National Human Exposure Assessment Survey (NHEXAS)

Arizona Study

Quality Systems and Implementation Plan for Human Exposure Assessment

The University of Arizona
Tucson, Arizona 85721

Cooperative Agreement CR 821560

Standard Operating Procedure **SOP-UA-F-3.1**

Title: Collection of Airborne Particulate Samples for Metals and Pesticides Analysis

Source: The University of Arizona

U.S. Environmental Protection Agency
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Human Exposure Research Branch

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Form TP-1

Collection of Airborne Particulate Samples for Metals and Pesticides Analysis

1.0 PURPOSE AND APPLICABILITY

This SOP describes the in-field use of a particulate sampling system (pumping and control unit, and size selective inlet impactors) for collecting samples of particulate matter from the air during a predetermined time period for the NHEXAS Arizona project, AZ Border project (Border AZ), and other Health and Environment projects. These air samples will be tested for target metal and pesticide concentrations. Separate SOPs discuss calibrating the pumping and control unit (SOP# UA-L-6.X) and preparing the impactors for sampling (SOP# UA-L-7.X and UA-L-8.X).

2.0 DEFINITIONS

2.1 AZ Border = The US border region is defined as 100 km north of the border. In this study, we define the border as 40 km north of the border. The Arizona Border Study or "Border AZ" is an alias for "Total Human Exposure in Arizona: A Comparison of the Border Communities and the State" conducted in Arizona by the University of Arizona / Battelle / Illinois Institute of Technology Consortium.

2.2 BUCKET = A plastic container with a buckle top or tight-fitting lid. One bucket is assigned to each household to be sampled. Household identification and stage numbers are listed on the outside of the container. The bucket contains all paperwork and questionnaires to be completed by field staff or household respondents. It serves as the primary vehicle for securing and transporting forms, data and samples to and from the field through the course of the study.

2.3 CHAIN OF CUSTODY RECORD (Fig.6) = A vital data tracking and quality assurance document which accompanies every sample and documents custody, receipt and transfer. The record documents a unique sample identification number assigned to the filters by the Materials Technician through entry of the filter into the Tracking System.

2.4 DATA COORDINATOR = The employee of the research project who supervises data batching, entry and verification.

2.5 FIELD COORDINATOR = The employee of the research project who supervises field data collection and operations. The Field Coordinator collates individual data into HH packets, and upon completion of all visits, sampling and QA checks, forwards the packet to the Data Coordinator.

2.6 FIELD KIT = A sampling tool-box containing appropriate collection and storage utensils.

For the Particulate Sampler it contains adapters for non-grounded outlets, electrical ground-check units, a heavy duty electrical extension cord, an electrical 3 way split device, extra PM Sampling Data Forms (Fig. 1), a Digital Volt Meter(DVM), a calibrated rotameter, an electronic mass flow meter, power surge protector, measuring tape, thermometer, combination lock and chain, a master key for the PM boxes, and aluminum foil wrap.

2.7 FIELD STAFF = The Field Coordinator, the Team Leader and the Team Members.

2.8 HRP OFFICE = The **H**ealth **R**elated **P**rofessions building, currently located at 1435 North Fremont Avenue, Tucson, AZ 85719. This is an annex of the Arizona Prevention Center and the primary headquarters for operations in support of NHEXAS Arizona, BORDER AZ, and other Health and Environment projects.

2.9 HOUSEHOLD (HH) = The residence occupied by study respondent(s).

2.10 HOUSEHOLD IDENTIFICATION NUMBER (HHID) = A unique number and character combination which is assigned to each household for identification purposes. This number must be recorded on all data (forms, samples, questionnaires and correspondence) collected from the household.

2.11 LAB SUPERVISOR = The employee of the research project who supervises laboratory analyses.

2.12 MATERIALS TECHNICIAN (Materials Tech) = The employee of the research project who is responsible for assembling and assigning field forms, questionnaires and equipment for field use. The Materials Technician also assigns unique sample identification numbers to all samples upon receipt from the manufacturer (UA-G-5.X).

2.13 N/A = Not Applicable.

2.14 NHEXAS Arizona = Acronym for National Exposure Assessment Survey, a research project conducted in Arizona by the University of Arizona / Battelle / Illinois Institute of Technology Consortium.

2.15 PM = Particulate Matter. $\mathbf{PM_{10}}$ refers to particulate < 10 microns (μm) in diameter. $\mathbf{PM_{2.5}}$ refers to particulate < 2.5 microns (μm) in diameter.

2.16 PM BOX = One of the pumping and control units used to regulate the timing and flow in liters per minute (Lpm) of air that is drawn into the metal and pesticide samplers. This unit is also known as Harvard Black Box, or The Black Box.

2.17 PACKET = A sturdy, envelope-like container that can be fully closed and is large enough to hold the physical data forms generated from sampling and surveying a study household.

2.18 QUALITY ASSURANCE (QA) = All those planned and systematic actions necessary for ensuring the accuracy, validity, integrity, preservation and utility of collected data.

2.19 QUALITY CONTROL (QC) = Those quality assurance actions providing a means to control and measure the characteristics of a datum, process or the adherence to established parameters.

2.20 RESPONDENT = A person in the study population of NHEXAS Arizona, BORDER AZ and other Health and Environment projects. Each household is assigned an HHID. All the family respondents are assigned an Individual Respondent Number (IRN). Each respondent can be uniquely identified by a combined HHID and IRN designator.

2.21 SAMPLE = The dust deposit left on the filter (or PUF) after sampling is complete. Sample may also refer to the filter (or PUF) before it is exposed, while sampler refers to the PM box / black box, and impactors.

2.22 SAMPLE IDENTIFICATION NUMBER = A numeric code that uniquely identifies every sample. It is generated by the NHEXAS tracking system by the Materials Technician and assigned to each filter by the Materials Technician or the Lab Supervisor.

2.23 SKC PUMP (figure 10) = The second pumping and control unit used to collect PM samples for pesticides and metals. This unit is manufactured by SKC Inc. The pump is programmable and a needle valve regulates the flow in liters per minute (Lpm) of the air that is drawn into the metal and the pesticide samplers

2.24 TEAM LEADER = The member of the field team who is primarily responsible for respondent contact, data collection, field form and questionnaire completion, and site QC checks of all data.

2.25 TEAM MEMBER= Member of a field team responsible for assisting the Team Leader in the collection of data and quality control checks in the field.

2.26 TRACKING SYSTEM = A database system containing information about the custody, transfer and storage of hard copy data, electronic data, field samples, and field sample aliquot.

2.27 VISIT = A scheduled appointment with participating respondents at their place of residence (HH) for the collection of samples, questionnaires and other data.

3.0 References

3.1 Lebowitz, M.D. 1993. Study Design (Revision of 31 Dec. 1993). EPA NHEXAS Cooperative Agreement.

3.2 SKC, Operating instructions, Universal Flow Sample Pump, Catalog number 224-PCXR8

3.3 Turner, W.A. "Manual for the Indoor Sampler," Draft Version, Harvard School of Public Health, Boston, MA, 1985.

3.4 Turner, W.A., Marple, V.A., and Spengler, J.D. "Indoor Aerosol Impactor" Presented at "First International Aerosol Conference," Minneapolis, Minnesota, September, 1984.

4.0 Discussion

4.1 The principles for the operation of the particulate samplers are fully described in references 3.1, 3.2 and are only briefly summarized in this section. There are two main components to the sampler - the pumping and control unit (i.e., the black box and the SKC pump), and the metals and pesticide impactors.

4.2 PM BOX: This pumping unit is designed to pull in a sample of air at a constant flow rate (4 SLPM, Standard Liters Per Minute of mass flow) during pre-set time periods, and to switch this flow from one sample line to another at pre-set intervals. This switching is done with a timer- controlled solenoid valve that directs the flow from the pump through one of two sampling lines. This sampler has a built in mass flow sensor that adjusts the speed or cycles of the pump as temperature or pressure vary.

4.3 SKC PUMP: The pumping unit is adjusted to pull in a sample of air at a constant flow rate (4 SLPM, Standard Liters Per Minute of volumetric flow) during pre-set time periods. Unlike the PM box, the SKC pump is a single line (sample line) sampler so separate pumps are used for metals and pesticides sampling. This sampler does not have a built in mass flow sensor to adjust the speed or cycles of the pump as temperature or pressure vary.

4.4 The PM_{10} impactors are placed on the ends of the sample lines, and are designed to remove particulate matter (PM) larger than 10 microns before the air is drawn through a filter and/or a foam PUF(only for pesticides) that traps the remaining PM of 10 microns in diameter or less. The $PM_{2.5}$ impactors remove particulate matter (PM) larger than 2.5 microns before the air is drawn through a filter that traps the remaining PM of 2.5 microns in diameter or less.

4.5 The filters used to collect dust for metals analysis are weighed before and after sampling is completed to determine the mass of PM collected during the time period that the pumping unit was active. These weights are calculated under very controlled conditions (see UA-L-9.X). The average concentration of PM in the air sampled that is less than 10 microns in aerodynamic diameter is determined by calculating:

(1) The mass of the PM collected on the filter,
(2) The duration of the sampling period, and
(3) The rate at which the air was drawn through the filter.

4.6 The PM fixed site air sampler will be used to collect samples inside and outside respondents homes for metals and pesticides concentration analysis. See Figure 7 for the data/sample flow diagram for the actively pumped particulate matter sample from the PM box and the SKC pump. The relative timing of the PM set-up and sample collection is displayed in Figure 8.

4.7 Samples for metals analysis will be collected using aluminum PM_{10} and $PM_{2.5}$ impactors and a 37 mm teflo filter (see Figure 4). The flow rate will be set at 4 Lpm over a sampling duration of 7 days. The cumulative integrated elapsed time for both indoor and outdoor metals samples will range from 84 to 168 hours out of a total of 168 possible.

4.8 Samples for pesticide analysis will be collected using an URG impactor with PM_{10} cut point and a 25 mm Teflo coated glass fiber filter and PUF (see Figure 5). The flow rate will be set at 4 Lpm over a sampling duration of 3 days. The cumulative elapsed integrated time for pesticide samples will be 18 - 72 hours out of a total of 72 possible.

5.0 RESPONSIBILITIES

5.1 The Project Field Coordinator (or delegate) will be responsible for:

(1) Training the Field Staff on how to properly collect and handle PM samples.
(2) Training the Field Staff on how to properly record field observations and data on the field data sheets.
(3) Training the Materials Technician how to properly assign impactors and equipment for field sampling.
(4) Providing the Staff with the Project's SOPs pertaining to this procedure and its methods.
(5) Insuring SOP procedures are followed by all Field Staff.
(6) Communicating with the Lab Supervisor and the Materials Technician to insure that field sampling occurs smoothly.
(7) Performing a QA Field audit on one out of ten HH sampled to insure PM setup, operation, tear down and sample transportation are accomplished according to

protocol.

(8) QA check of all field records upon receipt from the Team Leader

5.2 The Field Staff will be responsible for:

(1) Knowing and following the procedures described in this SOP for collection of particulate samples.
(2) Insuring proper labeling techniques of equipment and impactors.
(3) Insuring that filter ID #'s specified on the PM Sampling Data Form (Figure 1) correspond to the appropriate impactor:
  (a) Metal filter in the impactor with a red nozzle (PM box);
  (b) pesticide filter in the impactor with the silver nozzle (PM box).
(4) Recording the sampling information as directed in this SOP including:
  (a) Measuring and recording the set-up and take-down values as measured by the rotameter or the mass flow meter and the DVM (PM BOX only);
  (b) PM BOX: Recording the start/stop elapsed times (from both timers), and verifying that the elapsed times are non-zero and are reasonably close to the pre-set times for that sampler.
  SKC PUMP: Recording the preset 'sample' and the 'pump' run times and verifying that the elapsed times are equal to the preset ones.
(5) Notifying the Project Field Coordinator regarding equipment failure (SOP# UA-G-2.X) and field supply needs.

5.3 The Team Leader will be responsible for:

(1) Knowing the procedures described in this SOP and insuring that they are followed by the Team Members,
(2) Arranging sampling dates and times with the HH,
(3) Obtaining the impactors, the PM boxes and the SKC pumps from the Materials Technician,
(4) Collaborating with the Team Member(s) to select the appropriate sampling sites at each HH,
(5) Ensuring the integrity and custody of the sample and field forms collected,
(6) Quality control checks in the field,
(7) Properly transporting the metal impactors at room temperature to and from the Field sites, and the pesticide impactors to and from the field on blue ice with the glass portion of the impactor covered with aluminum foil,
(8) Forwarding individual QC checked field forms to the Field Coordinator for QA checks.

5.4 The Laboratory Supervisor (or delegate) will be responsible for:

(1) Insuring that the impactors are loaded with filters and that the corresponding filter ID numbers are placed on the impactor (on the top side of the base unit).
(2) Insuring appropriate turn-around times for calibrated equipment and loaded impactors.
(3) Pre- and post collection weights of metals filters.

5.5 The Materials Technician will be responsible for:

(1) The proper documentation and assignment of filters and impactors to HH.
(2) Stocking the HH Bucket with appropriate field sampling forms,
(3) Including Field Blanks with impactor assignment as appropriate.

6.0 MATERIALS AND REAGENTS

6.1 Materials

1. Pumping and control unit (the "black box" or the SKC pump).
2. Assigned URG pesticide impactors pre-loaded with 25 mm Teflon coated glass fiber filter and PUF.
3. Assigned aluminum Metals impactors pre-loaded with weighed 37 mm Teflo filter.
4. Adapters for non-grounded outlets.
5. Outdoor Heavy Duty Extension cord.
6. Three-way splitter.
7. PM Sampling Data Sheet (Figure 1).
8. Digital volt meter (DVM).
9. Calibrated rotameter or digital mass flow meter.
10. Power surge protector.
11. Measuring Tape.
12. Thermometer(Celsius or Centigrade), or psychrometer / hygrometer.
13. Combination Lock (with known combination) and chain.
14. Master key to the black box lock.
15. Outdoor PM stand set-up.
16. Pocket Calculator.

6.2 Reagents - N/A

7.0 PROCEDURE

7.1 Preparation

7.1.1 Field Site Selection Criteria

Indoor Site Selection

(1) Sampler sites are chosen by the Team Leader. Samplers are to be located in the main room where the HH members spend the majority of their time when indoors. This is frequently the room where the television is located. Never sample in a bedroom or private area where the sampler motor may disturb respondents. The impactors must be placed between 4 and 6 feet in height ("average breathing space" of subjects).
(2) Avoid PM set-up under fans, air circulation ducts or next to windows or doors.
(3) The safety of HH members and their pets must be considered when placing the box and attaching the sample-lines to the impactors.
(4) Locate the equipment near an available grounded electric outlet which is not controlled by a wall switch.
(5) Insure that the internal fan on the PM Box is not facing furniture or a wall which might retard PM Box cooling.
(6) Insure that the exhaust of the SKC pump is not obstructed. Any obstruction may cause a flow fault.
(7) Impactors must be placed approximately 2 feet from any wall to avoid concerns regarding laminar or sheet flow aberrations.
(8) Efforts should be made to avoid overhangs and 'dead-air' spaces
(9) PM sampler must be at least 10 feet from the active or passive VOC samplers (see UA-F-11.X X and UA-F-12.X) or obvious sources of PM contamination such as a fireplace or chair where a respondent habitually sits to smoke tobacco.
(10) Once a suitable site is chosen confer with the HH respondents and insure that the selected location is acceptable to the participants. Explain your location decision as necessary and find a mutually agreeable site.

Outdoor Site Selection

(11) The PM set-up should be placed outdoors on the North side of the HH, ten feet from the midpoint of the wall. Placement on the north side of the home is intended to protect the sampler from direct sunlight.
(12) If the North side of the HH faces a street or places the sampler at risk for theft or vandalism, place the sampler in a more secure part of the HH property. Indicate

the location on the Field Sheet (Fig. 1)

(13) The PM Box makes a noise equivalent to a fish-tank pump while the SKC pump is a little bit louder and should be kept away from sleeping quarters where possible.

(14) The sampler requires an outside outlet for electric power which is fully grounded. Check the outlet to be used with a ground tester. If the outlet fails to be adequately grounded, try another outlet /location on the property.

(15) Do not locate the sampler under trees, near pools of standing water, near animal cages or under tables, etc.

(16) Do not locate the sampler near obvious sources of contamination such as roads, alleys, sand-pits, etc.

(17) PM sampler must be at least 10 feet from the active or passive VOC samplers (see UA-F-11.X and UA-F-12.X).

7.1.2 Reagents - N/A

7.1.3 Standards and Blanks

(1) Flow rates on the pumping and control units are set and calibrated in the lab according to SOP #UA-L-6.X.

(2) Field measurements of flow rates are limited to verifying that the flow rates are within acceptable ranges based on
   1. The DVM reading from the mass flow controller (PM box only).
   2. The flow measured by a calibrated rotameter (PM box only).
   3. The ambient temperature in ^{o}C or ^{o}F at the time flow is checked.
   4. A direct reading of mass flow using a factory calibrated mass flow meter (see 7.2.2 B below).

(3) PM BOX: If either the DVM or the measured flow rate is out of range that PM box may not be used and another back-up box must be set-up.
SKC PUMP: If the measured flow rate is out of range, the pump must be adjusted to draw within the acceptable range.

(4) One filter from each batch of ten metal and ten pesticide filters will be randomly assigned as a field "blank". This filter will be loaded into an impactor (labeled as the field blank) and assigned to a household.

(5) The Field blank will undergo the same preparation, transportation, site setup, collection and post-field storage handling as the accompanying active sampler, but the blank will not be connected to the PM box and will not be exposed.

(6) The Field Blank will be analyzed with the exposed samples.

7.1.4 Samplers

(1) The Materials Technician will assign two pre-loaded aluminum impactors for PM_{10}

and two pre-loaded aluminum impactors for $PM_{2.5}$ sampling to each household. The filter ID will be recorded on the base of the impactor. The Impactor number and the filter information will be transferred to the appropriate sections on the PM Field Sheet (Figure 1). The Chain of Custody Record accompanying the filters will be placed in the appropriate HH bucket as the assignment is documented in the Tracking System.

(2) One or two (indoors and/or outdoors) pre-loaded URG impactors for pesticide sampling will also be assigned to each household by the Materials Technician. The filter and PUF ID numbers will be transferred to the field sheets. The loaded URG impactors will be labeled with the appropriate HHID and stored at -20°C until they are taken into the field in a cooler on blue ice.

(3) Two pre-calibrated PM black boxes and/or several SKC pumps will be assigned to each HH by the Materials Technician. PM Box calibration is detailed in SOP UA-L-6.X.

(4) All assigned samplers and samples will be labeled with the appropriate HHID number.

(5) Impactors for metals analysis may be stored in the HH Bucket with appropriate custody documentation.

(6) Impactors for pesticide analysis must be stored at -20°C with appropriate custody documentation until the Team Leader removes them to take them into the field.

(7) Metals filters/impactors are stored/transported at room temperature, while Pesticide filters and PUF are stored at -20°C and transported to and from the field on blue-ice with the glass portion of the impactor covered with aluminum foil.

(8) The Materials Technician and the Team Leader thoroughly check the PM box for loose or malfunctioning parts including:
   1. Mass flow sensor (front of box)
   2. Pump unit.
   3. Air hoses, especially from the flow sensor to the internal filter and from the internal filter to outside the box.
   4. Wires in the green box (Fig. 2) and inside the T2 Timer housing (Fig. 3).

(9) The Materials Technician and Team Leader verify that the sampling lines (black rubber hoses) are labeled on the distal end of the hose that connects to the impactor. The silver line which is connected to the pesticide impactor (or the $PM_{2.5}$ impactor) is marked with silver tape and the red line which connects to the PM_{10} metals impactor is marked with red tape.

(10) The Materials Technician and the Team Leader must complete the above checks before the set-up visit to ensure smooth implementation of this sampling protocol.

7.2 Field Procedures

There are some trouble shooting guides (Fig. 9) which may be consulted when setting-up

or retrieving the PM boxes. These should be kept in mind, referred to, and amended as needed.

7.2.1 Standards and Blanks Deployed

(1) The Field Blank for metals and pesticide analysis will undergo similar preparation, transportation, site setup, collection and post-field storage conditions as the accompanying active sampler, but the blank will not be connected to the PM box or the SKC pump and will not be exposed.
(2) The Field Blank filters will otherwise be treated the same as a sample filter. They will be transported in an impactor to the HH under appropriate conditions. The transportation cover will be removed from the top of the blank impactor while the actual PM samplers are uncovered, set up and run.
(3) This blank filter will be labeled as a 'blank' in the appropriate section of the PM Sampling Data Sheet (Fig. 1), and remain with the active samplers until collection.
(4) Upon collection, the blank receives no special handling, and is transported for analysis with the exposed samples.
(5) Duplicate sampling will be accomplished by running the duplicate set-up 'side by side' with the actual sampler.

7.2.2 Samples

A: SETUP

Both the PM box and the SKC pump may be used in this sampling procedure. A PM Box can be used to collect two samples since it has two sampling lines. SKC pumps (since they have a single sampling line), can only collect a single sample. If the metals (PM_{10} and $PM_{2.5}$) are to be collected over a seven day period, you should NOT connect a metals impactor and a pesticide impactor to the same PM Box. Since the pesticide sample is collected over a 72 hour period (not 7 days), you will not be able to program the PM Box so it conforms to the sampling demands of a 7 day metals sample and a 3 day pesticide sample. The time share option of the PM Box is useful only when both samples have the same (or similar) sampling periods.

PM BOX:

(1) Verify sample site suitability with the Team Leader and note any potential point sources. Record potential sources within 10 feet on the Field Sheet.
(2) Open the black box and feed the electrical cord and then the sampling lines (black hoses) through the hole in the left side of the box. Place the sample lines where: (see d below)
(3) Connect the DVM to the PM box by feeding the DVM leads through the hole on the left

side of the box. Turn the DVM 'on' to VDC.

(4) Place the sample lines where:
   (a) There will be no obstruction to flow through the hoses i.e., the hoses must not be stepped on or crushed during set-up or while sampling,
   (b) There will be no chance of anyone tripping over a hose or cord,
   (c) Dust and dirt will not be pulled into the pump when they are not connected to an impactor (off the floor or ground).

(5) Plug the cord from the black box into an electrical outlet that is not controlled by a wall switch.
   (a) Test to see whether the electrical outlet is grounded using a 'ground tester'. If the outlet is not grounded, find another outlet to use (if possible).
   (b) If the electrical outlet is already full, use a three-way splitter to plug in the box.
   (c) If there is no outlet nearby the selected sampling location, use the extension cord to connect to an outlet.

(6) Set the seven or fourteen day timer on the green box to the current approximate time by turning the dial clockwise until the arrow on the box is pointing towards the current day and time (within 4 hours). Note that each pin on the timer represents four hours.

(7) Turn on the PM box by pushing the black tabs to the 'in' position around the current day/time. The fan should come on and the pump will start running in about one minute.

(8) Check to see that the fan is functioning by holding your hand at the fan exhaust and feeling for a positive air current. If the fan is not functioning check to see if it is plugged in.

(9) Open the T_1 Timer housing (green box) and record the dial setting from the 'Trim Pot' (Fig. 2). Dial setting is verified to match calibration setting, but is not recorded.

(10) Uncap thermometer as applicable. The psychrometer or digital hygrometer may be used for temperature/RH recording as appropriate.

(11) Close the PM box lid and allow the box to warm-up for five minutes.

(12) While waiting for the box to 'warm-up' complete all applicable fields on the PM Sampling Field Sheet (Fig. 1).

(13) Verify that hoses are not crimped or trapped and connect the sample lines to the appropriate sampling heads. Connect the red sample line to the base of the metals impactor (Fig. 4), or the pesticides impactor (Fig. 5). Connect the silver line to the base of the second impactor (if any).

(14) If you will be collecting a second sample using the PM Box, the impactors should be placed 12 to 18 inches apart. This distance will minimize laminar flow distortions and allow side-by-side sampling.

(15) Verify that each impactor has the correct sample-ID label affixed to the outside of the impactor and that these sample identification numbers reflect those listed in the Chain of Custody documentation (Fig. 6).

(16) Crimp the sample line for one of the impactors briefly and watch the DVM. If the DVM fluctuates by at least 2 VDC then the line that you crimped is currently 'active' and you will begin the in-field flow rate testing with that line.

SKC PUMP:

(17) Verify sample site suitability with the Team Leader and note any potential point sources. Record potential sources within 10 feet on the Field Sheet.

(18) Open the box and feed the electrical cord and then the sampling line (tygon tubing) through the holes in the side of the box where the pump is located.

(19) Make sure that there is a small unobstructed piece of tygon tubing connected to the exhaust and it runs through a hole to the outside the box.

(20) Place the sample line where:
   (1) There will be no obstruction to flow through the tube i.e., the tube must not be stepped on or crushed during set-up or while sampling,
   (2) There will be no chance of anyone tripping over a tube or cord,
   (3) Dust and dirt will not be pulled into the pump when it is not connected to an impactor (off the floor or ground).

(21) Plug the cord from the SKC pump into an electrical outlet that is not controlled by a wall switch.
   (1) Test to see whether the electrical outlet is grounded using a 'ground tester'. If the outlet is not grounded, find another outlet to use (if possible).
   (2) If the electrical outlet is already full, use a three-way splitter to plug in the box.
   (3) If there is no outlet nearby the selected sampling location, use the extension cord to connect to an outlet.

(22) Unscrew the anti-tamper cover from the front of the pump. Turn on the SKC pump from the on/off switch using the screw driver tip. The pump will start running.

(23) Press the START/HOLD button to put the pump on hold.

(24) Connect the tygon tube to the base of the metal or the pesticide impactor depending what the pump is sampling for.

(25) Uncap thermometer as applicable. The psychrometer or digital hygrometer may be used for temperature / RH recording as appropriate.

(26) The same box contains both the 'metals PM_{10}' and the 'pesticides' or the $PM_{2.5}$ pumps. The PM_{10} metals impactor and the URG pesticide or $PM_{2.5}$ metals impactor are paired in the sampling stand but are between 12 to 18 inches apart: This distance minimizes laminar flow distortions but allows side-by-side sampling.

(27) Verify that each impactor has the correct sample-ID label affixed to the outside of the impactor and that these sample identification numbers reflect those listed in the Chain of Custody documentation (Fig. 6).

B: FLOW RATE VERIFICATION

Flow rates may be measured using a rotameter or a factory calibrated electronic mass flow meter. Guidelines for use of either piece of equipment are given below.

PM BOX:

Rotameter verification:

(1) Connect the rotameter to the inlet of the impactor. The top of the metals impactor twists off and the rotameter attaches directly to the impactor with an 'O' ring.
(2) The rotameter must be attached to the inlet jet of the URG impactor with a swage-lok fitting. **Do not over-tighten this fitting!** Tighten the fitting to 'hand-tight'. Overtightening will bow the inlet jet. Hand-tight pressure is sufficient to make a good seal. Seal the URG impactor/PUF housing with Teflon tape as necessary.
(3) Wait at least one minute for the flow to stabilize once you have connected the rotameter.
(4) Be sure the rotameter and the impactor are on a level surface. Verify that the inlet of the rotameter is not obstructed.
(5) Read the flow-rate at the center of the ball in the rotameter column once the DVM meter is within .05 VDC of the recommended reading pasted to the inside top of the PM box.
(6) Record the flow rates in the 'start' column of the PM Sampling Data Sheet (Fig. 1) on set up, and the 'stop' column on tear-down. Record the rotameter ID and the DVM ID on the Field Sheet.
(7) Once the flow-rate has been recorded, re-open the PM box and access the T_2 timer housing.
(8) Rotate the timer clockwise until you hear the solenoid 'click' and begin sampling the other line. Check the DVM and the rotameter on the second line to verify that the solenoid remained switched once you released the T_2 timer. If not, repeat the step.
(9) Close the box and wait at least two minutes for the PM box to stabilize. After two minutes repeat steps (3) through (5) above.
(10) Verify that each impactor flow rate indicates a mass flow of 4 liters per minute plus or minus 5% (200 mL/min) on set-up.
(11) If either the rotameter flow rate or DVM readings are out of tolerable range on set-up (see section 7.4) notify the Team Leader. The sampler should not be used in this instance and a back-up should be set-up.
(12) If a PM box fails to meet in field set-up specifications, indicate the failure and return it to the field area for testing and re-calibration as per UA-G-2.X.
(13) DO NOT reset flow or calibration in the field as this may only be done in the laboratory.

Mass Flow Meter verification:

(14) Connect the mass flow meter to the inlet of the impactor. The top of the metals impactor twists off and the flow meter attaches directly to the impactor with an 'O' ring.
(15) The rotameter must be attached to the inlet jet of the URG impactor with a swage-lok fitting. **Do not over-tighten this fitting!** Tighten the fitting to 'hand-tight'. Overtightening

will bow the inlet jet. Hand-tight pressure is sufficient to make a good seal. Seal the URG impactor/PUF housing with Teflon tape as necessary.

(16) Wait at least one minute for the flow to stabilize once you have connected the flow meter.

(17) Be sure the flow meter and the impactor are on a level surface. Verify that the inlet of the flow meter is not obstructed.

(18) Read the flow-rate directly from the digital display on the flow meter once the DVM meter is within .05 VDC of the recommended reading pasted to the inside top of the PM box.

(19) Record the flow rates in the 'start' column of the PM Sampling Data Sheet (Fig. 1) on set-up, and the 'stop' column on tear-down. Record the flow meter ID and the DVM ID on the Field Sheet.

(20) Once the flow-rate has been recorded, re-open the PM box and access the T_2 timer housing.

(21) Rotate the timer clockwise until you hear the solenoid 'click' and begin sampling the other line. Check the DVM and the flow meter on the second line to verify that the solenoid remained switched once you released the T_2 timer. If not, repeat the step.

(22) Close the box and wait at least two minutes for the PM box to stabilize. After two minutes repeat steps (16) through (21) above.

(23) Verify that each impactor flow rate indicates a mass flow of 4 liters per minute plus or minus 5% (200 mL/min) on set-up, that is 3.8 to 4.2 LPM.

(24) If either the flow meter flow rate or DVM readings are out of tolerable range on set-up (see section 7.4) notify the Team Leader. The sampler should not be used in this instance and a back-up should be set-up.

(25) If a PM box fails to meet in field set-up specifications, indicate the failure and return it to the field area for testing and re-calibration as per UA-G-2.X.

(26) DO NOT reset flow or calibration in the field as this may only be done in the laboratory.

SKC PUMP:

Rotameter verification:

(27) Connect the rotameter to the inlet of the impactor. The top of the metals impactor twists off and the flow meter attaches directly to the impactor with an 'O' ring.

(28) The flow meter must be attached to the inlet jet of the URG impactor with a swage-lok fitting. Do no over-tighten this fitting! Tighten the fitting to 'hand-tight'. Overtightening will bow the URG inlet jet. Hand-tight is sufficient. Seal the URG impactor /PUF housing with Teflon tape as necessary.

(29) The pump is currently on hold (see SETUP step 23). Press the FLOW AND BATTERY CHECK button. The pump will start again. Wait between one to three minutes for the flow to stabilize once you have connected the flow meter.

(30) Be sure the flow meter and the impactor are on a level surface. Verify that the inlet of the

flow meter is not obstructed.

(31) Read the flow-rate at the center of the ball in the rotameter column. The flow rate has to be as close to 4 Lpm as possible. A minimum flow rate of 3.8 Lpm and a maximum of 4.2 Lpm is needed.

(32) Use a small screw driver to turn the flow adjustment control screw as needed to bring the flow rate to the proper range.

(33) Wait for one minute and repeat steps 30 through 32 (above) as needed.

(34) Record the flow rates in the 'start' column of the PM Sampling Data Sheet (Fig. 1) on set-up, and the 'stop' column on tear-down. Record the flow meter ID on the Field Sheet. Once the flow-rate has been recorded, press the FLOW AND BATTERY CHECK button to set the pump on hold again.

(35) Verify that the impactor flow rate indicates a mass flow of 4 liters per minute plus or minus 5% (200 mL/min) on set-up, that is 3.8 to 4.2 LPM.

(36) If an SKC pump fails to meet in field set-up specifications, indicate the failure and return it to the field area for testing.

Mass Flow Meter verification:

(37) Connect the mass flow meter to the inlet of the impactor. The top of the metals impactor twists off and the flow meter attaches directly to the impactor with an 'O' ring.

(38) The flow meter must be attached to the inlet jet of the URG impactor with a swage-lok fitting. Do no over-tighten this fitting! Tighten the fitting to 'hand-tight'. Overtightening will bow URG inlet jet. Hand-tight is sufficient. Seal the URG impactor /PUF housing with Teflon tape as necessary.

(39) The pump is currently on hold (see SETUP step 23). Press the FLOW AND BATTERY CHECK button. The pump will start again. Wait between one to three minutes for the flow to stabilize once you have connected the flow meter.

(40) Be sure the flow meter and the impactor are on a level surface. Verify that the inlet of the flow meter is not obstructed.

(41) Read the flow-rate directly from the digital display on the flow meter. The flow rate has to be as close to 4 Lpm as possible. A minimum flow rate of 3.8 and a maximum of 4.2 is needed.

(42) Use a small screw driver to turn the flow adjustment control screw as needed to bring the flow rate to the proper range.

(43) Wait for one minute and repeat steps 41 and 42 as needed.

(44) Record the flow rates in the 'start' column of the PM Sampling Data Sheet (Fig. 1) on set-up, and the 'stop' column on tear-down. Record the flow meter id on the Field Sheet. Once the flow-rate has been recorded, press the FLOW AND BATTERY CHECK button to set the pump on hold again.

(45) Verify that each impactor flow rate indicates a mass flow of 4 liters per minute plus or minus 5% (200 mL/min) on set-up, that is 3.8 to 4.2 LPM.

(46) If an SKC pump fails to meet in field set-up specifications, indicate the failure and return it to the field area for testing.

C: TIMER SETUP

If the metals (PM_{10} and $PM_{2.5}$) are to be collected over a seven day period, you should NOT connect a metals impactor and a pesticide impactor to the same PM Box. Since the pesticide sample is collected over a 72 hour period (not 7 days), you will not be able to program the PM Box so it conforms to the sampling demands of a 7 day metals sample and a 3 day pesticide sample. The time share option of the PM Box is useful only when both samples have the same (or similar) sampling periods.

PM BOX:

Record the times described below in the "START" column of the PM Sampling Data Sheet (Figure 1) when setting up the PM sampler, and in the "STOP" column when retrieving the samplers.

(1) Open the PM box.
(2) On the T_1 control (green box) (Fig. 2), push one black tab on the timer **IN** for each four hour time period that the sampler should be **ON** or operating.
(3) Start the sampling cycle immediately and 'stop' the cycle at the designated day and time.
(4) Each pin on the analog timer represents 4 hours.
(5) Open the T_2 Timer box (Fig. 3) and set the switches (tabs) to alternate between **IN** (solenoid **ON - samples on the silver line**) and **OUT** (solenoid **OFF - samples on the red line**). The ratio between 'On' and 'Off' will be determined by the sampling configuration :

PM_{10} on RED LINE and $PM_{2.5}$ on SILVER LINE then Ratio = 50/50
PM_{10} on RED LINE and SILVER LINE unused then Ratio = All 'On'
$PM_{2.5}$ on RED LINE and SILVER LINE unused then Ratio = All 'On'
Pesticide on RED LINE and SILVER LINE unused then Ratio = 1/4 or 1/2 as directed by the Team Leader.

(6) Be sure that ALL pins on the T_2 timer are properly set. This Timer rotates once every 24 hours. A consistent repeated pattern on the T_2 timer will guarantee the desired ratio. For example: if you depress one pin down for every 3 pins up you will achieve a ratio of 1:3. If the PM Box samples for 72 hours with this pin setting, it will sample for 18 hours on the silver line and 54 hours on the red line.
(7) Record (to the nearest 0.1 hour) the start time from the Tamura Analog elapsed hour

meter on the (T_1) green box (Fig. 2).

(8) Record (to the nearest 0.1 hour) the elapsed time indicated on the Tamura Analog elapsed hour meter on the outer cover of the T_2 box (Fig. 3).

(9) The T_1 elapsed hour meter records the total number of hours that the PM box was actively pumping at 4 SLPM (both red and silver lines). The T_2 elapsed hour meter records the total number of hours that the solenoid had switched and the PM box was pumping air from the silver line only. T_1 minus T_2 equals the total time the PM box was drawing air through the red line.

SKC PUMP:

Record the times described below in the "START" column of the PM Sampling Data Sheet (Figure 1) when setting up the PM sampler, and in the "STOP" column when retrieving the samplers. There are three set-up times that may be entered in the pump. The delayed start, the sample period (time that pump is active) and the pump period (time that pump is actually sampling). To scroll through the different time options press the MODE button. To scroll through the digits on the pump's display press the DIGIT SELECT button, and to change a digit press the DIGIT SET button. Time is measured in minutes on the SKC Pump. Any of the times programmed may be as high as 9999 minutes since there are only four digits on the display.

(10) Press the SET-UP button.

(11) The indication 'set up delayed start' will appear at the bottom of the pump's display and four zeros will appear. Enter the desired delayed start value in minutes using the SELECT and SET DIGIT keys (see Table 1 below). Record this value on the Field Sheet.

(12) Press the MODE button.

(13) The indication 'set up sample period' will appear at the bottom of the display. Enter the desired sample period value in minutes using the SELECT and SET DIGIT keys (see Table 1 below). Record this value on the Field Sheet.

(14) Press the MODE button.

(15) The indication 'set-up pump period' will appear at the bottom of the display. Enter the desired pump period value in minutes using the SELECT and SET DIGIT keys (see Table 1 below). Record this value on the Field Sheet.

(16) Scroll through the different set-up values by depressing the MODE button to verify that you have entered the correct times.

(17) Press the START/HOLD button. The pump will start after the programmed delayed start minutes have elapsed.

(18) Screw the anti-tamper cover back on the pump.

Table 1. Common Timer Settings (minutes) when Using SKC Pumps.

Sample	Delayed Start	Sample Period	Pump Period	Comments
PM_{10} Metals	5	9999	9999	7 day continuous
PM_{10} Metals	5	4320	3240	1:3 Split over 3 days
$PM_{2.5}$ Metals	5	9999	9999	7 day continuous
$PM_{2.5}$ Metals	5	4320	3240	1:3 Split over 3 days
Pesticides	5	4320	2160	1:1 Split over 3 days
Pesticides	5	4320	1040	1:3 Split over 3 days
PAHs	5	4320	2160	1:1 Split over 3 days
PAHs	5	4320	1040	1:3 Split over 3 days

D: SAMPLER SET-UP COMPLETION

PM BOX

(1) Push any excess air hoses and electrical cords into the box, and arrange it so that the hoses are not crushed or crimped by the cover or by the T_2 assembly.
(2) Make sure that no cords or wires are pinched when the cover of the box is closed.
(3) Shield the PM box from rain using a rain-hood in outdoor set-ups.
(4) Latch and lock the lid of the PM box.

SKC PUMP

(5) Push any excess air tubes and electrical cords into the box, and arrange it so that the hoses are not crushed or crimped when the box is closed.
(6) Make sure that no cords or wires are pinched when the cover of the box is closed.
(7) Shield the box from rain using a rain-hood in outdoor set-ups.

E: PM SAMPLER RETRIEVAL

PM BOX:

(1) Return to the home after the sampling period is over with an additional PM box and samples to be used if the sampling PM box fails any quality control checks upon tear

down.

(2) Unlock the black box and open it.

(3) Record (to nearest 0.1 hour) the elapsed time from the green box (T_1) and from the T_2 timer on the PM Sampling Data Sheet (Figure 1).

(4) Turn on the pump by pushing the black tabs on the green box nearest the black arrow to the "in" position. The fan should come on and the pump will start running in about one minute.

(5) Close the box and allow the pump to warm up for at least five minutes.

(6) Check the flow rates as described previously.

(7) Calculate the approximate run times and record these on the Field Sheet (Fig. 1).

(8) The TOTAL time = [T_1(stop) - T_1(start)], should approximately equal the number of sampling days x 24 hours per day.

(9) The silver line time = [T_2(stop) - T_2(start)]. This value indicates the total sample time for the sampler connected to this line.

(10) The TOTAL time minus the silver line time [(T_1 Stop - T_1 Start) - (T_2 Stop - T_2 Start)], equals the total sample time for the sampler on the red line

(11) NOTE large deviations in any of these times or ratios on the PM Sampling Data sheet, flag the sampler, and report deviations to the Field Coordinator.

(12) Disconnect each impactor from the sample line and rotameter / mass flow meter. Cover the metals impactor with aluminum foil and transport back to the field office in the HH bucket. Cover the glass bottom of the pesticide URG impactor with aluminum foil and seal the impactor with the red cap, place it in a Freezer Ziploc bag and return it to the field office on blue-ice.

(13) Unplug the sampler. If used, remove the grounded plug adapter and extension cord.

(14) Pull the sample lines and electrical cord into the box. Coil these around the interior of the box - try to avoid tangling the lines, so that they are easy to remove for the next use.

(15) Close and latch the box.

(16) Team Members must complete the appropriate sections on the PM Sampling Data Sheet (Fig.1) and on the Chain of Custody Record (Fig.6).

(17) Once back from the field, the Pesticide Sampler is stored at -20 degrees Celsius and the Metals Sampler are stored at room temperature.

(18) If the PM box fails any quality control checks upon tear down repeat sampling as outlines in 7.2.2 with the extra PM box and samples that have been taken into the field.

SKC PUMP:

(19) Return to the home after the sampling period is over with an additional SKC pump and samples to be used if the original pump setup fails any quality control checks upon tear down.

(20) Open the box.

(21) The display of the pump should be on. Record the time (sample period) that is displayed in

the 'Total box run time' section of the field form.

(23) Press the PUMP RUN TIME button and hold it down. Record the time displayed in the 'Pesticide Sample Time' or the 'Metals Sample time' depending on the type of the sample.

(24) Check the flow rates as described previously.

(25) Turn the pump off.

(26) Disconnect each impactor from the sample line and rotameter / mass flow meter. Cover the metals impactor with aluminum foil and transport back to the field office in the HH bucket. Cover the glass bottom of the pesticide URG impactor with aluminum foil and seal the impactor with the red cap, place it in a Freezer Ziploc bag and return it to the field office on blue-ice.

(27) Unplug the sampler. If used, remove the grounded plug adapter and extension cord.

(28) Pull the sample lines and electrical cord into the box.

(29) Close and latch the box.

(30) Team Members must complete the appropriate sections on the PM Sampling Data Sheet (Fig.1) and on the Chain of Custody Record (Fig.6).

(31) Once back from the field, the Pesticide Sampler is stored at -20 degrees Celsius and the Metals Sampler is stored at room temperature.

(32) If the SKC Pump fails any quality control checks upon tear down repeat sampling as outlined in 7.2.2 with the extra SKC Pump and samples that have been taken into the field.

7.3 Calculations

The calculations outlined below apply only to the PM Box. No calculations are necessary when using the SKC Pump.

7.3.1 The start and stop time readings from the elapsed time meter on the green box (T_1) and on the T_2 box are all required to calculate the sampling time for the two impactors.

(1) The sample time for the impactor connected to silver sample line, is determined by the elapsed time on T_2 : Silver Line = ($T_{2\,STOP}$ - $T_{2\,START}$).

(2) The sample time for the impactor connected to the red sample line is determined by subtracting the amount of time that pump flow was directed through the silver sample line (the elapsed time from T_2) from the total elapsed pump time recorded on T_1 : Red Line = ($T_{1\,STOP}$ - $T_{1\,START}$) - ($T_{2\,STOP}$ - $T_{2\,START}$).

7.3.2 Sample Line #1 (silver)

(1) Sample time = $T_{2_{stop}}$ - T_{2start}.

7.3.3 Sample Line #2 (red)

(1) Sample time = $(T_{1stop} - T_{1start}) - (T_{2stop} - T_{2start})$.

7.4 Quality Control

(1) 10 percent of all samples will be used for QA/QC purposes.

(2) Field teams consist of 2 - 3 Team members assigned to different tasks when in the HH. On the PM Sampling Data Sheet (Figure 1), there are double check points at many critical data entry/recording moments. These opportunities serve as an independent verification of the data and the readings recorded. The Team Member independently verifies the values recorded by their team-mate and records an "x" in the appropriate box.

(3) Once the Field Team Member has completed the set-up in either the indoor or outdoor environment, she or he switches with a second Field Team Member and verifies the readings recorded for the alternate location.

7.4.1 Tolerance limits

(1) The measured flow rate through the sample line should be within 5% (0.2 LPM) of the 4.0 LPM target when the sampler is set up and within 10% (0.4 LPM) of 4.0 LPM after sampling has occurred. These limits have been calculated, graphed and labeled on each rotameter in the rotameter's units of measurement so that a field check of mass flow rate while using the rotameter can be made.

(2) The calibration of each 'black box' occurs at the laboratory. A card containing the calibration limits (in DVM units) will be mounted inside of the top cover of each box. Field Team Members must verify that the DVM reading while flow rate checking each impactor is within +/- .05 VDC. If the VDC is not within .05 VDC on set-up, the PM box may not be used.

(3) The total run time for the pump (section 7.2) should be within 4 hours of the pre-set run time. In the case of the PM box, elapsed sample time may show variation due to the four hour increment in clock function and external factors related to sampler reliance on an external power source.

(4) Sampler site location is flexible within the bounds of safety and security. Whenever site criteria are not met the field team must document the Field Sheet appropriately.

7.4.2 Detection Limits

(1) The rotameter will be read at the center of black the ball to the nearest minor division.

(2) The DVM will be read to within +/- 0.01 volts.

(3) The elapsed time meters will be read to the nearest 0.1 hour (PM box).

7.4.3 Corrective Actions

(1) If either a rotameter, a mass flow meter or a DVM measurement is out of its specified 0.2 LPM or .05 VDC tolerance limit when setting up the sampler, the box will not be used and will be labeled and returned to the lab for testing and recalibration.

(2) If the rotameter or the mass flow meter flow measurement is out of its specified 10% (0.4 LPM) limit after sampling, the sample will be flagged as suspect. If the deviation exceeds 15% (0.6 LPM), the sample will be killed. In both cases the box should be labeled and returned to the lab. The Field Coordinator must be notified.

(3) If the total run time for the pump is not within 4 hours of the pre-set sampling time, the Field Coordinator will be notified. The PM box will be labeled and returned to the lab for recalibration per UA-G-2.X. The SKC pump will be labeled and returned to the lab for testing.

(4) A duplicate sample will be collected by running two ambient PM boxes or two SKC pumps side by side. Field and lab blank sampling will be accomplished and will account for 10% of all samples collected.

(5) In the HH sampling site the Team Leader supervises all work and completion of forms. Team Members work collectively and check each other's work for accuracy, precision and compliance with SOP procedure and policy.

(6) The "comments" section on the PM Sampling Data Form will be completed, as necessary, to document sampling variation or possible concerns of the Field Staff.

(7) The Field Coordinator or delegate supervises 1 out of 10 sampling procedures to assure proper sample collection, transportation and storage.

(8) Apparent mis-labeling problems detected in the field may be corrected by the Team Members when appropriate and in accordance with SOP #UA-C-2.X.

8.0 RECORDS

8.1 PM Sampling Data Sheet (Fig. 1)

This sampling sheet records critical field operation and tracking information regarding the use of the PM sampler. This data sheet (Fig.1) will serve as the primary record of field sampling and activities. The Team Member operating the PM Sampler is responsible for the thorough completion of this form.

8.2 Chain of Custody Record. (Fig. 6)

8.2.1 This Record (Fig. 6) will serve as the primary record of sample custody. The Team Leader and the Field Team are responsible for the thorough completion of this form.

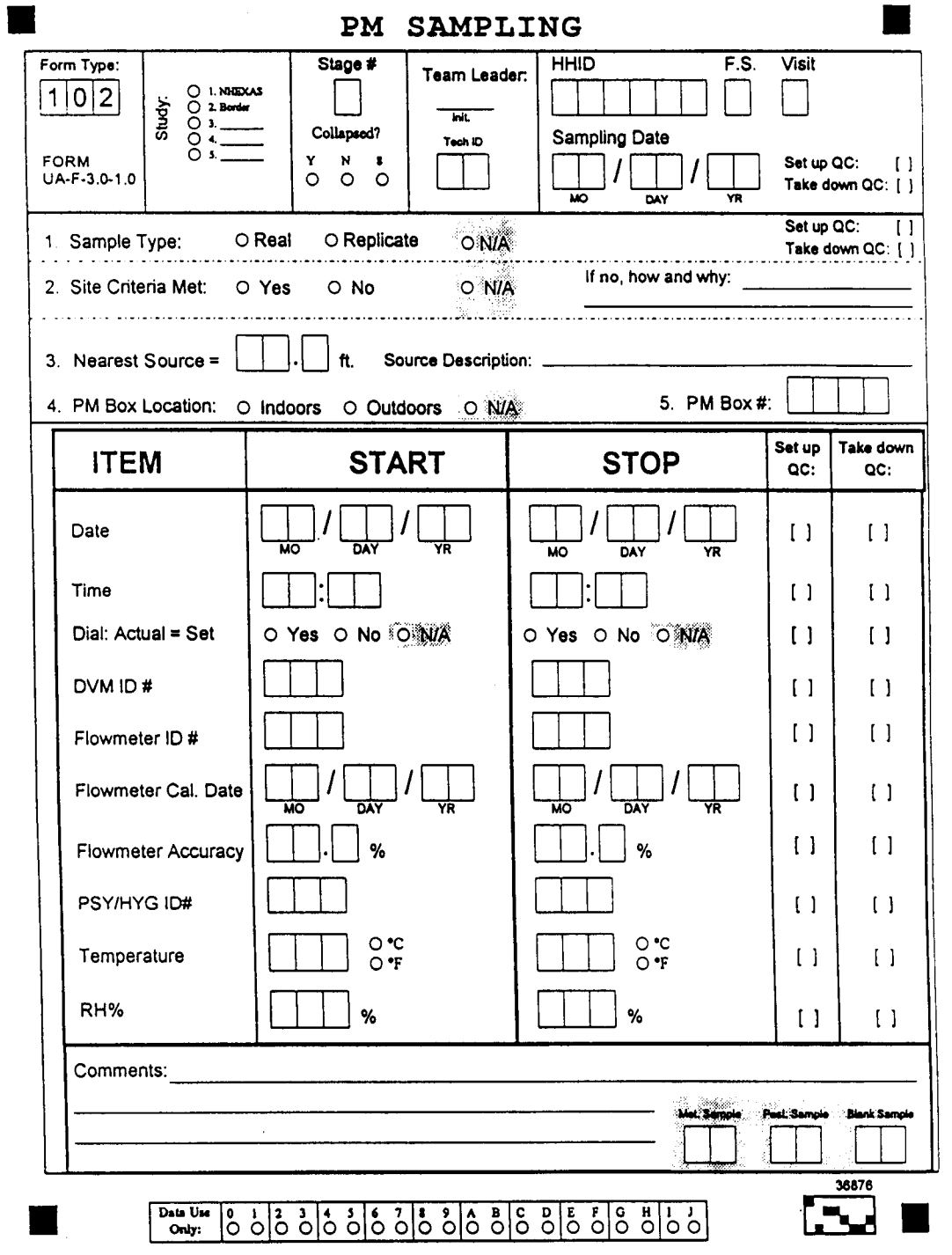
8.2.2 The completed original Chain of Custody Record will remain with the data sample except when the filters are left at a HH while sampling is taking place. The Chain of Custody Record will be stored with the appropriate field sampling sheet in the HH Bucket until the filter is collected from the field. The custody record will then be reunited with the sample by the Team Leader.

8.3 Sample

8.3.1 The impactor will also have the Sample/Filter ID recorded on it. The HHID will be labeled on the impactor where appropriate, and as HHID labels are available.

8.3.2 The original Chain of Custody Record will remain with the sample (except while left with sampler in the field) regardless of where it is shipped or stored.

Figure 1. PM Sampling Data Sheet (page 1 of 2).



PM SAMPLING

Form Type: 102
FORM UA-F-3.0-1.0

Study: ○ 1. NHEXAS ○ 2. Border ○ 3. ____ ○ 4. ____ ○ 5. ____

Stage #

Collapsed? Y ○ N ○ S ○

Team Leader: ____ Init.

Tech ID

HHID

F.S.

Visit

Sampling Date MO / DAY / YR

Set up QC: [ ]
Take down QC: [ ]

1. Sample Type: ○ Real ○ Replicate ○ N/A

2. Site Criteria Met: ○ Yes ○ No ○ N/A If no, how and why: ____

3. Nearest Source = ____ ft. Source Description: ____

4. PM Box Location: ○ Indoors ○ Outdoors ○ N/A 5. PM Box #:

ITEM	START	STOP	Set up QC:	Take down QC:
Date	MO / DAY / YR	MO / DAY / YR	[ ]	[ ]
Time	:	:	[ ]	[ ]
Dial: Actual = Set	○ Yes ○ No ○ N/A	○ Yes ○ No ○ N/A	[ ]	[ ]
DVM ID #			[ ]	[ ]
Flowmeter ID #			[ ]	[ ]
Flowmeter Cal. Date	MO / DAY / YR	MO / DAY / YR	[ ]	[ ]
Flowmeter Accuracy	. %	. %	[ ]	[ ]
PSY/HYG ID#			[ ]	[ ]
Temperature	○ °C ○ °F	○ °C ○ °F	[ ]	[ ]
RH%	%	%	[ ]	[ ]

Comments: ____

Met. Sample | Pest. Sample | Blank Sample

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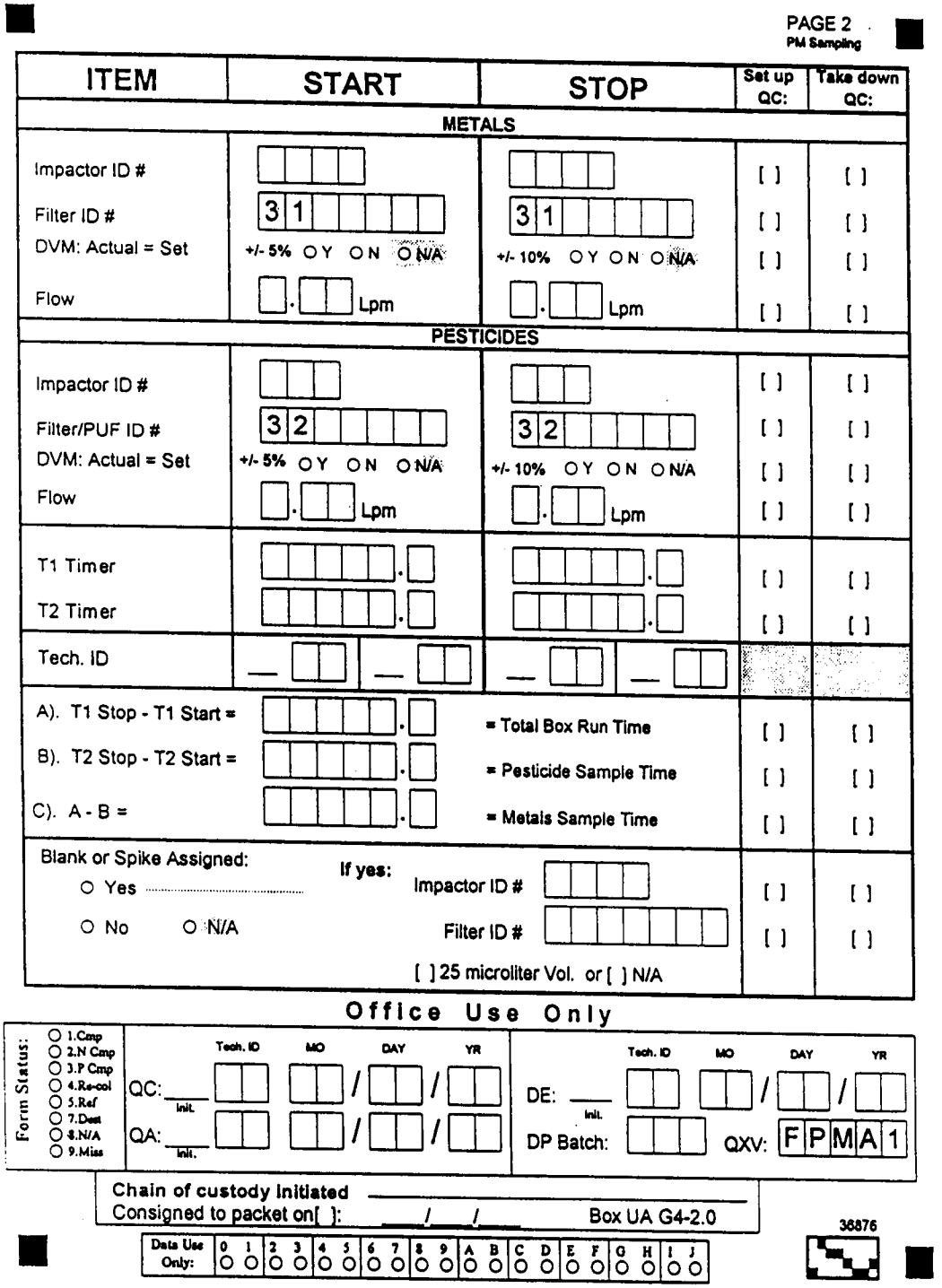
Data Use Only: 0 1 2 3 4 5 6 7 8 9 A B C D E F G H I J

Figure 1. PM Sampling Data Sheet (page 2 of 2).



PAGE 2
PM Sampling

ITEM	START	STOP	Set up QC:	Take down QC:
METALS				
Impactor ID #			[ ]	[ ]
Filter ID #	31	31	[ ]	[ ]
DVM: Actual = Set	+/- 5% O Y O N O N/A	+/- 10% O Y O N O N/A	[ ]	[ ]
Flow	. Lpm	. Lpm	[ ]	[ ]
PESTICIDES				
Impactor ID #			[ ]	[ ]
Filter/PUF ID #	32	32	[ ]	[ ]
DVM: Actual = Set	+/- 5% O Y O N O N/A	+/- 10% O Y O N O N/A	[ ]	[ ]
Flow	. Lpm	. Lpm	[ ]	[ ]
T1 Timer	.	.	[ ]	[ ]
T2 Timer	.	.	[ ]	[ ]
Tech. ID	_ _	_ _		
A). T1 Stop - T1 Start =	.	= Total Box Run Time	[ ]	[ ]
B). T2 Stop - T2 Start =	.	= Pesticide Sample Time	[ ]	[ ]
C). A - B =	.	= Metals Sample Time	[ ]	[ ]
Blank or Spike Assigned: O Yes ..... O No O N/A	If yes: Impactor ID # / Filter ID #	[ ] 25 microliter Vol. or [ ] N/A	[ ] [ ]	[ ] [ ]

Office Use Only

Form Status: O 1.Cmp O 2.N Cmp O 3.P Cmp O 4.Re-col O 5.Ref O 7.Dest O 8.N/A O 9.Miss

QC: ___ Init. Tech. ID / MO / DAY / YR

QA: ___ Init. Tech. ID / MO / DAY / YR

DE: ___ Init. Tech. ID / MO / DAY / YR

DP Batch: QXV: FPMA1

Chain of custody initiated _____
Consigned to packet on[ ]: ___/___/___ Box UA G4-2.0

Data Use Only: 0 1 2 3 4 5 6 7 8 9 A B C D E F G H I J

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Figure 2. Inside the PM Black Box (pumping unit).

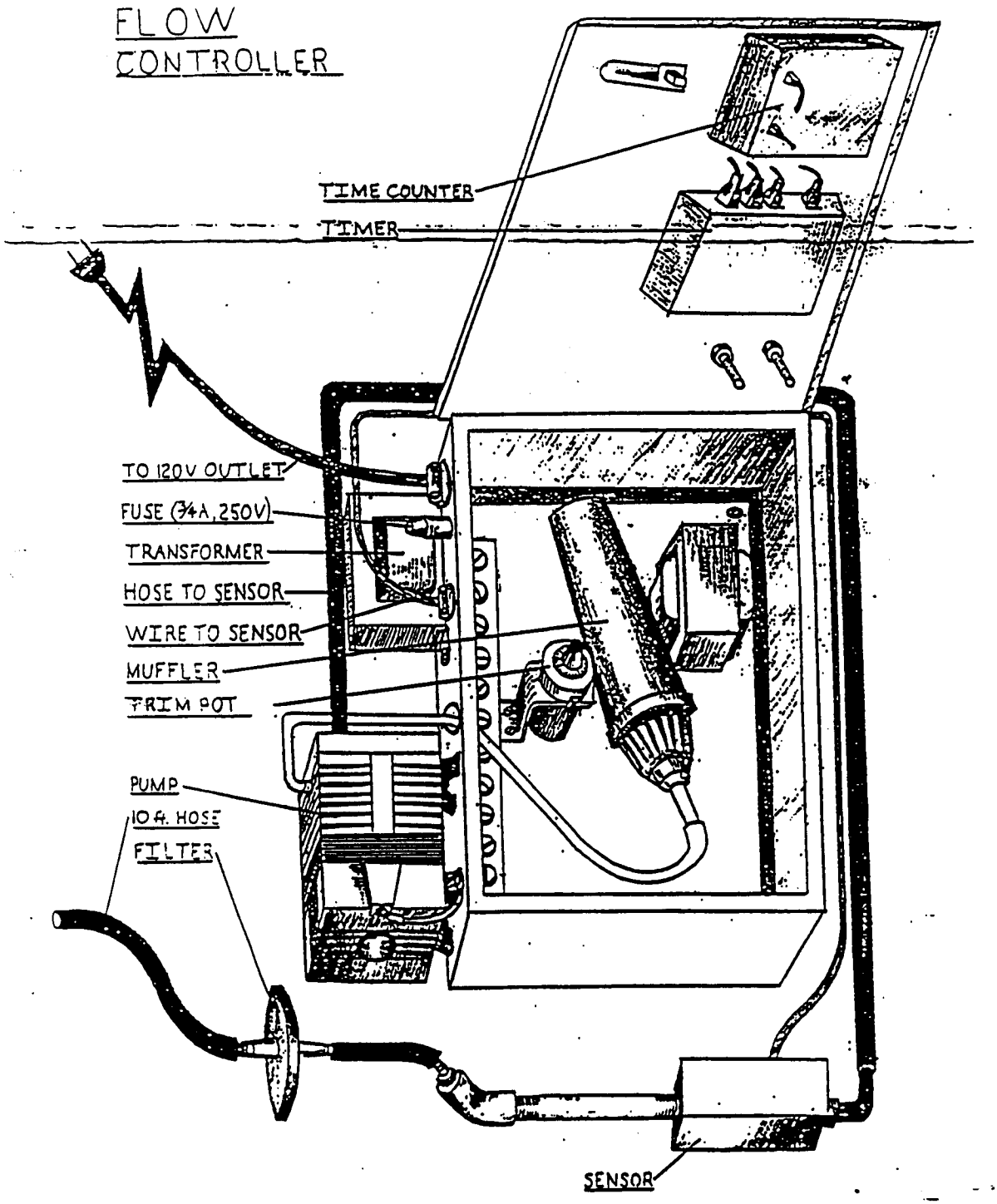


Figure 3. Inside the T_2 Timer Housing.

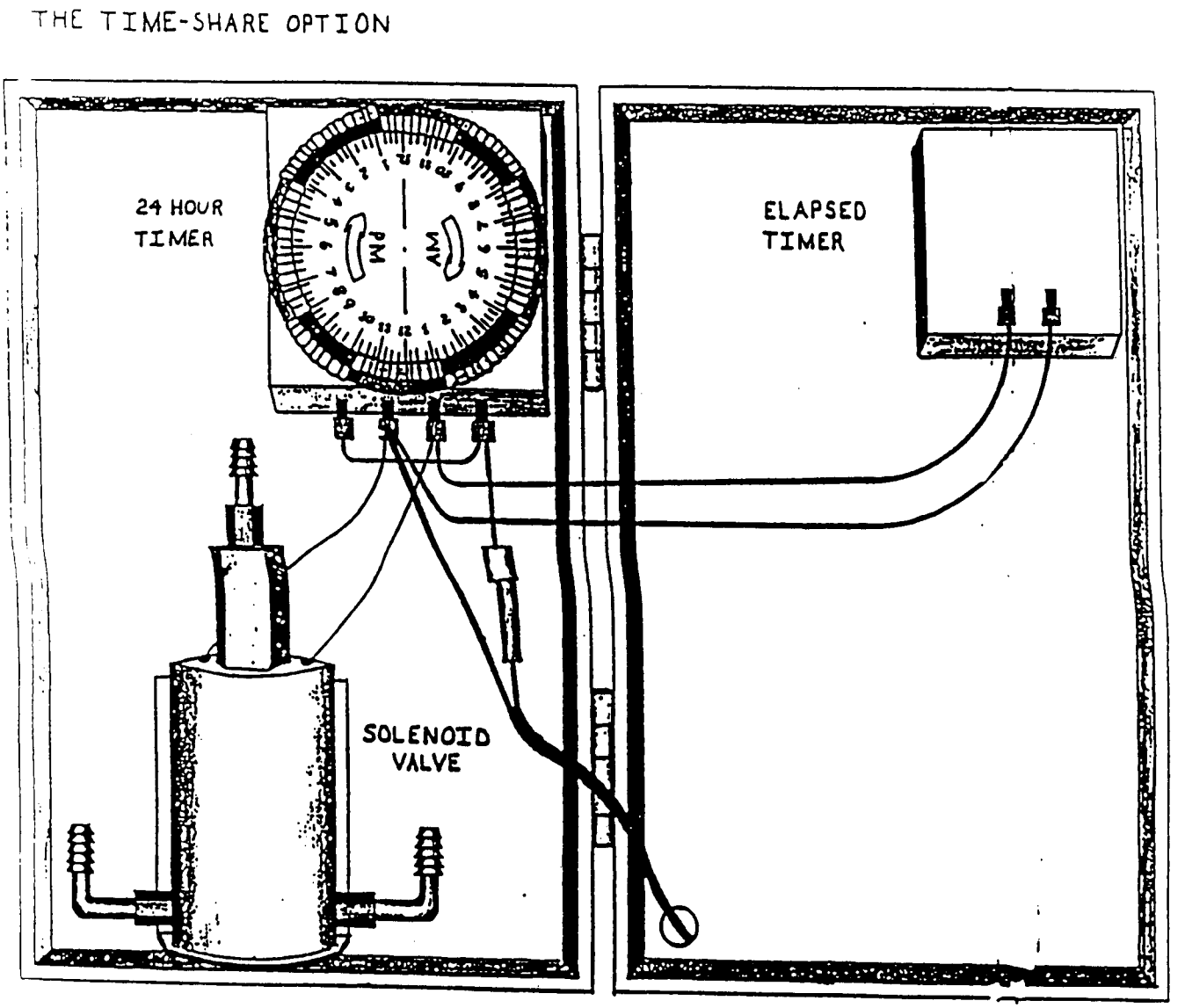


Figure 4. Aluminum Impactor for the metals analysis.

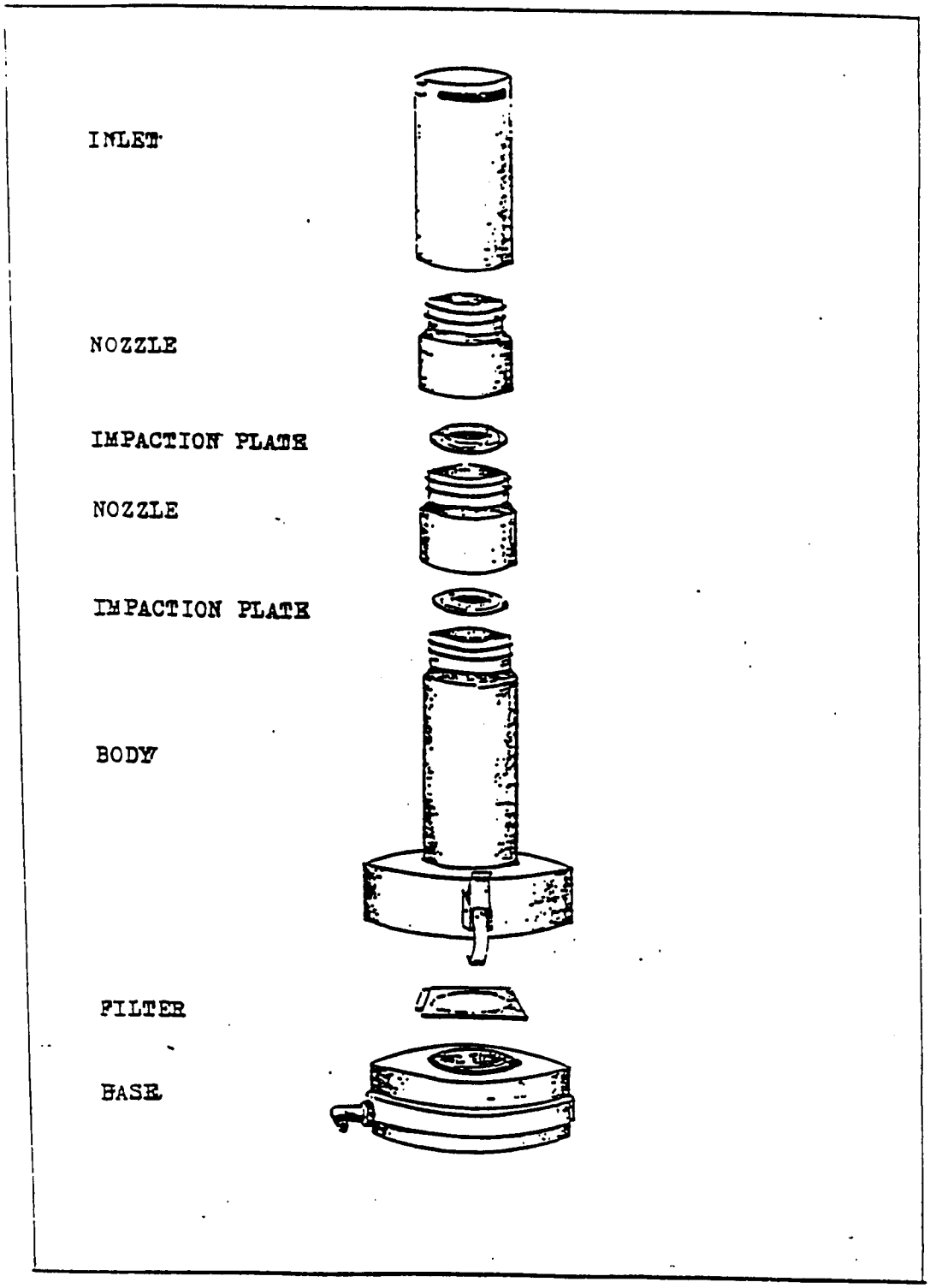


Figure 5. URG Impactor for Pesticide Analysis.

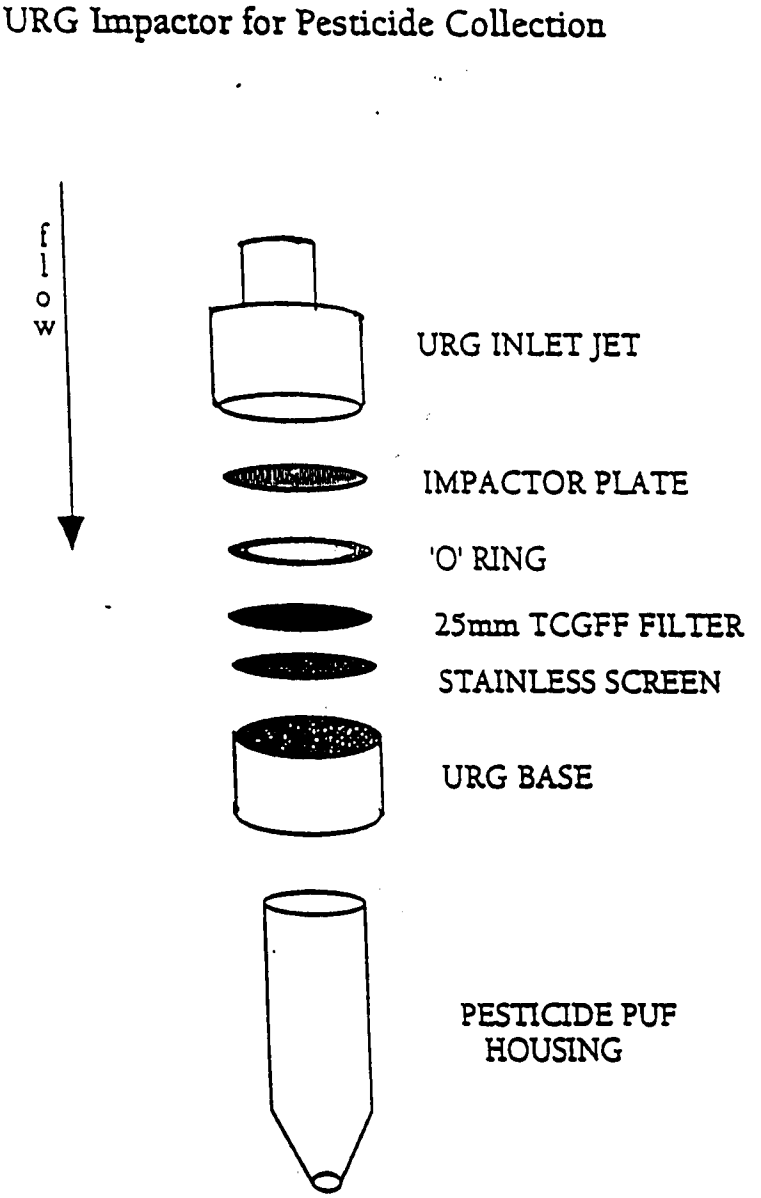


Figure 6. Chain of Custody Record.

Chain of Custody Record
NHEXAS Arizona Project (CR-821560)
Respiratory Sciences
1435 N. Fremont Ave
Tucson, AZ 85719
(520) 626 - 4226

Sample Type: ______________________. page ____ of ____.

Generated by: ______________________/______________________
print name *signature*

Date Generated	Time	Sample ID	# of Containers	Remarks
___/___/___	___:___			

History of Sample Handling and Custody

Relinquished or Received	Signature	Date mo / day / yr	Time	Action
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	
[Rel] or [Rec]		___/___/___	___:___	

FORM = UA-G4.0 - 1.2

Attach Additional Pages as Necessary

Figure 7. Handling of Particulate Sample (Metals) from the Harvard Sampler (PM Box) or the SKC pump.

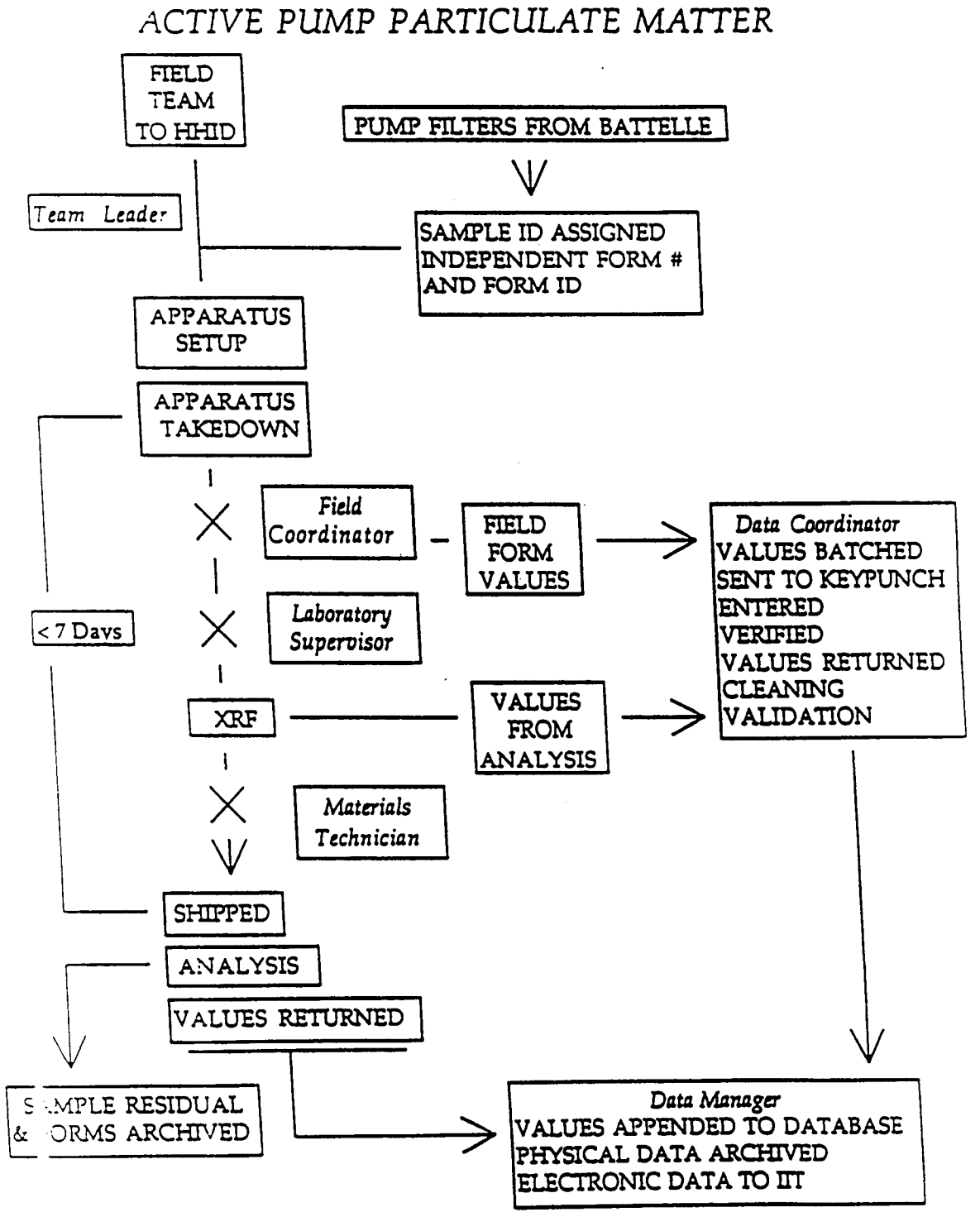


Figure 8. Relative Timing of Sample Collection (page 1 of 3).

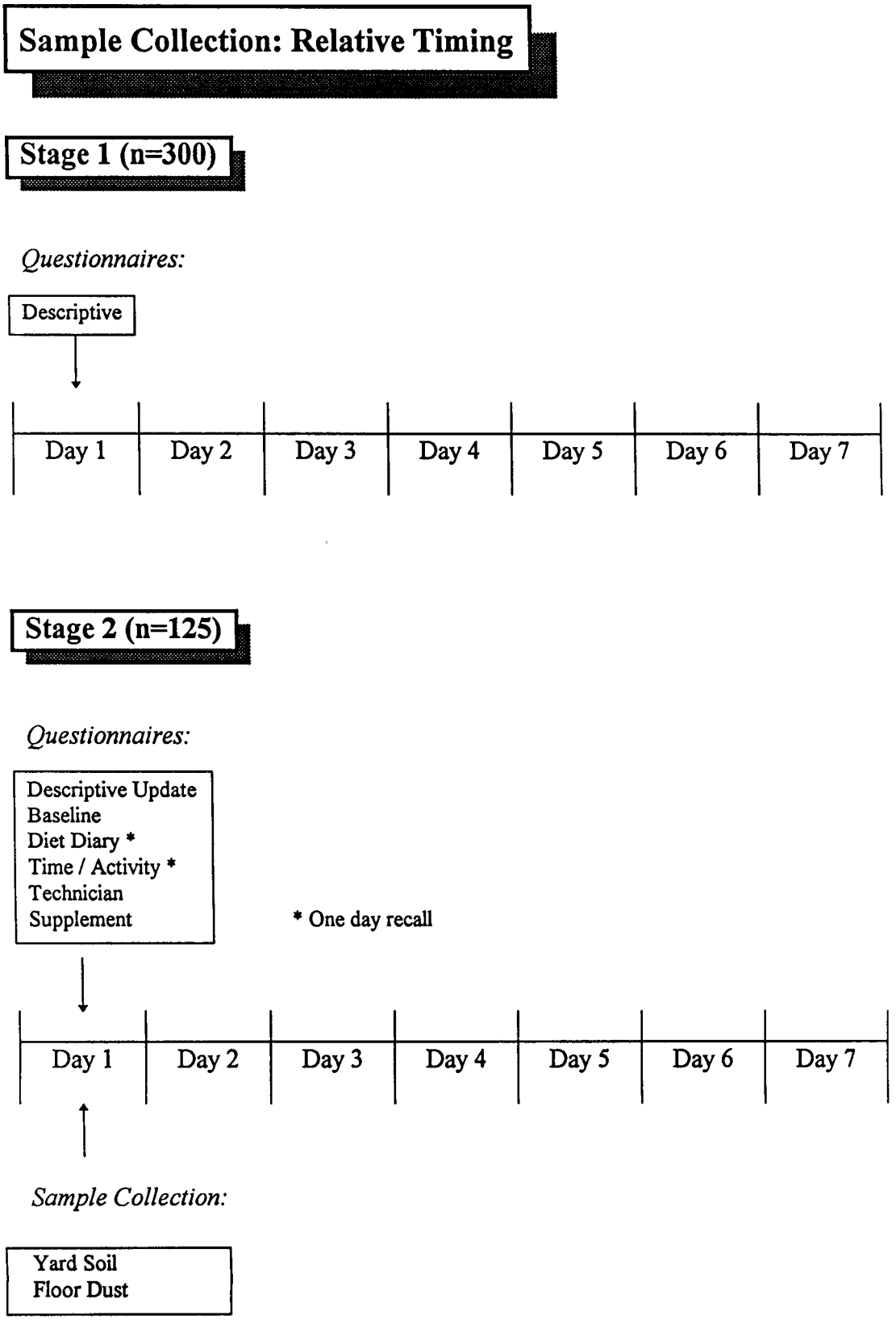
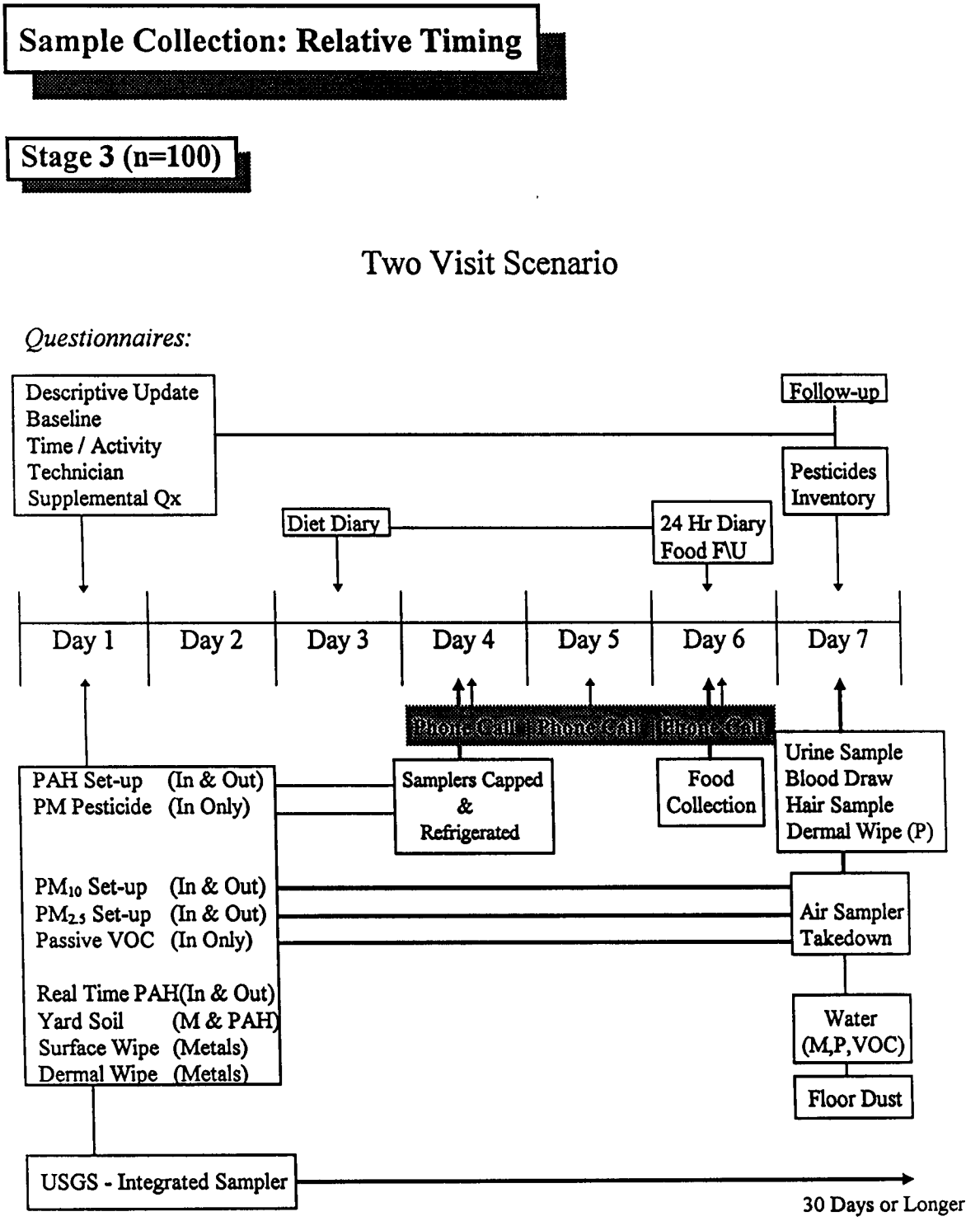
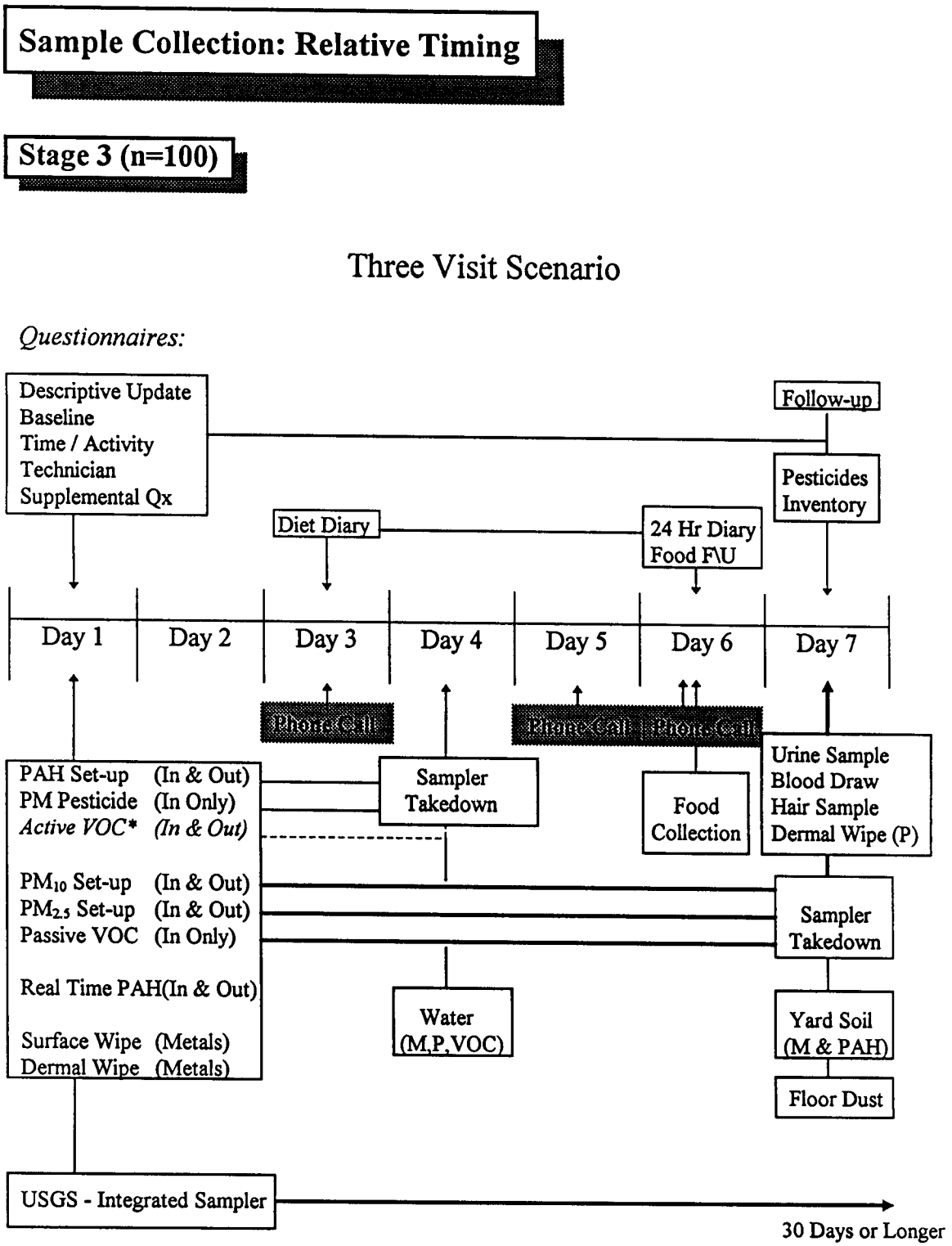


Figure 8. Relative Timing of Sample Collection (page 2 of 3).



* Active VOC is collected in a subset of 25 homes only

Figure 8. Relative Timing of Sample Collection (page 3 of 3).



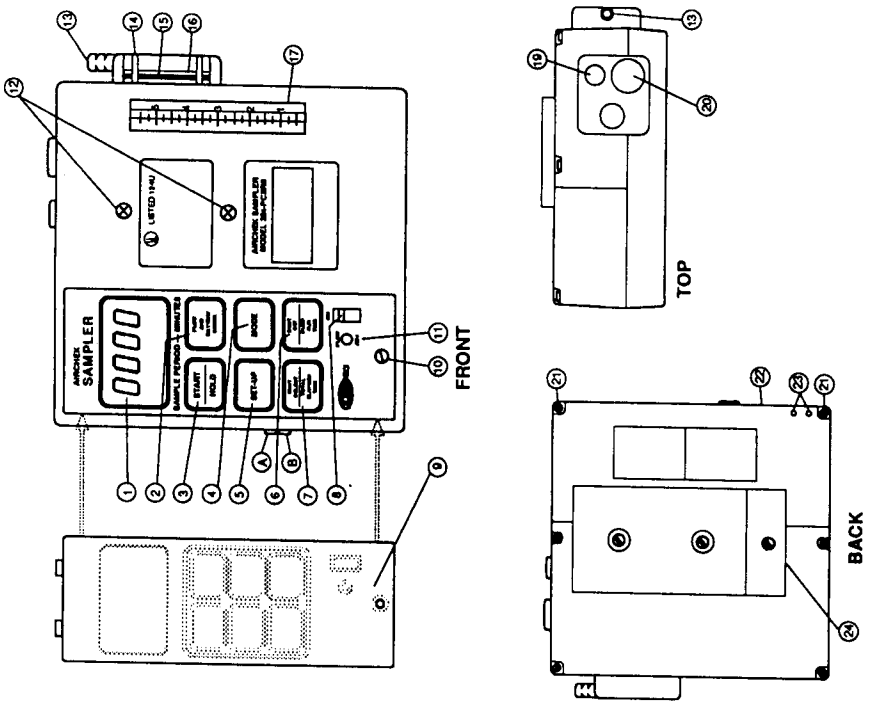
* Active VOC is collected in a subset of 25 homes only

Figure 9. Field Trouble shooting guide for the PM Sampler.

PM TROUBLE SHOOTING GUIDE

POSSIBLE SYMPTOMS	POSSIBLE SOLUTIONS
Box does not turn on	1. Check if fuse has blown. 2. Check socket used to plug the box in (is it controlled by a wal switch?) 3. Check the terminals; should be tight.
Rotameter flow is low	1. Check for blockage/crimps in the lines. 2. Check for crimp in the outlet hose of the pump that leads to the muffler. 3. Check impactor base; should be securely clipped to the body of the impactor. 4. Check vents on sides of box. 5. Close box lid while readings are taken.
Rotameter flow is high	1. Allow a full 5 minute warm-up before taking readings. 2. Close box lid while readings are taken.
Box is too noisy	1. Check for loose material in the fan. 2. Check muffler.
Box is hot	1. Check the vents on sides of the box; are they blocked? 2. Check fan; is it plugged in?
DVM out of range	1. Close lid of box while taking readings.

Figure 10. SKC Pump Diagrams and Part Description.



Diagrams/Part Description

Figure 1 – Model 224-PCXR8

No. Part Name and Description

1. **LCD Display.** Indicators for all sampler functions.
2. **Flow and Battery Check Key.** Allows setting flow rate and testing battery condition.
3. **Start/Hold Key.** Used when ready to begin the sampling cycle, pause the sampling cycle and restart the cycle after pause.
4. **Mode Key.** During set-up allows changing between delayed start, pump run time and total elapsed time.
5. **Set-up Key.** Allows setting the delayed start, pump run time and total elapsed time desired.
6. **Digit Set/Pump Run Time Key.** Allows setting the flashing digit to the desired value or viewing the actual pump run time during the actual sampling cycle.
7. **Digit Select/Total Elapsed Time Key.** Allows selecting which time digit is being set when in set-up mode or viewing total elapsed time during the actual sampling cycle.
8. **On/Off switch.** Allows the pump to be shut down completely for long periods of storage (over 30 days).
9. **Anti-tamper cover.** Protects controls from accidental contact or tampering.
10. **Cover screw.** Fastens anti-tamper cover.
11. **Flow adjustment control.** Adjusts flow from 750–5000 ml/min.
12. **Accessory mounting screws (2).** Secure accessories such as impinger and trap holders.
13. **Filter housing (intake).** Air intake port and trap.
14. **Filter housing screws (4).** Secure Filter housing
15. **Filter O-ring.** Leak seal for filter in housing.
16. **Filter (10 micron nylon).** Filters particulates before entering pump.
17. **Built-in flowmeter.** Monitors for flow changes.
19. **Regulator shut-off cap screw.** Accesses regulator shut-off valve screws.
20. **Discharge air cap screw.** Accesses exhaust port.
21. **Battery pack screws (2).** Secures pack to pump.
22. **Battery pack assembly.** Provides power to pump.
23. **Charging jack.** Connector for battery charger.
24. **Belt clip.** Secures pump to worker.

A. **Compensation pot A.** Adjusts pump compensation which is factory set. Access screw guards against accidental contact or tampering.

B. **Compensation pot B.** Adjusts pump compensation which is factory set. Access screw guards against accidental contact tampering.