres}}{1.0}$$

where:

- Flow Rate_{STP} = Control set point of the mass flow meter (equivalent flow at 0EC and 1 atmosphere).
- Flow Rate_{Vol} = Volumetric flow rate set point (L/min) as entered by the user in the Setup Screen of the sampler. This value is 16.7 L/min (1 m³/h) for most applications.
- Ave Temp = The current temperature (EC) as measured by the temperature transducer mounted on the sample tube of the hub unit or the value entered for average temperature by the user in the Setup Screen.
- Ave Pres = The current pressure (atmospheres) as measured by the pressure transducer in the hub unit, or the value entered for average pressure by the user in the Setup Screen.

6.2.7 Mass concentration data reported to the EPA must be referenced to standard cubic meters of air based on a standard temperature of 25EC and standard pressure of 1 atmosphere. For the instrument to report mass flow volumes according to this standard, the user must ensure that the standard temperature and

standard pressure parameters in the Setup Screen are set at their default values of 25EC and 1 atmosphere, respectively.

The flow rates referenced internally by the instrument to 0EC are converted to EPA standard conditions (25EC and 760 mmHg) using the following computation:

$$\text{Volume}_{\text{EPA}} = (\text{Volume}_{\text{STP}}) \left(\frac{\text{Std Temp} + 273.15}{273.15} \right) \left(\frac{1 \text{ Atm}}{1 \text{ Atm}} \right)$$

This “Volume_{EPA}” is the value displayed and stored by the Partisol® Sampler. This feature saves the user from having to make the conversion manually, as must be done with conventional high-volume samplers.

6.3 Microprocessor-Enabled Functions

6.3.1 The operation of the Partisol® Sampler is controlled by an embedded microprocessor equipped with a battery-backed, real-time clock and internal storage capability. The operator uses a display and keypad to interact with the system. The software allows the user to view the data, program the instrument, and set operating parameters (see Figure 3). The following is a brief description of the screens in the sampler.

6.3.1.1 The **Title Screen** appears when the user first turns on the sampler and contains the name of the instrument and software revision number.

6.3.1.2 The **Main Screen** displays the operating statistics for each installed unit on a separate line, including the volume of air drawn through each sampling station and the elapsed time that the unit was operating. In most programming modes, the Main Screen also allows the user to enter the conditions under which each sampling station is to be active. This screen also displays the presence of any status conditions currently detected by the sampler.

6.3.1.3 The **Programming Screen** is present in the Meteorological and Time programming modes and allows the user to enter the conditions under which each sampling station is to be active.

6.3.1.4 The **Statistics Screen** displays the current operating condition of the sampler, including the flow rate, ambient temperature and pressure, the status of serial and analog inputs, and the software version number.

6.3.1.5 The **Setup Screen** contains the basic configuration of the sampler, including the number of sampling stations, current programming mode, flow rate set point, type of analog output, current time and date, and standard and average temperatures and pressures.

6.3.1.6 The **Filter Data Screen** allows the user to scroll forward and backward through time to view the operating data corresponding to each filter exposed in the Partisol® Sampler. Data stored for each filter include the station number, time and date of first and last exposures, programming mode, volume and elapsed time during which the filter was exposed, average temperature, and average pressure.

6.3.1.7 The **Interval Data Screen** allows the user to scroll forward and backward through time to view half-hour summaries of the sampler's operation. Data stored for each 30 min period of operation include the length of time during which each sampling station was active, the average temperature and pressure, as well as the minimum, average, and maximum flow rate.

6.3.1.8 The **RS232 Setup Screen** allows the user to configure the Partisol® Sampler for two-way serial communication and includes the baud rate and data transmission protocol.

6.3.1.9 The **Calibration Screen** displays the values necessary for the user to perform audits and calibrations on the Partisol® Sampler.

6.3.1.10 The **Diagnostics Screen** displays the current state of the system's analog inputs and outputs and its digital outputs.

6.3.2 Programming Modes

The Partisol® Sampler can operate in a number of programming modes.

6.3.2.1 The **Basic** mode supports sample collection from midnight to midnight.

6.3.2.2 In the **Manual** mode, the user selects the currently active sampling station through direct keypad entry.

6.3.2.3 In the **Time** mode, the operation of the sampling stations is controlled according to time and date ranges entered by the user. This feature is included in the advanced EPROM.

6.3.2.4 In the **Meteorology** mode, the sampling stations is controlled by wind velocity and/or direction criteria entered by the user. This feature is included in the advanced EPROM and requires a compatible wind vane/anemometer to measure wind direction and velocity.

6.3.2.5 The **Analog Input** mode enables control of the sampler through an externally-generated analog input. This feature is included in the advanced EPROM.

6.3.2.6 The **Serial Input** mode allows the user to control the operation of the Partisol® Sampler through a two-way RS232 link. This feature is included in the advanced EPROM.

6.3.3 Status Conditions

The current status condition is displayed on the **Main Screen** of the Partisol® Sampler and is stored as part of the 30-min Interval Data. The following status definitions indicate the present condition of the sampler.

6.3.3.1 The **"OK"** condition means there are no current status conditions.

6.3.3.2 The **"F"** (Flow) condition occurs whenever the current volumetric flow rate varies more than 7% from the set point for the volumetric flow rate entered in the Setup Screen.

6.3.3.3 The **"T"** (Ambient Temperature) condition ensures that the ambient temperature sensor located on the sample tube of the hub unit measures correctly. This status occurs whenever the ambient temperature indicated by the temperature sensor is less than -40EC or greater than 60EC.

6.3.3.4 The **"P"** (Pressure Transducer) condition ensures that the ambient pressure sensor located in the hub unit measures correctly. This conditions occurs whenever the ambient pressure indicated by the pressure sensor is less than 0.4 atmospheres.

6.3.3.5 The **"I"** (Instrument Temperature) condition reacts to the internal temperature of the Partisol® Sampler as measured on one of its electronics boards. This diagnostic determines whether the temperature of the system electronics is approaching the operational limits; it is activated whenever the instrument temperature is less than 5EC or greater than 60EC.

6.3.3.6 The **"S"** (Serial Communication) condition indicates that a failure has occurred in the sampler's RS232 interface.

6.3.3.7 The **"E"** (Electrical Outage) condition indicates that an interruption has occurred in the supply of main power.

6.3.3.8 The **"R"** (Relay Control Hardware) condition indicates that a fault has occurred in the digital input/output section of the system electronics.

7. Filters

This section covers the initial inspection of 47-mm filters used in the Partisol® system, as well as the equilibration and weighing before use. Further, the procedure for filter insertion and removal is described along with the means by which post-collection equilibration and weighing occur and the computations involved in

determining the mass concentration. Follow the guidelines described in this section closely to ensure data quality.

7.1 Filter Media

A number of different media are available in the standard 47-mm size for use with the Partisol® Sampler. They are:

- Pallflex TX40 Filters.
- Teflon® Filters.
- Quartz Fiber Filters.

These media are currently acceptable for use in EPA equivalent and reference PM₁₀ instrumentation. All are suitable for particulate mass measurement; however, one type of media may be preferable to others depending upon the type of post-collection chemical speciation desired. Filter media may be used for EPA PM₁₀ reporting purposes as long as the material meets the collection efficiency, integrity, and alkalinity requirements of 40 CFR Part 50 Appendix J. Further, materials must have relatively low pressure drop characteristics so that the sampler can maintain the 16.7 L/min flow rate required for the PM₁₀ inlet during an entire 24-h sampling period.

7.2 Filter Handling and Inspection

Take deliberate care when handling and transporting sample filters. Quartz fiber filters are very brittle, while other type of material are susceptible to tearing.

[Note: Keep filters clean and never touch filters with fingers. Filters should be stored and transported in petri dishes. Only non-serrated forceps should be used to handle the 47-mm filters used with the sampler.]

Inspect each filter visually for integrity before use. Check for pinholes, chaff or flashing, loose material, discoloration, and non-uniformity.

7.3 Weighing of Filters

7.3.1 Filters ready for field use have been pre-weighed in the laboratory, under prescribed climate control conditions of temperature and relative humidity, using Inorganic Compendium Method IO-3.1, *Selection, Extraction and Preparation of Filter Material*.

7.3.2 Within Method IO-3.1, the user is provided guidance on proper selection of filter material in order to meet project specific data quality objectives (DQOs), how to visually inspect a new lot of filters for consistency and identification of defects, and initial weighing of the filters so a net concentration of particulate matter can be calculated after sampling.

7.3.3 The user should follow the procedures outlined within Method IO-3.1 as part of meeting the program's standard operating procedures (SOPs) and quality control (QC) requirements.

7.4 Filter Exchange

[Note: With the exception of the Basic programming mode, the sampler must be in the "Stop" operating mode before filters are exchanged. Press < F4: Run/Stp> when in the Main Screen to toggle between the "Run" and "Stop" operating modes. When in the Basic programming mode, leave the sampler in the "Run" operating mode, but be careful not to exchange the filter in the currently-operating sampling station. The active unit is displayed on the second line of the Main Screen as "Curr. "]

7.4.1 For each sampling station where a filter is being exchanged, record the valid and total exposure times and the standard volume (V_{STD}) displayed on the Main Screen.

7.4.2 Lift the handle of the filter exchange mechanism in the hub or satellite unit into its upward position to expose the area in which the filter cassette is installed.

7.4.3 If a filter is currently installed in the sampling unit, remove the filter cassette with its filter and place it immediately into its uniquely-numbered petri dish. A groove in the filter holding mechanism allows the user to gain better access to the filter cassette for removal.

7.4.4 Take the new filter cassette with its unused filter installed out of its petri dish and place it into the filter holding well of the filter exchange mechanism. The enclosure of the sampling station serves as a good storage location for the petri dish currently in use.

7.4.5 Close the filter exchange mechanism.

7.4.6 If the Partisol® Sampler is being operated in its Basic programming mode, use the soft function keys in the Edit Mode to define the sampling program for the newly-installed 47-mm filters. Make sure that the hardware remains in the "Run" operating mode so that the newly-defined sampling program is executed; press < F4: Run/Stp> if the sampler is currently in the "Stop" operating mode.

7.4.7 If the unit is in any other programming mode besides the Basic mode, use the soft function keys in the Edit mode to define the sampling program for the newly-installed 47-mm filters. Then, return the sampler to the "Run" operating mode by pressing < F4: Run/Stp> in the Main Screen to execute the newly-defined sampling program.

7.5 Computation of Mass Concentration

Compute the average mass concentration for particulate matter (PM), $\mu\text{g}/\text{m}^3$, corrected to standard temperature and pressure (25EC and 760 mm Hg), of PM_{10} , $\text{PM}_{2.5}$ or TSP during the sampling period of each filter by using the following formula with the information assembled above:

$$\text{PM} = \frac{(W_f - W_i) \times 10^6}{V_{\text{std}}}$$

where:

PM = Average mass concentration, $\mu\text{g}/\text{m}^3$, corrected to standard temperature and pressure (25EC and 760 mm Hg).

W_i = Average initial weight of clean filter, g.

W_f = Average final weight of exposed filter, g.

- 10^6 = Conversion factor from grams (g) to micrograms (μg).
- V_{std} = The volume (m^3) drawn through the filter, corrected to standard temperature and pressure, as recorded in Section 6.2.7.

For 24-h PM_{10} measurement averages to be valid for EPA reporting purposes, the "Valid Time" recorded in the Filter Data storage area must be at least 23 h. The "Total Time" is the length of time during which the sample stream flows through a filter, and the "Valid Time" is the length of time during which the status condition is "OK." Therefore, the "Valid Time" is always less than or equal to the "Total Time."

8. Routine Maintenance

The routine maintenance of the Partisol® Sampler consists of the following procedures.

- 8.1** Inspect filter cassettes for contamination *after every use*. Wipe with a clean dry cloth as required.
- 8.2** Inspect the seals that rest against the filter cassette in the hub and satellite units *every time a filter is exchanged*. Wipe with a clean dry cloth as required. Replace if worn or damaged.
- 8.3** Clean each PM_{10} inlet *after every 14 days of inlet usage*. The PM_{10} inlet must be cleaned with the corresponding sampling station is not operating.
- 8.4** Exchange the large in-line filter in the hub unit *every 6 months* of system operation. Turn the sampler off to replace the large in-line filter.
- 8.5** Check the voltage level of the batteries on the main computer board of the hub unit *every 6 months*.

9. Audit

This section describes the means by which the ambient temperature, ambient pressure, and sample flow rate measured by the hub unit are audited. In addition, this part describes the procedure for performing a leak check of the hub and satellite units. The audit should be performed every 3 months of continuous operation. Individual monitoring organizations may, however, abide by different standards.

9.1 Temperature Audit of the Partisol® Sampler

- 9.1.1** Press < F2: Calib> when in the Setup Screen to access the Calibration Screen (see Figure 4).
- 9.1.2** Determine the current temperature (EC) at the ambient temperature sensor positioned on the sample tube of the hub using an external thermometer, [$\text{EC} = 5/9 \times (\text{EF} - 32)$].
- 9.1.3** Verify that the value for temperature displayed in the "Calc" column of the Calibration Screen is within $\pm 2\text{EC}$ of the measured temperature. If this is not the case, perform the temperature calibration procedure described in Section 10.3.

9.2 Pressure Audit of the Partisol® Sampler

9.2.1 Press < F2: Calib> when in the Setup Screen to access the Calibration Screen (see Figure 4).

9.2.2 Determine the current ambient station pressure in atmospheres (absolute pressure, not corrected to sea level).

- To convert from mm Hg at 0EC to atmospheres, multiply by 0.001316.
- To convert from millibars to atmospheres, multiply by 0.000987.
- To convert from inches Hg at 32EF to atmospheres, multiply by 0.03342.

9.2.3 Verify that the value for pressure displayed in the "Calc" column of the Calibration Screen is within ± 0.02 atmospheres of the measured ambient pressure. If not, perform the pressure calibration procedure described in Section 10.4.

9.3 Leak Check of the Partisol® Sampler

[Note: To ensure leak tightness, a filter cassette containing a new 47-mm filter must be installed in each sampling station tested.]

9.3.1 Return the Partisol® sampler to the Main Screen.

9.3.2 The device must be in the "Stop" operating mode to perform a leak test. If the hardware is currently in the "Run" operating mode, as shown in the upper right-hand corner of the Main Screen, press < F4: Run/Stp> to enter the "Stop" operating mode.

9.3.3 Display the Calibration Screen (see Figure 4) by pressing < F5: Setup> and then < F2: Calib> when in the Main Screen.

9.3.4 Carefully remove the size-selective inlet from sampling station being checked.

9.3.5 Install the optional Flow Audit Adapter supplied with the sampler on the end of the sample tube of the sampling station being checked.

9.3.6 Turn on the pump by pressing < F7: PumpOn> (< SHIFT> < F2>) when in the Calibration Screen.

9.3.7 Press either < F2: Hub1> , < F3: Sat2> , < F4: Sat3> , or < F5: Sat4> , depending upon which sampling station is currently being checked.

9.3.8 Shut off the valve on the Flow Audit Adapter.

9.3.9 Shut off the flow to the flow controller assembly by turning the manual valve located on the manifold in the hub (marked in Figure 5).

9.3.10 Record the reading on the vacuum gauge in the hub.

9.3.11 Shut off the flow to the pump by turning the other manual valve located on the manifold in the hub (marked in Figure 6).

9.3.12 Record the reading on the vacuum gauge 10 s after the pump valve is closed. This reading should not drop below half of the original reading during this 10 s period. If this is not the case, trace the internal (and external) flow paths to identify problems in tubing or connections.

9.3.13 Open the flow controller valve and pump valve that were closed in Sections 9.3.9 and 9.3.11 above.

9.3.14 Open the valve of the Flow Audit Adapter and remove this hardware from the sampling station being checked. Replace the size-selective inlet.

9.3.15 Perform Sections 9.3.5 through 9.3.14 for each sampling station in the Partisol® system.

9.3.16 Return to the Main Screen by pressing < ESC> twice.

9.4 Flow Audit of the Partisol® Sampler

[Note: Perform the temperature audit, pressure audit, and leak check described above before executing the flow audit procedure below.]

- 9.4.1** Return the Partisol® sampler to the Main Screen.
- 9.4.2** The device must be in the "Stop" operating mode to perform a flow audit. If the hardware is currently in the "Run" operating mode, as shown in the upper right-hand corner of the Main Screen, press < F4: Run/Stp> to enter the "Stop" operating mode.
- 9.4.3** Install a filter cassette containing a 47-mm filter into the filter holder of the hub unit. This filter will be thrown away at the end of this flow audit.
- 9.4.4** Display the Calibration Screen (see Figure 4) by pressing < F5: Setup> and then < F2: Calib> when in the Main Screen.
- 9.4.5** Carefully remove the size-selective inlet from the hub.
- 9.4.6** Install the Flow Audit Adapter provided with the sampler on the end of the sample tube of the hub.
- 9.4.7** Attach a volumetric flow meter to the Flow Audit Adapter. R&P offers such a flow meter as part number 10-001742-0120 for 120 VAC and 10-001742-0240 for 240 VAC (see Figure 7).
- 9.4.8** Turn on the pump by pressing < F7: PumpOn> (< SHIFT> < F2>); then press < F2:Hub1> .
- 9.4.9** Use the < F8: DecrFlw> (continuously decrease flow), < F9: HoldFlw> (maintain current flow rate), and < F10: IncrFlw> (continuously increase flow) keys to display the flow rate in the "Calc" column of the Calibration Screen at approximately 16.7 L/min. As the servo valve in the hub closes and opens to increase and decrease the sample flow rate, the potentiometer value, "Pot," changes. This figure generally should not drop below 0.5 VDC or exceed 4.5 VDC.
- 9.4.10** Determine the flow in units of actual L/min using the external flow meter and verify that it matches the value displayed for flow in the "Calc" column of the Calibration Screen to within $\pm 7\%$. If this is not the case, perform the flow calibration procedure described in Section 10.
- 9.4.11** Return to the Main Screen by pressing < ESC> twice.
- 9.4.12** Restore the sampling hardware to its original state by removing the flow metering hardware and re-installing the size selective inlet on the sample tube of the hub. Remove the filter cassette from this sampling station and throw away the filter installed in it.

10. Calibration of the Partisol® Sampler

[Note: This section contains instructions for performing an interface board, temperature, pressure, and flow calibration of the Partisol® Air Sampler. The temperature and pressure calibrations must be done before the flow calibration.]

10.1 Interface Board Calibration

[Note: The interface electronics board is located on the bottom panel of the area behind the keypad in the hub unit (labeled in Figures 8 and 9).]

10.1.1 Locate the two red test points on the front section of the interface board. These two test points are labeled "+ 6V" and "+ 10V."

10.1.2 Locate the black ground test point labeled "GND" between the two large black capacitors.

10.1.3 Ensure that the sampler is turned on and that the display backlight is on. The backlight must be on during the + 6 V calibration. If the backlight is off, press any key on the keypad to turn it on.

10.1.4 Place the positive lead of a multimeter on the + 6 V test point.

10.1.5 Place the ground lead on the ground test point.

10.1.6 Locate R21 on the on the rear section of the interface board. R21 is a horizontal pot, and its designation "R21" is silk-screened on the board.

10.1.7 Tweak R21 until the multimeter reads $6.00 \text{ VDC} \pm 0.05 \text{ V}$.

10.1.8 Place the positive lead of the multimeter on the + 10 V test point.

10.1.9 Locate R44 on the rear section of the interface board. R44 is a blue vertical pot, and its designation "R44" is silk-screened on the board.

10.1.10 Tweak R44 until the multimeter reads $10.000 \text{ VDC} \pm 0.002 \text{ V}$.

10.2 Analog Input Calibration

[Note: The following procedure must be performed after the interface board calibration and before the temperature, pressure, and flow calibrations.]

10.2.1 Return the Partisol® sampler to the Main Screen.

10.2.2 The device must be in the "Stop" operating mode to perform an analog input calibration. If the hardware is currently in the "Run" operating mode, as shown in the upper right-hand corner of the Main Screen, press < F4: Run/Stp > to enter the "Stop" operating mode.

10.2.3 Press < F5: Setup > and then < F2: Calib > when in the Main Screen to access the Calibration Screen (see Figure 4).

10.2.4 Plug the six-pin end of the Analog Input Calibration Cable supplied with the sampler (part number 51-002604) into the socket labeled "ANEMOMETER" on the back of the Partisol® hub unit.

10.2.5 Plug the four-pin end of the Analog Input Calibration Cable into the socket labeled "USER OUTPUT" on the back of the Partisol® hub unit.

10.2.6 Attach the positive lead from a multimeter with four-digit resolution to the green test point labeled "PWM1" on the interface board. Attach the ground lead to the ground test point (see Figure 10).

10.2.7 Use the arrow key to position the cursor so that it is in the location labeled "A/O."

10.2.8 Press < Enter > to enter the Edit Mode. Type in a number between 0.050 and 0.150 volts and press < Enter > .

10.2.9 Observe the number displayed in the row labeled "A/I" in the column labeled "Calc." Ensure that this number does not vary more than ± 0.005 volts after watching it for 5 s. If this number is not stable, choose a new number for "A/O" between 0.050 and 0.150 volts.

10.2.10 Read the voltage displayed on the multimeter.

10.2.11 Use the arrow keys to position the cursor so that it is in the row labeled "A/I" and the column labeled "Act."

10.2.12 Press Edit to enter the Edit Mode. Type the voltage read from the multimeter (to three digit accuracy, i.e., 0.xxx) in this position and press < Enter > . To calculate the "Offset."

10.2.13 Ensure that the number now displayed in the row labeled "A/I" and the column labeled "Calc" matches the number displayed on the multimeter within ± 0.005 volts.

10.2.14 Use the arrow key to position the cursor so that it is in the location labeled "A/O."

10.2.15 Press < F1: Edit > to enter the Edit Mode. Type in a number between 4.800 and 4.900 volts and press < Enter > .

10.2.16 Observe the number displayed in the row labeled "A/I" in the column labeled "Calc." Ensure that this number does not vary more than ± 0.005 volts after watching it for 5 s. If this number is not stable, choose a new number for "A/O" between 4.800 and 4.900 volts.

10.2.17 Read the voltage displayed on the multimeter.

10.2.18 Use the arrow keys to position the cursor so that it is in the row labeled "A/I" and the column labeled "Act."

10.2.19 Press < Edit> to enter the Edit Mode. Type the voltage read from the multimeter (to three digit accuracy, i.e., 0.xxx) in this position and press < ENTER> to calculate the "Span."

10.2.20 Ensure that the number now displayed in the row labeled "A/I" and the column labeled "Calc" matches the number displayed on the multimeter within ± 0.005 volts.

10.2.21 Remove the multimeter leads from the interface board and the Analog Input Calibration Cable from the back of the Partisol® hub.

10.2.22 After completing the analog input calibration, perform the temperature, pressure, and flow calibrations.

[Note: If the instrument has been reset and you have recorded the value of "Offset" and "Span" for the flow, you may enter these numbers directly when in the Edit Mode.]

10.3 Temperature Calibration

10.3.1 Return the Partisol® sampler to the Main Screen.

10.3.2 The device must be in the "Stop" operating mode to perform a temperature calibration. If the hardware is currently in the "Run" operating mode, as shown in the upper right-hand corner of the Main Screen, press < F4: Run/Stp> to enter the "Stop" operating mode.

10.3.3 Press < F5: Setup> and < F2: Calib> when in the Main Screen to access the Calibration Screen (see Figure 4).

10.3.4 Determine the current temperature (EC) at the ambient temperature sensor positioned on the sample tube of the hub using an external thermometer, $[EC = 5/9 \times (EF - 32)]$.

10.3.5 Press < F1: Edit> to enter the Edit Mode and move the cursor to the "Act" (actual) column in the row labeled "Temp."

10.3.6 Enter the current ambient temperature (EC) and press < ENTER> to leave the Edit Mode. Use the < F6: +/-> key to enter negative temperatures when in the Edit Mode.

10.3.7 Upon receiving the actual temperature, the system's microprocessor automatically computes "Span" for the ambient temperature. Note this number for future reference.

[Note: If the instrument has been reset and you have recorded the value of "Span" for the ambient temperature, you may enter it directly in the "Span" column when in the Edit Mode.]

10.4 Pressure Calibration

10.4.1 Return the Partisol® sampler to the Main Screen.

10.4.2 The device must be in the "Stop" operating mode to perform a pressure calibration. If the hardware is currently in the "Run" operating mode, as shown in the upper right-hand corner of the Main Screen, press < F4: Run/Stp> to enter the "Stop" operating mode.

10.4.3 Press < F5: Setup> and < F2: Calib> when in the Main Screen to access the Calibration Screen (see Figure 4).

10.4.4 Determine the current ambient station pressure in atmospheres (absolute pressure, not corrected to sea level).

- To convert from mm Hg at 0EC to atmospheres, multiply by 0.001316.
- To convert from millibars to atmospheres, multiply by 0.000987.
- To convert from inches Hg at 32EF to atmospheres, multiply by 0.03342.

10.4.5 Press < F1: Edit> to enter the Edit Mode and move the cursor to the "Act" (actual) column in the row labeled "Pres."

10.4.6 Enter the current ambient pressure (atmospheres) and press < ENTER> to leave the Edit Mode.

10.4.7 Upon receiving the actual pressure, the system's microprocessor automatically computes "Span" for the ambient pressure. Note this number for future reference.

[Note: If the instrument has been reset and you have recorded the value of "Span" for the ambient pressure, you may enter it directly in the "Span" column when in the Edit Mode.]

10.5 Flow Calibration

[Note: The temperature and pressure calibrations described above must be performed before undertaking the flow calibration. In addition, the leak check discussed in Section 9.3 must also be undertaken before the flow calibration executed.]

10.5.1 Return the Partisol® sampler to the Main Screen.

10.5.2 The device must be in the "Stop" operating mode to perform a flow calibration. If the hardware is currently in the "Run" operating mode, as shown in the upper right-hand corner of the Main Screen, press < F4: Run/Stp> to enter the "Stop" operating mode.

10.5.3 Carefully remove the size-selective inlet from the hub.

10.5.4 Install a filter cassette containing a 47-mm filter into the filter holder of the hub unit. This filter will be thrown away at the end of this flow calibration.

10.5.5 Display the Calibration Screen (see Figure 4) by pressing < F5: Setup> and then < F2: Calib> when in the Main Screen.

10.5.6 Install the Flow Audit Adapter with its valve open on the end of the sample tube of the hub.

10.5.7 Attach a volumetric flow meter to the Flow Audit Adapter (see Figure 7).

10.5.8 Leave the pump turned off. If it is currently on, press < F6: PumpOff> to turn it off.

10.5.9 Press < F1: Edit> to enter the Edit Mode and move the cursor to the "Act" (actual) column in the row labeled "Flow."

10.5.10 Enter a zero in this position and press < ENTER> to leave the Edit Mode. This procedure causes the microprocessor to compute "Offset," which is the zero offset for the mass flow sensor. Note this number for future reference.

10.5.11 Turn on the pump by pressing < F7: PumpOn> and then press < F2: Hub1> to cause the sample flow to pass through the sample tube of the hub.

10.5.12 Use the < F8: DecFlw> (continuously decrease flow), < F9: HoldFlw> (maintain current flow rate), and < F10: IncrFlw> (continuously increase flow) keys so that the flow rate in the "Calc" column of the Calibration Screen is approximately 16.7 L/min. As the servo valve in the hub closes and opens to increase and decrease the sample flow rate, the potentiometer value, "Pot," changes. This figure should generally not drop below 0.5 VDC or exceed 4.5 VDC.

10.5.13 Determine the flow in actual L/min using the external flow meter.

10.5.14 Press < F1: Edit > to enter the Edit Mode and move the cursor to the "Act" (actual) column in the row labeled "Flow."

10.5.15 Enter the flow determined by the external flow meter and press < ENTER > to leave the Edit Mode. This procedure causes the microprocessor to compute "Span," which is the span offset for the mass flow sensor. Note this number for future reference.

[Note: If the instrument has been reset and you have recorded the value of "Offset" and "Span" for the flow, you may enter these numbers directly when in the Edit Mode.]

10.5.16 Return to the Main Screen by pressing < ESC > twice.

10.5.17 Restore the sampling hardware to its original state by removing the flow metering hardware and re-installing the size selective inlet on the sample tube of the hub. Remove the filter cassettes from the hub and satellite units, and throw away the filters installed in them.

11. Siting

11.1 As with any type of air monitoring study in which sample data are used to draw conclusions about a general population, the validity of the conclusions depends on the representativeness of the sample data. Therefore, the primary goal of a monitoring project is to select a site or sites where the collected particulate mass is representative of the monitored area.

11.2 Basic siting criteria for the placement of ambient air samplers are documented in Table 1. This list is not a complete listing of siting requirements; instead, an outline to be used by the operating agency to determine a sampler's optimum location. Complete siting criteria are presented in 40 CFR 58, Appendix E.

11.3 Additional factors not specified in the Code of Federal Regulations (CFR) must be considered in determining where the sampler will be deployed. These factors include accessibility under all weather conditions, availability of adequate electricity, and security of the monitoring personnel and equipment. The sampler must be situated where the operator can reach it safely despite adverse weather conditions. If the sampler is located on a rooftop, care should be taken that the operator's personal safety is not jeopardized by a slippery roof surface during inclement weather. Consideration also should be given to the fact that routine operation (i.e., calibrations, filter installation and recovery, flow checks, and audits) involves transporting supplies and equipment to and from the monitoring site.

11.4 To ensure that adequate power is available, consult the manufacturer's instruction manual for the sampler's minimum voltage and power requirements. Lack of a stable power source can result in the loss of many samples because of power interruptions.

11.5 The security of the sampler itself depends mostly on its location. Rooftop sites with locked access and ground-level sites with fences are common. In all cases, the security of the operating personnel as well as the sampler should be considered.

12. Operation Procedure

The Basic programming mode is the default setting of the Partisol® Sampler, which allows the user to collect samples for 24-h periods from midnight to midnight on each 47-mm filter in the sampling stations of the Partisol® system. The hardware is set for this mode when it is turned on for the first time. Information concerning the sampler's other programming modes may be found in the operating manual.

[Note: Do not attempt operation of the Partisol® Sampler until the hardware is installed according to the instructions in the operating manual. Also refer to the operating manual regarding the entry of appropriate system parameters in the Setup Screen before setting up the software for sampling in the Basic programming mode.]

12.1 The user defines the sampling program (i. e., during which 24-h periods the Partisol® hardware samples) in the Main Screen (see Figure 11). If the sampler is not currently in the Main Screen, press < ESC > until this display appears.

12.2 The right-most column of the screen labeled "Date" contains the only editable information. The user enters the dates in this field during which 24-h samples are to be collected in the hub and satellite units.

12.3 Follow the procedure below with the Main Screen displayed on the sampler to set up a Basic sampling program. If the sampler is currently in the "Run" operating mode, do not switch to the "Stop" operating mode. Leave the device in its current operating mode when executing the steps below.

12.3.1 Exchange the 47-mm collection filters in all sampling stations whose filter status, as shown in the "Stat" column of the Main Screen, is "DONE." If the sampler is being operated for the first time or at a new location, install new filters in each of the system's sampling stations. These filter exchanges and/or installations must be done in accordance with the instructions in Section 7.

12.3.2 Press < F1: Edit > to enter the Edit Mode and change the sampling dates shown in the "Date" column of the Main Screen. The cursor changes from an underline shape to a large square shape when the hardware enters the Edit Mode.

12.3.3 Press < F1: Daily > when in the Edit Mode to set a range of sequential dates automatically across sampling stations beginning with the next full 24-h period. This command affects all sampling stations except for the currently active one (if any), as indicated by "ON" in the "Stats" column. Alternatively, press < F2: Today+ 1 > when in the Edit Mode to assign tomorrow's date to the sampling station on the current line. Perform this action on each line that is to receive a new date, using the cursor keys to move from one date line to another.

12.3.4 Press the arrow keys to move from line to line, and among the day and month areas of each date field on the Main Screen. Press < F3: + > , < F4: + + > , < F6: - - > , and < F7: - > to increment and decrement the values of the day and month areas of each date. The days and months also may be entered directly from the keypad.

[Note: If < ENTER > is pressed after making a change to a field in the Edit Mode, the sampler returns to the View Data Mode. Press < F1: Edit > again to return to the Edit Mode, if wished. Note that using the cursor keys after each edit (not < ENTER >) enables the user to remain in the Edit Mode until all desired values have been changed.]

[Note: The system does not allow the user to change the sampling date of a sampling station that is currently active.]

12.3.5 Leave the Edit Mode by pressing < ENTER > to retain the changes made above. To cancel these edits, press < ESC > and perform the above steps again.

12.3.6 If the Model 2000 sampler is currently in the "Stop" operating mode, as indicated in the upper right-hand corner of the Main Screen, press < F4: Run/Stop > when in the View Data Mode to put the

sampler into the "Run" operating mode. Do not change operating modes if the hardware is already in the "Run" operating mode.

13. Interferences

To ensure a proper size cut point when using the R&P PM₁₀ inlet, the Partisol® Sampler should only be operated at a volumetric flow rate of 16.7 L/min. The procedure for auditing the flow is described in Section 9.4, while Section 10.5 contains the steps involved in a full calibration of the flow. A status condition "F" appears when the instrument determines that the flow rate is not within 7% of its set point (see Section 6).

14. Performance Criteria and QA

The detailed steps required for filter handling and inspection, conditioning, weighing, and installation is described in Section 7. The Partisol® Sampler contains extensive diagnostics that monitor its operation (see Section 6), indicating whether the hardware is operating within its required bounds. Section 9 contains the procedures necessary to perform a field audit of the sampler.

The most important factors to observe in the assurance of quality data are filter quality and its seating in the filter cassette, the correctness of the flow rate, and the leak tightness of the system.

15. Records

A Filter Log is recommended to record the data relevant to the conditioning, weighing, and exposure of the filter, as well as the computation of PM₁₀ concentration averages (see Figure 12). Individual users may want to develop their own documentation to track audits (see Section 9) and calibrations (see Section 10).

16. References

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10. 40 CFR, Part 58, Appendix A, B.

TABLE 1. MINIMUM SAMPLER SITING CRITERIA

Scale	Height above ground, meters	Distance from supporting structure, meters		Other spacing criteria
		Vertical	Horizontal ^a	
Micro	2 to 7	> 2	> 2	<ol style="list-style-type: none"> 1. Should be > 20 meters from trees. 2. Distance from sampler to obstacle, such as buildings, must be twice the height and the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270 degrees around the sampler inlet. 4. No furnace or incineration flues should be nearby.^b 5. Spacing from roads varies with traffic (see 40 CFR 58, Appendix E). 6. Sampler inlet is at least 2 m but not greater than 4 m from any collocated PM₁₀ sampler. (See 40 CFR 58, Appendix E).
Middle, neighborhood, urban, and regional scale	2 to 15	> 2	> 2	

^aWhen inlet is located on rooftop, this separation distance is in reference to walls, parapets, or penthouses located on the roof.

^bDistance depends on the height of furnace or incineration flues, type of fuel or waste burned, and quality of fuel (sulfur, ash, or lead content). This is to avoid undue influences from minor pollutant sources.



Figure 1. Example of Partisol® Air Samplers, with Satellite on Left and Hub on Right.

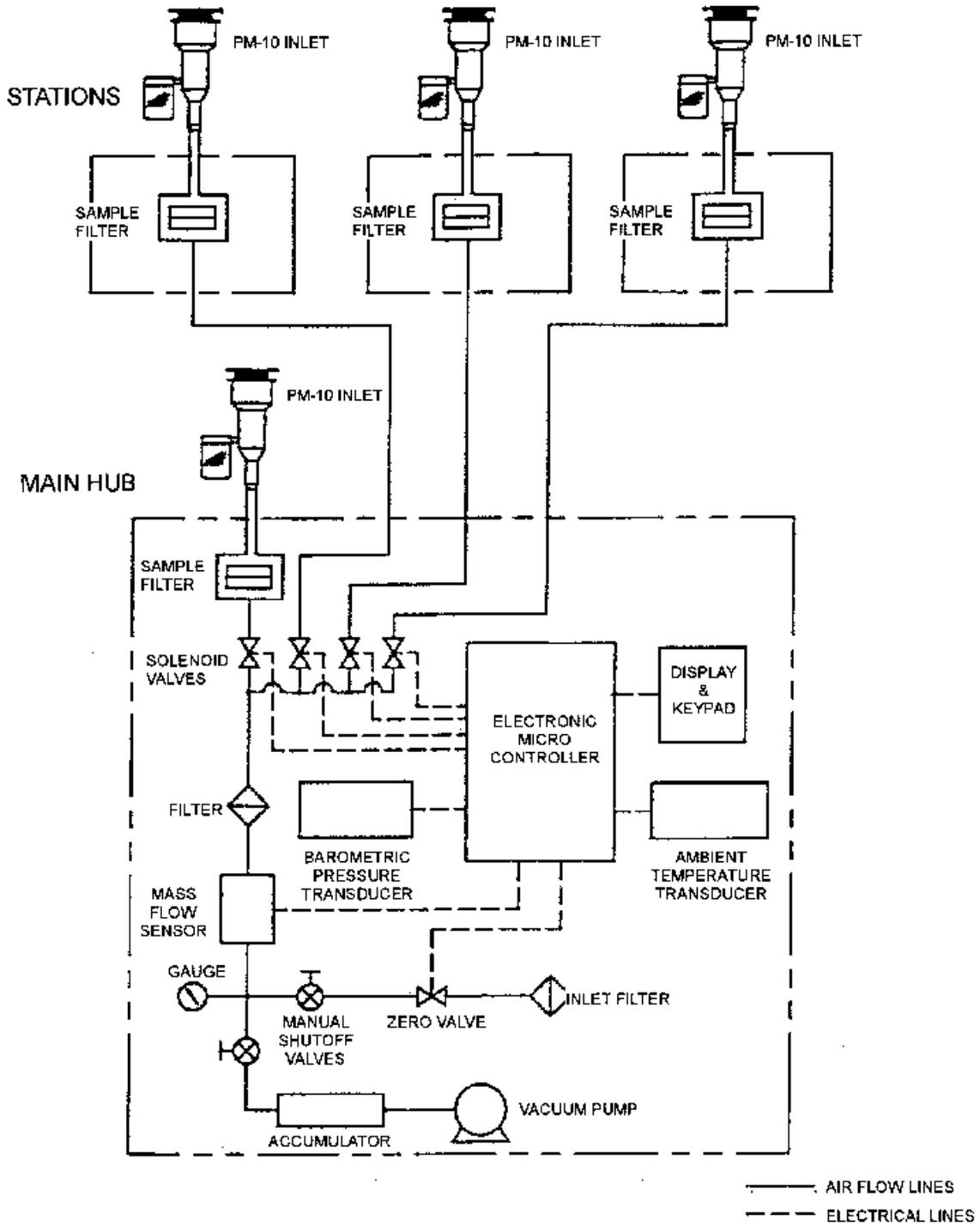


Figure 2. Example of Partisol® Flow Schematic.

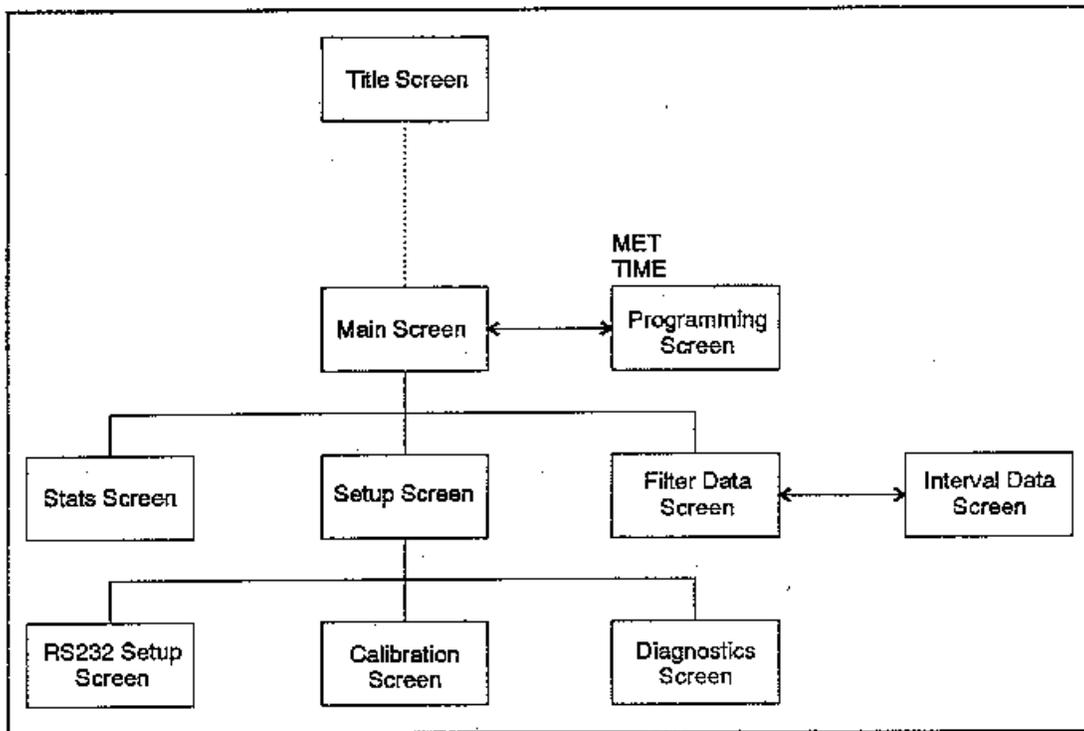


Figure 3. Example of hierarchy of Screens, used on R&P Partisol® monitors.

BASIC		Calibration			STOP	
	Calc	Act	Offset	Span		
A/I:	1.003	0.000	0.0000	1.0000		
Temp:	27.9	0.0		1.0000		
Pres:	0.998	0.000		1.0000		
Flow:	16.7	0.0	0.0000	1.0000		
A/O: 1.00 Pot:3.752 Flow Adj: Hold H1						
Edit	Hub1	Sat2	Sat3	Sat4	>	
<u>Soft Function Keys In View Data Mode</u>						
Edit	Hub1	Sat2	Sat3	Sat4	>	Unshifted
PumpOff	PumpOn	DecrFlw	HoldFlw	IncrFlw	<	Shifted
<u>Soft Function Keys In Edit Mode</u>						
--	-	+	++	Bksp	>	Unshifted
+/-					<	Shifted

Figure 4. Example of R&P Partisol® Calibration Screen.

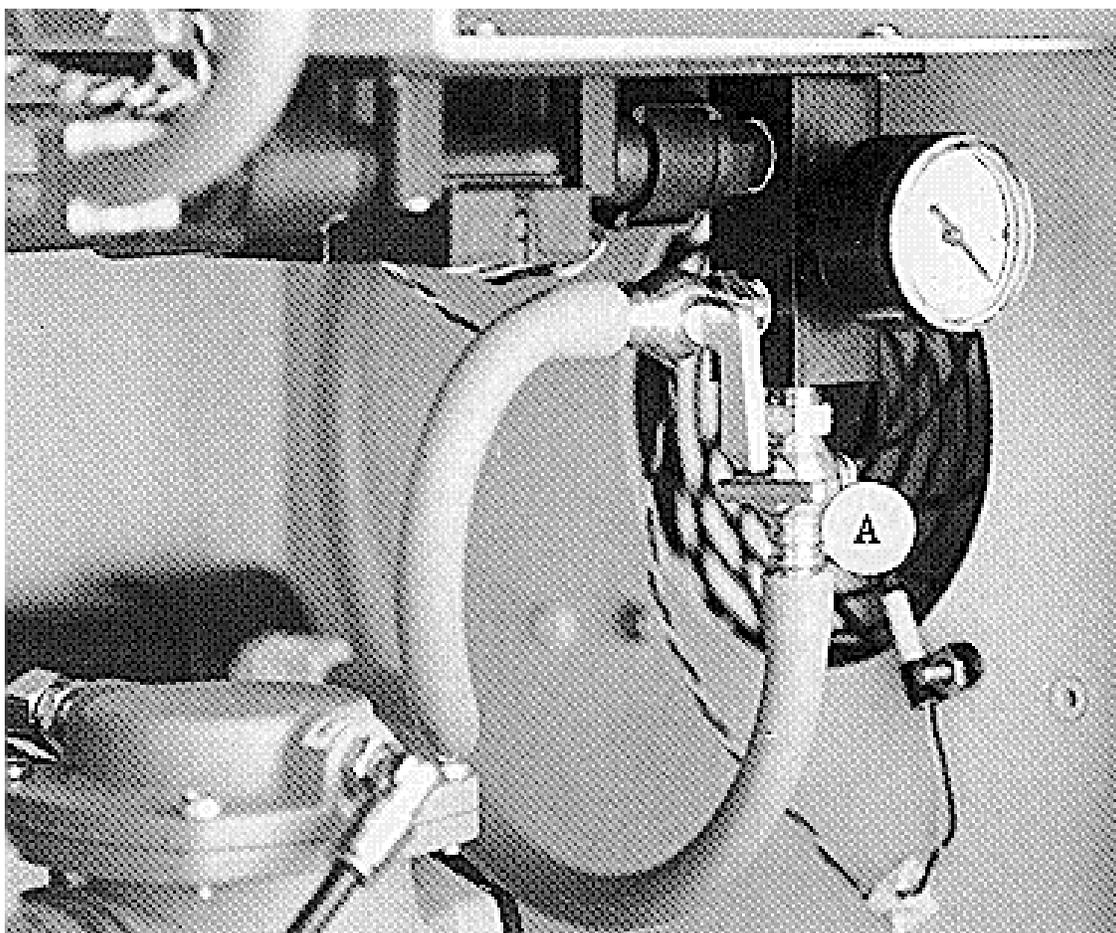


Figure 5. Example of R&P Partisol® flow control manual valve (A) shown in its closed position.

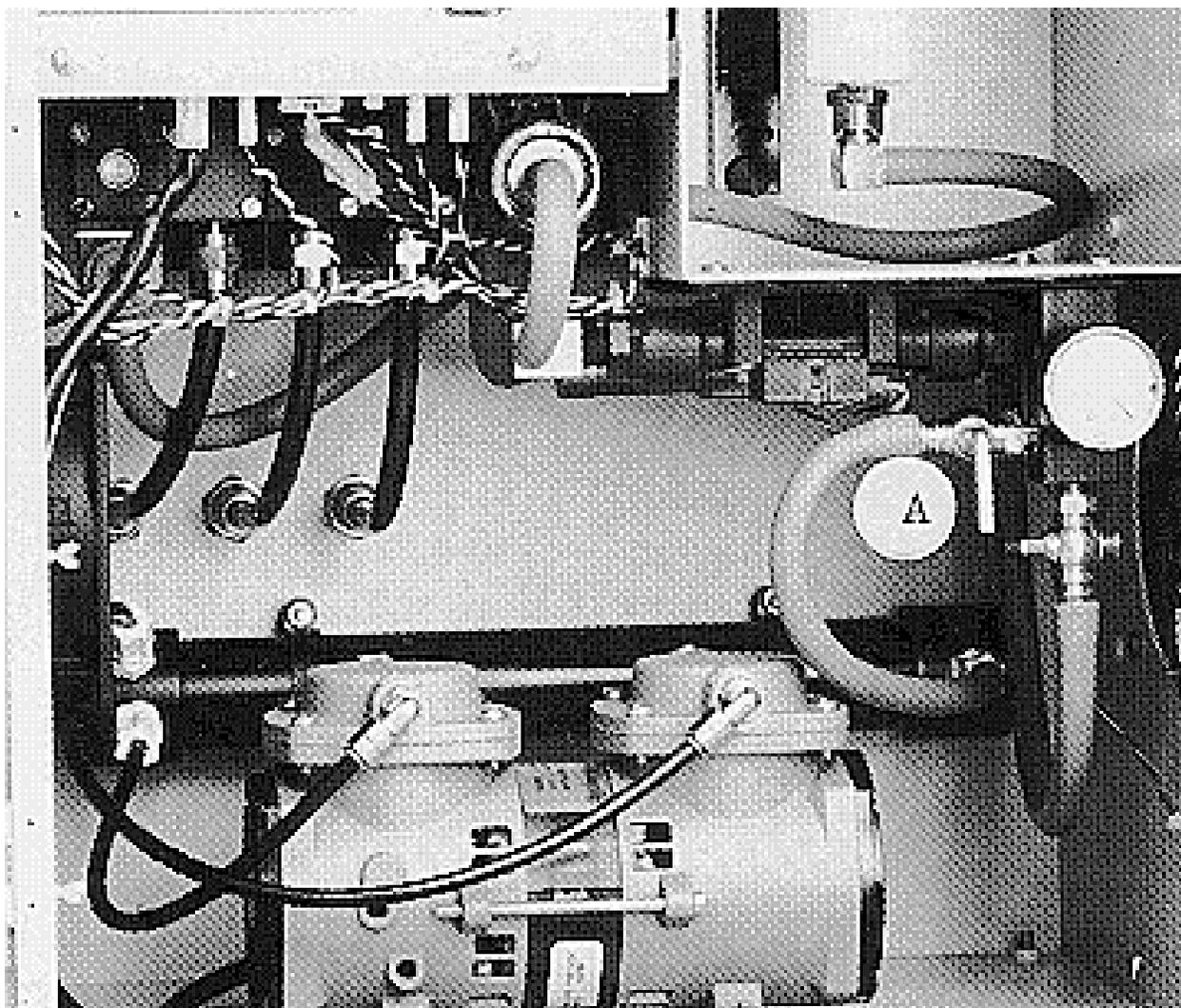


Figure 6. Example of R&P Partisol® pump manual valve (A) shown in its closed position.

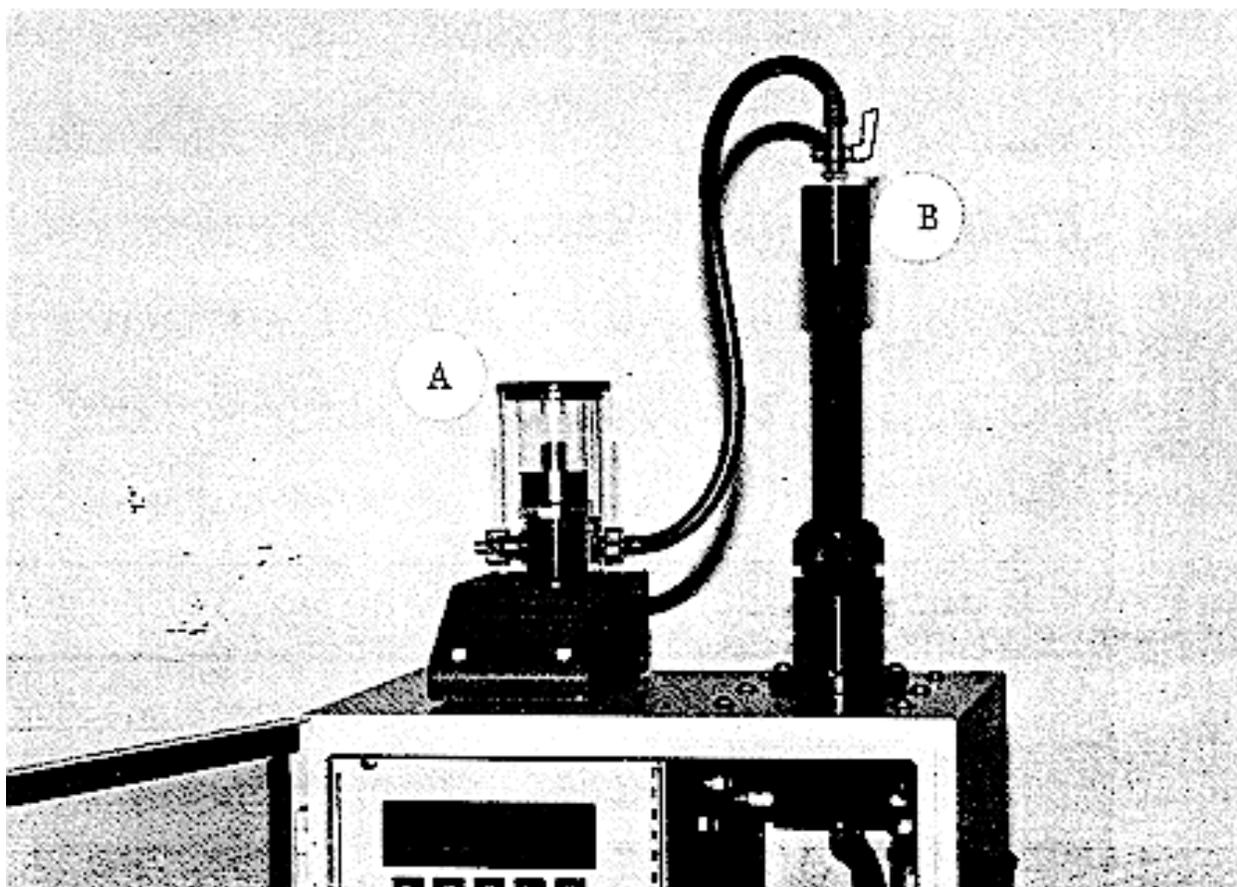


Figure 7. Example of R&P Partisol® flow meter (A) attached to flow audit adapter (B).

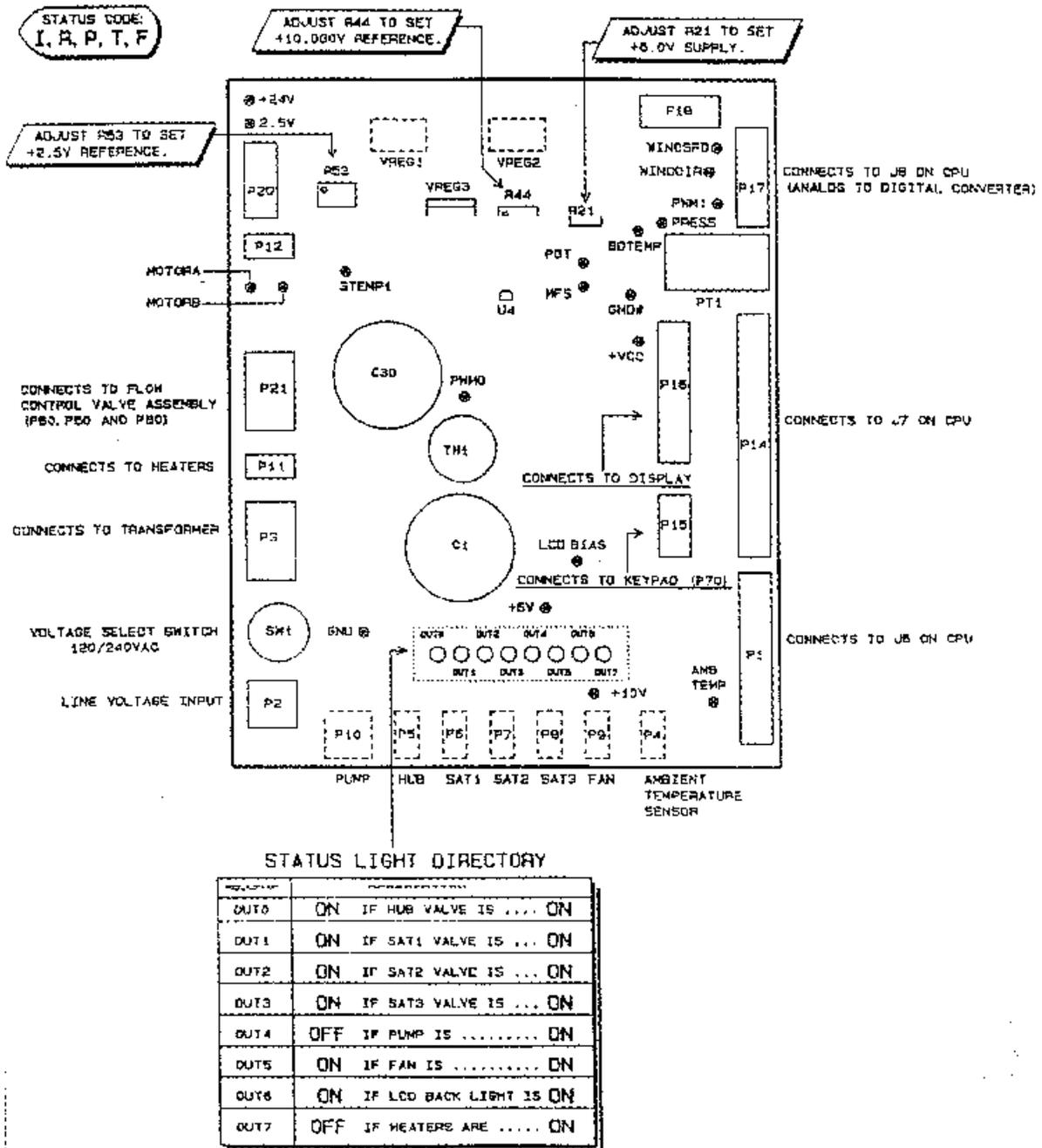


Figure 8. Example of R&P Partisol® layout of Interface Board.

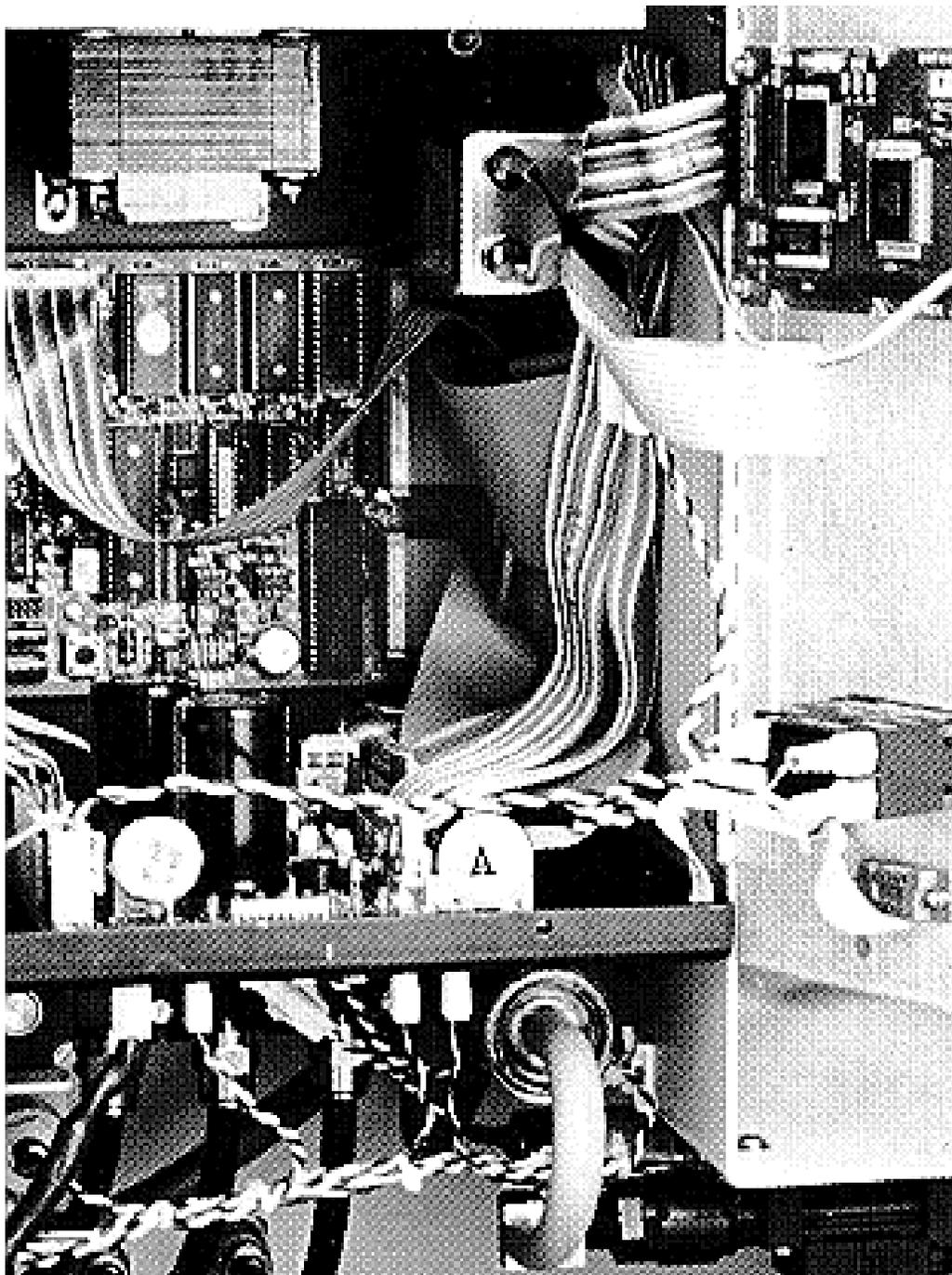


Figure 9. Example of R&P Partisol® interface board (A).

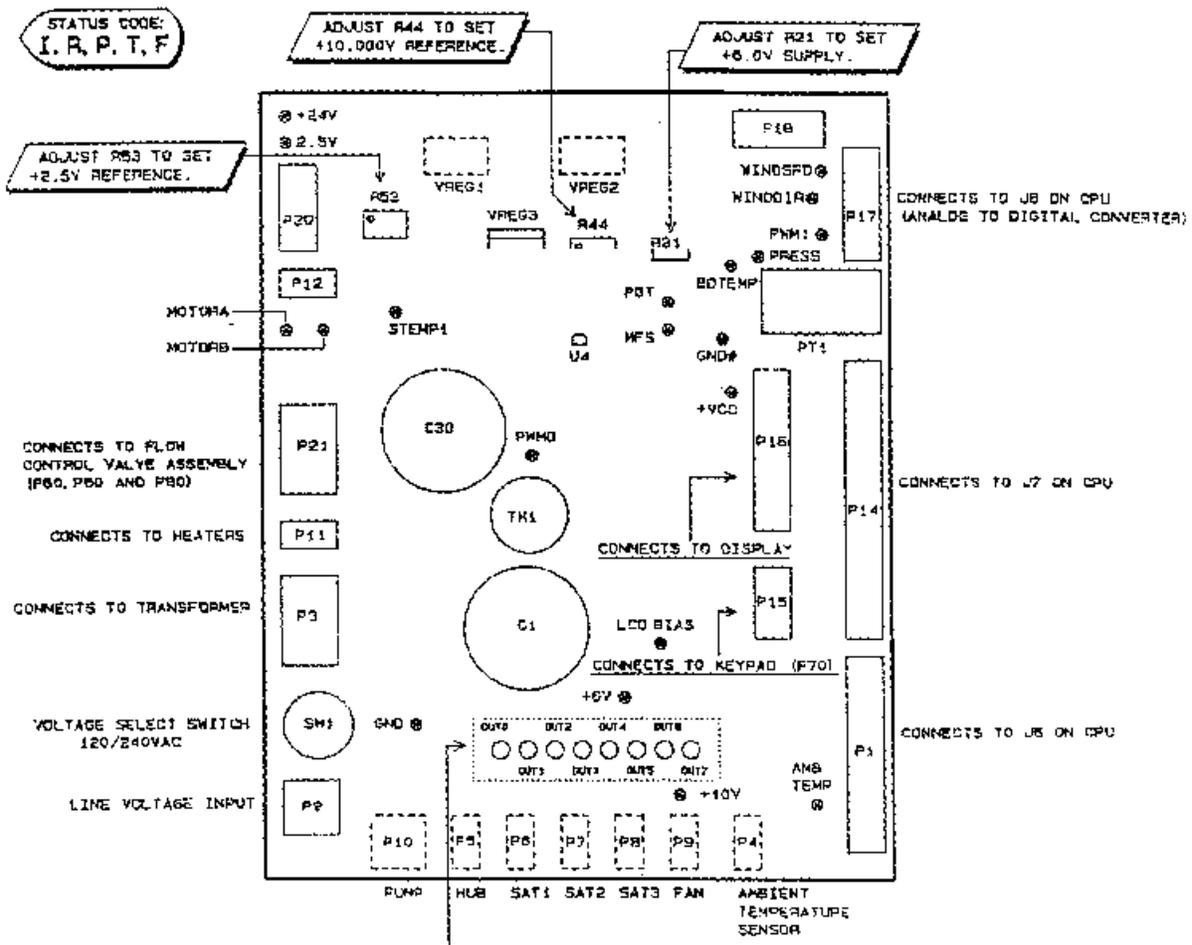


Figure 10. Example of R&P Partisol® lead locations on interface board.

BASIC						Partisol Main Screen						RUN	
16:21		03-Oct-93		Curr:2		Status:Ok							
Stat		Std Vol		Valid		Total		Date					
H1: DONE		24.143		24:00		24:00		02-Oct					
S2: ON		16.342		16:21		16:21		03-Oct					
S3: OFF		0.000		0:00		0:00		04-Oct					
S4:													
Edit		Stats		Storage		Run/Stp		Setup					
<u>Soft Function Keys in View Data Mode</u>													
Edit		Stats		Storage		Run/Stp		Setup				Unshifted	
													Shifted
<u>Soft Function Keys in Edit Mode</u>													
Daily		Today+1		+		++		Bksp		>		Unshifted	
--		-		+		++		Bksp		<		Shifted	

Figure 11. Example of R&P Partisol® main screen, basic programming mode.

Filter Log												
Partisol® Model 2000 Air Sampler												
Filter Number	Initial Conditioning		Initial Weighing		Filter Exposure		Post-Collection Conditioning		Post-Collection Weighing		DW W(F)-W(0)	Concentration $DW \times 10^{-6} / V(\text{STD})$
	Conditions	Weights	Weights	Conditions	Exposure Period	Exposure Stats	Conditions	Conditions	Weights	Conditions		
	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:	RH: Temp: Date: Time:		Val Time: Tot Time: V(STD)	RH: Temp: Date: Time:	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:	RH: Temp: Date: Time:		Val Time: Tot Time: V(STD)	RH: Temp: Date: Time:	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:	RH: Temp: Date: Time:		Val Time: Tot Time: V(STD)	RH: Temp: Date: Time:	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:	RH: Temp: Date: Time:		Val Time: Tot Time: V(STD)	RH: Temp: Date: Time:	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:	RH: Temp: Date: Time:		Val Time: Tot Time: V(STD)	RH: Temp: Date: Time:	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:	RH: Temp: Date: Time:		Val Time: Tot Time: V(STD)	RH: Temp: Date: Time:	RH: Temp: Date: Time:	W1 : W2 : W3 : W(0):	RH: Temp: Date: Time:		

Figure 12. Example of R&P Partisol® Filter Log.

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