STATE OF CALIFORNIA

AIR RESOURCES BOARD

QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX E

HIGH VOLUME SAMPLER

MONITORING AND LABORATORY DIVISION

March 1992

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AIR RESOURCES BOARD

QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX E.1

HIGH VOLUME SAMPLER

MONITORING AND LABORATORY DIVISION

JANUARY 1989

E.1.1 SAMPLING PROCEDURE

E.1.1.1 SAMPLING FREQUENCY

The high volume samplers are run on a six-day sampling schedule specified by the United States Environmental Protection Agency (U.S. EPA). For certain projects, the sampling frequency may be increased to daily or every three days. Figure E.1.1.1 shows the standard six-day sampling schedule. The sampling duration is 24 hours, 0000 to 2400 hours PST. Special sampling (sulfates, etc.) may require varied time schedules and other than the 0000 hour starting time.

E.1.1.2 PRE-RUN PROCEDURE

1. Air Sample Report - Prior to each run, record on the Air Sample Report the reporting agency, station address, station name, instrument number, and county, site, agency, and project codes. Figure E.1.1.2 shows the Air Sample Report, Form PTSD-2. These reports are available from the Instrumentation and Operations Support Section, telephone number (916) 445-0616.

2. Clean Filter Installation - Open the sampler cover and remove the faceplate. Wipe the inside of the filter shelter and support the frame with a clean cloth to remove accumulated material. Remove the filter from the manila folder. Center the preweighed filter with the rough side up on the filter adaptor assembly. Replace the faceplate and carefully tighten the wing nuts, spring clips, or other fasteners on your particular sampler. Filters are available from the Instrumentation and Operations Support Section, telephone number (916) 445-0616.

   NOTE: Undertightening the faceplate will allow air leakage. Overtightening will damage the rubber faceplate gasket. Keep the gasket clean to prevent the filter from sticking to the faceplate or gasket.

3. Initial Flow Meter Reading - Prior to each run, it must be verified that the sampler flow rate is at the set point value (within five percent) listed in Table E.2.0.1. This table gives standard flow rates (SCFM) at various site elevations.

   a. Samplers with Flow Recorders

Record the filter number, station number, and run date on the back of the circular chart. Carefully insert the new chart into the recorder. Center the tab on the slotted drive so that the chart will rotate the full 360 degrees without binding or slipping. Rotate the chart so that the pen head rests on the predetermined start time (usually 0000 hours). Check the zero setting. If the pen is not at 0 CFM, tap the recorder lightly to verify that the pen is free. If it still does not zero, reset the pen to 0 CFM using the zero adjust (see Figure E.1.1.3). Turn on the sampler (clean filter in place), tap the recorder lightly, and allow it to run for five minutes. Using the sampler calibration curve, convert the flow meter reading to standard flow rate (SCFM) and verify this value is at the set point (within five percent) listed in Table E.2.0.1. Record these values on the Monthly Checksheet (see Section E.1.2.2) and on the Air Sample Report. On these forms, standard flow rate is termed "true air flow" (SCFM). If outside of the setpoint range, adjust the sampler flow controller potentiometer and repeat this paragraph.

b. Samplers with Rotameters

Turn on the sampler and allow it to run for five minutes. Connect the rotameter. The rotameter and tubing must be the same as those used in the calibration. Observe the J rotameter at eye level (the same level as during the calibration) and read the value at the center of the ball to the nearest whole number. Using the sampler calibration curve, convert the rotameter reading to standard flow rate (SCFM) and verify this value is at the setpoint ($\pm$5 percent) listed in Table E.2.0.1. Record these values on the Monthly Checksheet (see Section E.1.2.2) on the Air Sample Report. On these forms, standard flow rate is termed “true air flow” (SCFM). Use the rotameter only for checking the initial and final flow meter readings. At all other times, store the rotameter indoors or inside the hi-vol shelter to avoid contamination and damage.

4. Timer Setting - Set the timer clock to start at the predetermined start time on the designated date, and to shut off 24 hours later, as follows:

a. Dayton and Paragon 7-Day Timer: There are two separate trippers on the dial rim they are not interchangeable. Place

Tripper A at the time the switch should turn on. Place Tripper B at the time the switch should turn off. Trippers must be tight against the dial rim. Tighten tripper screws with fingers only. Grasp dia1 and rotate CLOCKWISE ONLY until current day and time of day appear at time pointer (do not turn the time pointer).

b. General Metal Works Timer/Programmer (GMW-800)

Sixth-Day Sampling: Place all seven-day switches in the DOWN position. Reset the indicator light to the fifth from the left position (Thursday) by sequentially pressing the **DAY RESET** switch. Place the sixth DAY (Friday) in the UP position. Set the toggle switch between clocks "A" and "B" to the left-hand position. The sampling period is from midnight of the current day to midnight the following day, and every six days thereafter.

Note: When in the sixth-day sampling mode, disregard days of the week nomenclature; the days of the week should be regarded as numbered positions only and do not identify the actual day. For 24-hour, or episode sampling, refer to the instructions in the Manufacturer's Operating Manual.

24-Hour Sampling (alternate procedure to 4b): With all seven-day switches and the sixth-DAY SAMPLE switch in the DOWN position, reset the indicator light to the present day by sequentially pressing the DAY RESET switch. The toggle switch between clocks "A" and "B" is set in the left- hand position. The desired sampling day switch is placed in the UPWARD position. The sampling period is from midnight to midnight.

5. Elapsed Time Meter - Record the initial elapsed time meter reading on the Monthly Checksheet.

E.1.1.3 POST-RUN PROCEDURE

1. Final Flow Meter Reading

a. Samplers with Flow Recorders

Before removing the filter and flow chart, make sure that the recorder trace shows the final flow. If not, the sampler must be started to determine the final flow.

Remove the flow chart from the recorder and examine the trace for abnormalities. Note and investigate any abrupt changes in air flow. If the start and finish air flows are not representative of your geographic area, note this on the Air Sample Report under "Remarks".

b. Samplers with Rotameters

Connect the rotameter to measure the final flow meter reading as soon as practica1 after the 24-hour sample. Run the sample for five minutes and observe the rotameter at eye level and determine the flow meter reading as stated in E.1.1.2. 3b. If the start and finish flows are not representative of your geographic area, note this on the Air Sample Report under "Remarks".

2. Exposed Filter Removal - Remove the faceplate from the supporting screen. Grasp the exposed tilter without touching the darkened area. Fold it in half width-wise with the darkened side in. A satisfactory filter is one which has a uniform white border. Dark streaks into the border may indicate an air leak which invalidates the sample. If there are insects on the filter, remove them carefully. Note on the Air Sample Report if the filter is torn or ruptured, if pieces of filter are left sticking to the gasket, if the start or finish times are not known, or if the flows are outside the acceptable range *. Invalidations will be determined by laboratory staff.

3. Timer and Elapsed Time Meter Check - After each run, check how long the sampler ran by reading the elapsed time meter. Record the final elapsed time meter (ETM) reading on the Monthly Check-sheet. These ETM readings are used in calculating the concentration of collected particulates as they are more accurate than the timer or flow chart times. Adjust the trippers accordingly on those timers that are adjustable, to meet the timer acceptance limits of 24 hours $\pm$ 15 minutes.

* The acceptable range is 39 to 60 CFM multiplied by the altitude correction factor found in Table E.2.0.l. The acceptable limits of run duration are 24 $\pm$ 1 hours.

4. Air Sample Report - Record on the Air Sample Report the sampling conditions code, start and finish dates and times, the initial and final flow meter or flow chart readings. Using the sampler calibration Curve, convert the flow meter or flow chart readings to true air flow, in SCFM, and record these values on the Air Sample Report.

5. Sample Shipment - Place the flow chart (if used), exposed filter, and original and one carbon copy of the Air Sample Report in the glassine envelope provided. Mail to the Support Laboratory designated on the return envelope address sticker. Give the remaining carbon copy of the Air Sample Report to the Senior Instrument Technician.

E.1.1.4 QUALITY CONTROL CRITERIA FOR FILTER SAMPLES

Quality control invalidation criteria for filter samples collected on Total Suspended Particulate (TSP) High Volume Samplers are listed below. All samples collected in the field will be checked using these criteria. If a sample is found to be invalid per these criteria, the sample and report form will be sent to the laboratory and a make-up run will be scheduled immediately.

1. Filter Contamination - Filter samples which are dropped or become contaminated by any foreign matter (i.e., dirt, finger marks, ink, liquids, etc.) will be invalidated.

2. Damaged or Torn Filters - Filter samples with tears or pinholes which occurred before or during sampling will be invalidated.

3. Sample Flowrate - The sample flowrate must be greater than or equal to 39 SCFM and less than or equal to 60 SCFM. ($\geq$ 39 and $\leq$ 60 SCFM). The actual flowrate through samplers operating at elevations higher than 1,000 feet will vary with altitude. If the flowrate through the sampler varies outside the calculated acceptable range for each site for more than one hour during the sampling period, the sample will be invalidated. This includes irregular flowrate excursions and the sampler warm-up stabilization period.

4. Start/Stop Times - The sampler start and stop time must be 1200 midnight ±30 minutes. Filter samples collected by samplers starting before 2330 hours and stopping after 0030 hours, as indicated by the Dickson Chart recorder, will be invalidated. Please note that if the Dickson recorder chart indicates the sample run began before 2330 hours or ended after 0030 hours, the sample is invalid unless the operator can determine that the error in start/stop time was the result of an accidental error in the recorder pen alignment and notes the error and verifies the validity of the sample in the comments section of the report form.

5. Sample Run Duration - Sample run duration shall be at least 23 hours and no more than 25 hours (1440 ± 60 minutes). Filter samples collected on samplers which operated for less than 23 hours or more than 25 hours, as documented by the Dickson recorder chart and/or the elapsed time meter, will be invalidated.

6. Power Failure - If a power failure during a sample run causes the stop time or sample run duration requirements (#4 and #5 above) to be violated, the sample collected during the run will be invalidated.

7. Dickson Recorder Chart - A complete Dickson recorder chart, documenting the flowrate through the sampler for 24 hours, must be submitted to the laboratory with each filter sample. Filter samples without a complete Dickson recorder chart record will be invalidated. If the Dickson recorder chart record is damaged (such as the center drive section torn out) so a complete 24-hour record of the sample run cannot be recorded, the sample will be invalidated.

   Note: In cases of inking problems where the trace is incomplete, if the operator states the sampler operated properly in the comments section of the report form, the sample will be considered valid.

8. Report Form - The filter sample will be invalidated if a completed 24-Hour Report Form is not included with the sample when received by the laboratory staff.

9. Filter Leakage - If the filter sample shows evidence of air leakage due to a worn or improperly seated gasket, the sample will be invalidated.

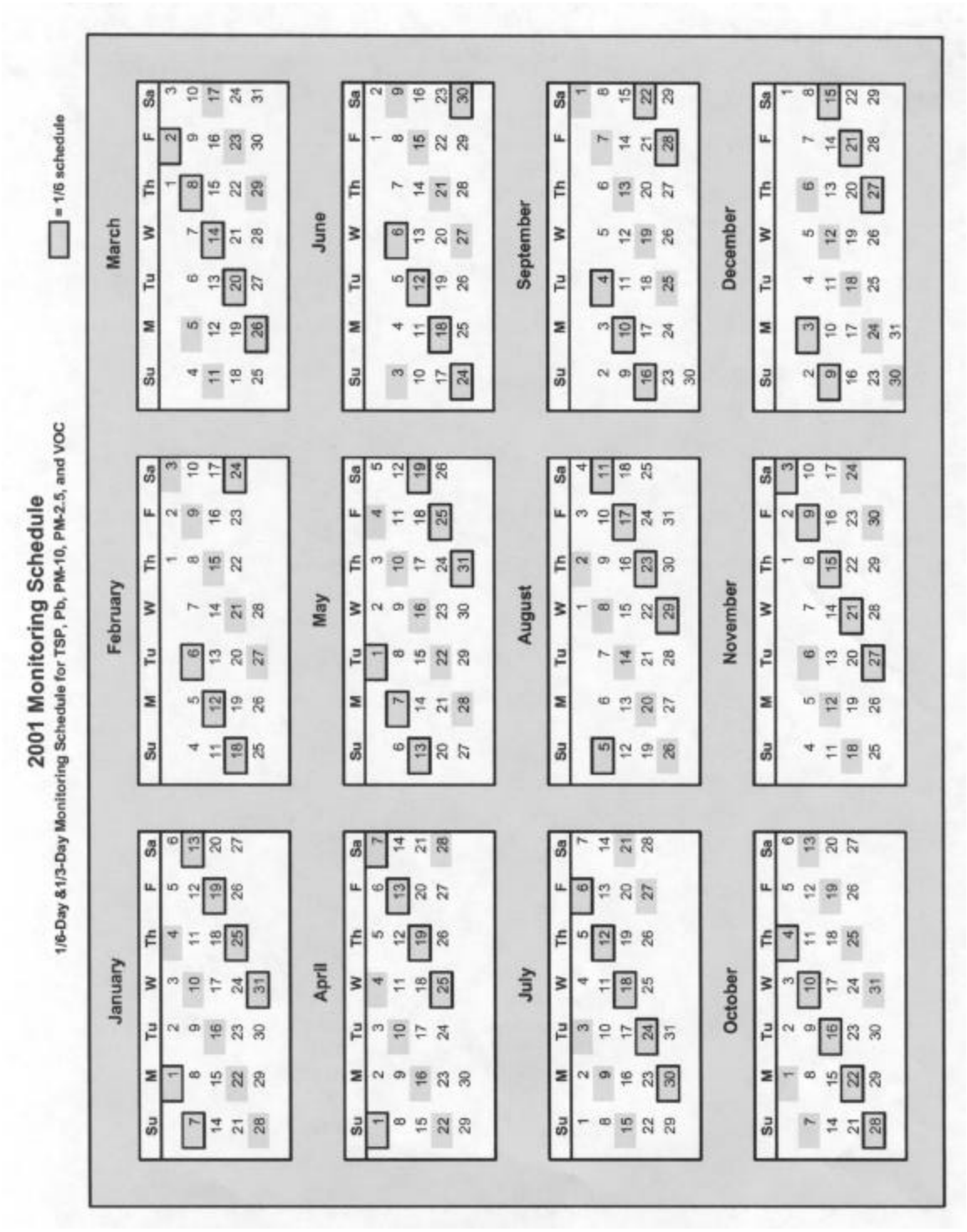
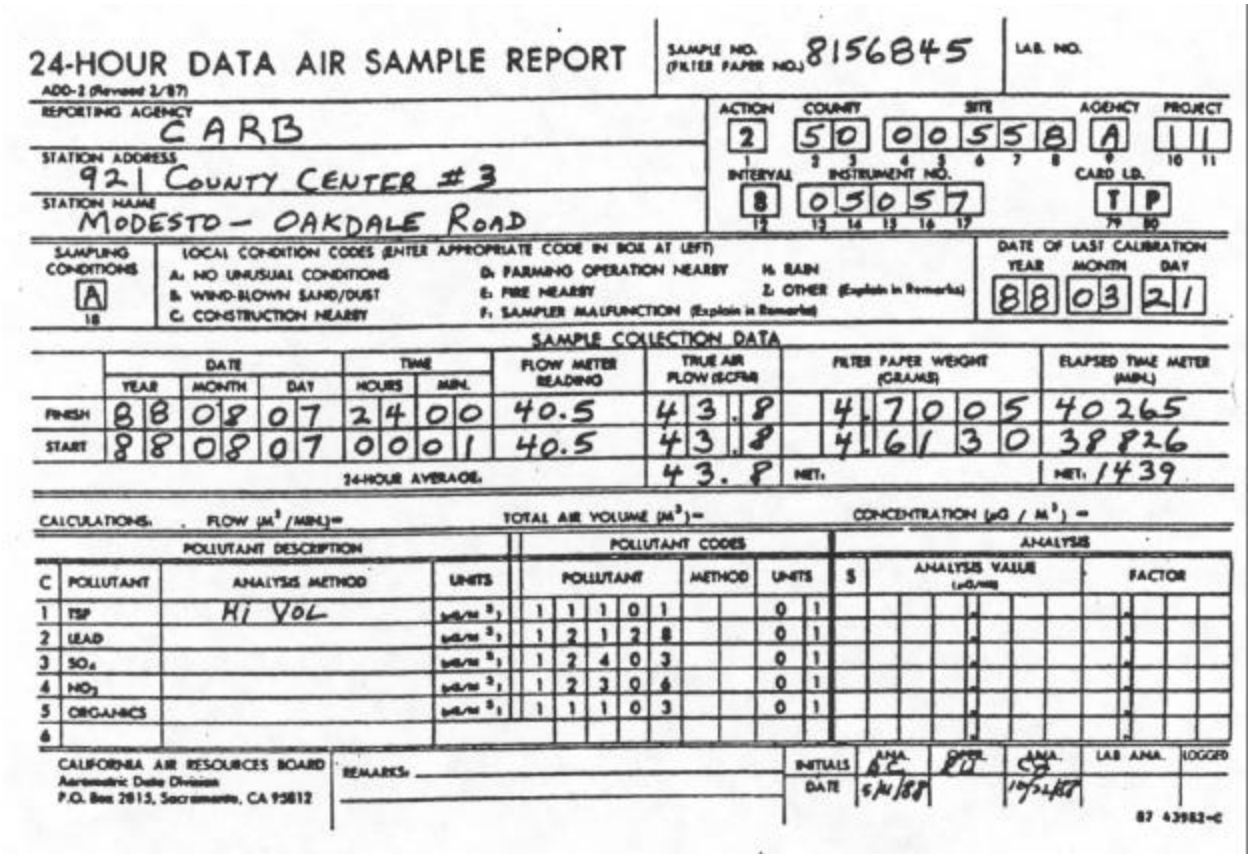


Figure E.1.1.1
2001 Sampling Schedule



24-HOUR DATA AIR SAMPLE REPORT

SAMPLE NO. (FILTER PAPER NO.) 8156845 LAB. NO.

ADD-2 (Revised 2/87)

REPORTING AGENCY: CARB

STATION ADDRESS: 921 County Center #3

STATION NAME: Modesto – Oakdale Road

ACTION: 2 COUNTY: 50 SITE: 00558 AGENCY: A PROJECT:

INTERVAL: 8 INSTRUMENT NO.: 05057 CARD I.D.: TP

SAMPLING CONDITIONS: A

LOCAL CONDITION CODES (ENTER APPROPRIATE CODE IN BOX AT LEFT)
A. NO UNUSUAL CONDITIONS
B. WIND-BLOWN SAND/DUST
C. CONSTRUCTION NEARBY
D. FARMING OPERATION NEARBY
E. FIRE NEARBY
F. SAMPLER MALFUNCTION (Explain in Remarks)
H. RAIN
Z. OTHER (Explain in Remarks)

DATE OF LAST CALIBRATION: YEAR 88 MONTH 03 DAY 21

SAMPLE COLLECTION DATA

	DATE YEAR	MONTH	DAY	TIME HOURS	MIN.	FLOW METER READING	TRUE AIR FLOW (SCFM)	FILTER PAPER WEIGHT (GRAMS)	ELAPSED TIME METER (MIN.)
FINISH	88	08	07	24	00	40.5	43.8	4.7005	40265
START	88	08	07	00	01	40.5	43.8	4.6130	38826
24-HOUR AVERAGE							43.8	NET:	NET: 1439

CALCULATIONS: FLOW (M³/MIN.)= TOTAL AIR VOLUME (M³)= CONCENTRATION (µG / M³) =

C	POLLUTANT	ANALYSIS METHOD	UNITS	POLLUTANT CODE	METHOD	UNITS	S	ANALYSIS VALUE (µG/M³)	FACTOR
1	TSP	Hi Vol	µg/m³	11101		01			
2	LEAD		µg/m³	12128		01			
3	SO_4		µg/m³	12403		01			
4	NO_3		µg/m³	12306		01			
5	ORGANICS		µg/m³	11103		01			
6									

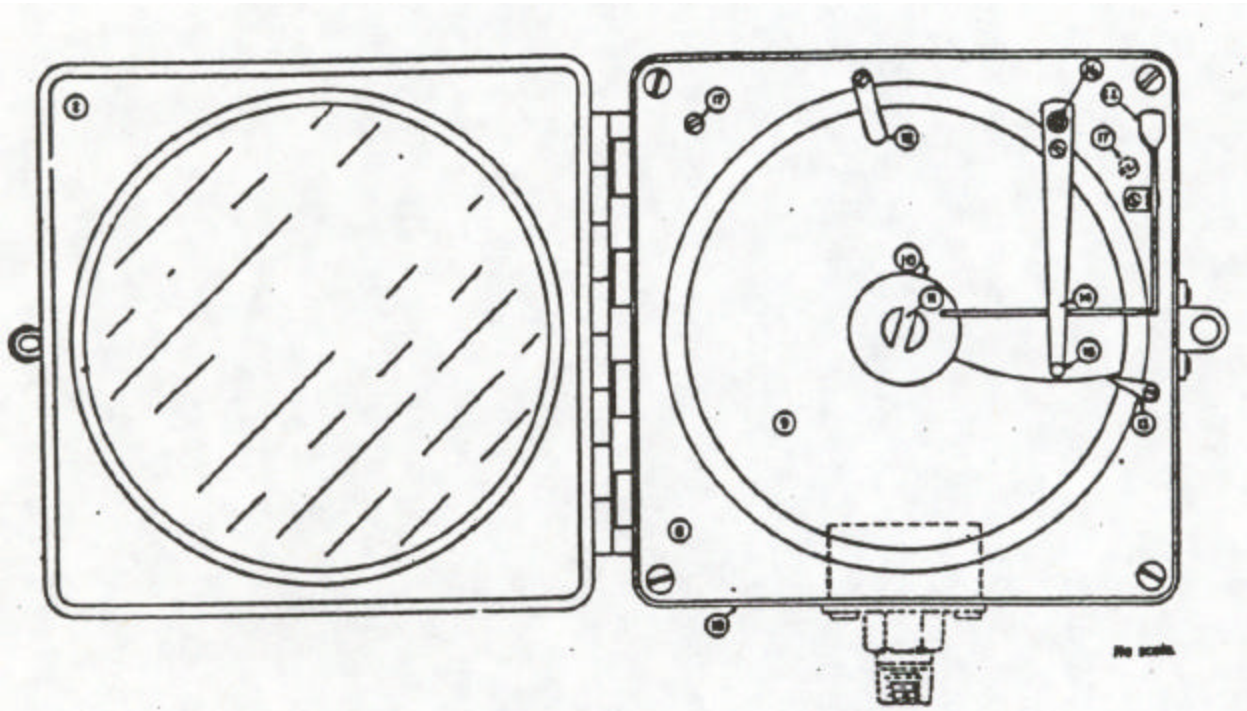
CALIFORNIA AIR RESOURCES BOARD
Aerometric Data Division
P.O. Box 2815, Sacramento, CA 95812

REMARKS:

	ANA.	CHKD.	ANA.	LAB ANA.	LOGGED
INITIALS	BC	BD	CS		
DATE	6/21/88		10/24/88		

87 43982-C

Figure E.1.1.2
24-Hour Data Air Sample Report



2. Door Assembly
8. Instrument Dial Assembly
9. Chart
10. Chart Hub
11. Chart Hub Slot
12. Chart Guide Clip
13. Time Index Clip
14. Pen Arm Assemby
15. "V" Standard Pen Point
16. Pen Arm Shaft Bracket
17. Calibration Adjustment Screw
19. Case Assembly
22. Pen Lifter

Figure E.1.1.3
Dickson Recorder
Model No. 1 (4-in. Dia. Charts)

E.1.2 ROUTINE SERVICE CHECKS

E.1.2.1 GENERAL INFORMATION - Perform the following service checks according to the attached schedule (Table E.1.2.1) and the procedures documented in this Section and in Section E.1.3. Checks may be performed more frequently, but should be performed at least at the prescribed intervals. Also attached is a copy of the Monthly Quality Control Maintenance Checksheet (Figure E.1.2.1), which you should complete for each run and forward monthly to your supervisor.

E.1.2.2 EACH RUN

1. Initial Flow Meter Reading - Run the sampler for at least five minutes and record the flow meter reading as measured in E.1.1.2, 3. If the value is outside of the average initial flowmeter range, take a second reading. If the second reading falls out of bounds, check the line voltage and change the filter. Perform a calibration if neither of the above checks identifies the trouble. For samplers used on a more frequent schedule than every six days, check the initial flow meter reading each run, but record it on the Monthly Checksheet no more than every three days.

   NOTE: The average initial flow meter reading is determined by averaging the first four initial flow meter readings after the high volume sampler is calibrated. Establish the upper and lower tolerance limits by multiplying the average reading by 1.15 and 0.85, respectively. Record these limits on the Monthly Checksheet.

2. True Air Flow Rate - Using the sampler calibration curve, convert the flow meter reading to true air flow, in SCFM, and record this value on the Monthly Checksheet.

3. Faceplate Gasket - At the end of each run, inspect the faceplate gasket to see if it has lost resilience and become deformed or flattened. The resulting air leakage shows as an irregular edge of particulate deposit on the filter; when the condition is noticed, replace the gasket.

4. Recorder Operation - During the initial flow meter check, observe the flow recorder. If the pen is sticking, indicating a possible hysteresis lag, determine the cause. The electric chart drive is permanently lubricated and requires no

periodic maintenance. Replace the recorder if erratic or inoperative. Recalibrate after replacing the recorder. If the pen is dry, place a small amount of ink in the hole by the pen tip; if it is a cartridge type, replace the pen. After inking or pen replacement, turn on the sampler briefly to verify that the recorder is inking and zeroing properly.

5. Elapsed Time Meter Readings - Record pre-run and post-run elapsed time meter readings on the Monthly Checksheet.

E.1.2.3 800 Hour Checks

1. Sampler Motor Brushes - The electric motor of the sampler uses a pair of carbon brushes which wear during sampler operation and periodically must be replaced. Do this on a regular basis rather than wait until brushes wear down and excessive pitting and arcing occurs or the motor stops. Change the brushes every 800 hours (48,000 minutes) of operation for samplers operated at reduced line voltage (90V). All samplers should be equipped with an elapsed time meter. If not, contact your supervisor who will arrange for meter installation. Record the date changed and the elapsed time meter reading on the Monthly Checksheet. Recalibrate after changing brushes, noting the following precaution:

    a. Calibrating and sampling should only be performed after a break in a period of two hours to properly seat the brushes against the armature. This period requires running the sampler against a resistance equivalent to a clean filter or a number 18 calibration plate.

2. Armature - Once the armature becomes worn, the brush life drops considerably, to 300 hours or less. When opening the motor housing to change the brushes, inspect the armature. Replace the motor if the armature has excessive wear, such as deep grooving on the commutator or lack of segmentation. Recalibrate.

3. Motor - When replacing brushes, pull at the center motor shaft to check for excessive play. If shaft play exceeds 1/8" in any one direction, replace the motor.

4. Motor Wiring - Inspect motor windings for any abnormalities such as burnt wires. Clean dust from motor. If motor is inoperative or unable to give a flow

rate (with two clean filters in place) of at least true value listed in Table E.2.0.1, troubleshoot the system (motor, flow controller, line voltage) and correct as required.

5. Motor Gaskets - Inspect top and bottom gaskets for wear and deterioration and replace if necessary. Twisted power leads indicate that motor gaskets are not holding motor firmly and gaskets need to be replaced.

6. Timer Calibration - Check upon installation and every 800 hours against an elapsed time meter. It not within $\pm$15 minutes/24 hours, adjust and repeat test on next scheduled run.

7. Elapsed Time Meter - Check upon installation and every 800 hours against a standard timepiece of known accuracy, such as a standard electric clock connected during a scheduled run. If not within $\pm$ 2 minutes/24 hours, adjust or replace.

8. Recalibration - Conduct a flow rate calibration at 800-hour intervals or after any motor maintenance is done, such as replacement of brushes, repair or replacement of motor, or flow rate measuring device (rotameter or recorder). Also calibrate if the initial flow meter reading falls outside the average initial flow meter reading tolerance limits shown on the Monthly Checksheet. Conduct the calibration according to the standard procedure in this manual, Appendix E.2. Note the break-in period when motor maintenance is performed. (See la., above)

9. Flow Meter Tubing - On all samplers, inspect the tubing for deterioration or cracks. Replace, if necessary.

E.1.2.4 ADDITIONAL CHECKS

1. Clean Rotameter - Clean the rotameter when the float behaves erratically or when foreign matter is detected. Recalibrate. Use alcohol as a cleaning solvent. Some cleaning solvents should not be used, as they will dissolve the plastic rotameters.

2. Replace Motor - See E.1.2.3, 2-4.

NOTE: The Model GMW-800 Timer/Programmer has trippers that are not adjustable. If this timer is not within acceptance limits, notify your supervisor.

Table E.1.2.1
High-Volume Sampler Service Schedule

	EACH RUN	800 HOUR INTERVALS
CHECK AND RECORD INITIAL FLOW METER READING & TRUE AIR FLOW RATE	X	
INSPECT FACEPLATE GASKET	X	
CHECK OPERATION OF FLOW RECORDER	X	
INSPECT FLOW METER TUBING		X
RECORD INITIAL AND FINAL ELAPSED TIME METER READINGS	X	
CHECK FLOW RECORDER INKING	X	
REPLACE MOTOR BRUSHES		X
INSPECT ARMATURE		X
INSPECT MOTOR WIRING		X
INSPECT MOTOR GASKETS		X
CHECK TIMER CALIBRATION		X
CHECK ELAPSED TIME METER		X
CALIBRATION*		X
CLEAN ROTAMETER	as required	
REPLACE MOTOR	as required	

* or each time the initial flow meter reading falls outside average initial flow meter reading tolerance limits, or specified maintenance (see paragraph E.1.2.3,8) is performed.

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET
HIGH VOLUME SAMPLER/SSI

LOCATION: CITRUS HEIGHTS
MONTH/YEAR: JAN/1985
STATION NUMBER: 34-293
TECHNICIAN: C. FRANKLIN
SAMPLER PROPERTY NUMBER: 0697
AGENCY: ARB
SAMPLER MAKE AND MODEL: GMW-2000

Date	1/7	1/13	1/19	1/25						
Initial / True Flow Meter/Air Flow Reading / Rate	48.8 / 44.9	48.9 / 45.0	48.9 / 45.0	49.0 / 45.1						
Initial Elapsed Time Meter Reading	51,916	53,370	54,820	56,264						
Final Elapsed Time Meter Reading	53,363	54,816	56,259	57,709						

Average Initial Flow Meter Reading Tolerance Limits 41.6 to 56.2

OPERATOR INSTRUCTIONS:

1. Each Run: Check and record initial flow meter reading, inspect faceplate gasket, verify flow recorder operation, record initial and final elapsed time meter readings.

2. 90 Day Interval (SSI only): Clean sampler. Date last cleaned: _____.

3. 800 Hour Intervals:

   Replace sampler motor brushes. Date replaced: 10-28-84.
   Elapsed time meter reading: 48162.

   Inspect armature, motor shaft, motor gaskets, motor wiring, and flow meter tubing.
   Date last inspected: 10-28-84. Elapsed time meter reading: 48162.

   Calibrate timer and elapsed time meter. Date last calibrated: 10.30-84.
   Elapsed time meter reading: 49618.

   Calibrate sampler. Date last calibrated: 10-28-84.
   Elapsed time meter reading: 48162.

Date	Comments or Maintenance Performed:
1/29	REPLACED FACEPLATE GASKET WHICH WAS DAMAGED

ADD-35 (1/86) Reviewed By: R. GREEN Date: 2-7-85

Figure E.1.2.1
Monthly Quality Control Maintenance Checksheet

E.1.3 DETAILED MAINTENANCE PROCEDURES

E.1.3.1 REPLACING CARBON BRUSHES

1. Unplug the main power cord from the timer. Unplug flowmeter tubing. Remove motor from hi-vol shelter.

2. Remove the nuts on the locking clamp which secures the cylindrical motor housing to the sampler head (or unscrew the adapter mounting plate in some designs).

3. Remove the top rubber gasket. Put it aside.

4. Loosen nut on power cord where cord enters the motor housing.

5. Remove the motor from the housing.

6. Disconnect flat electrical connector from each brush by sliding it out toward the armature using pliers.

7. Remove screws from clamps securing both brush holders. Remove the old brushes and discard.

8. Install the new brushes so that the slot in the base of the brush holder seats on the metal base peg. Tighten screws on brush holder clamps.

9. Slide the flat electrical connector into each brush holder, the reverse of step 6, above.

   CAUTION: Make sure the electrical connectors are not touching commutator surface.

10. Dust off both gaskets with a clean cloth. Replace if the rubber is deteriorated.

11. Reassemble the motor into its cylindrical housing and assemble to the mating, sampler head--the reverse of steps 2 to 5 above.

12. Install the motor in the hi-vol shelter. Connect the power cord and flowmeter tubing.

13. Recalibrate sampler.

E.1.3.2 REPLACING SAMPLER MOTOR

1. Follow steps 1 to 5 and 10 to 13 in Appendix E.1.3.1, above.

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES
FOR
AIR QUALITY MONITORING

APPENDIX E.2

CALIBRATION PROCEDURE
HIGH VOLUME SAMPLERS

MONITORING AND LABORATORY DIVISION

DECEMBER 1980

E.2.0 PROCEDURE

The high volume sampler is calibrated using an orifice transfer standard that has been standardized against a primary standard Roots meter. The orifice transfer standard is referenced to 25°C and 760 mm Hg. Two different types of orifice calibrators are available. One type uses multihole adapter plates to vary the flow. The second type has an adjustable flow restrictor. In either case, the calibrator is connected to a differential pressure gauge or slack tube manometer. Pressure drops and indicated flow meter readings are recorded and corrected for elevation, as necessary. Using the pressure drops, the standard (true) flowrates are calculated using the certification equation for the transfer standard. Finally, a working sampler calibration curve of standard flowrate vs. indicated flowrate is plotted. The field calibration procedure assumes that:

1. Elevations below 1,000 feet are equivalent to standard conditions.

2. The effect of temperature on the indicated flowrate is negligible and therefore, is not used in the determination of the standard flowrate.

E.2.0.1 APPARATUS

1. Orifice Calibrator Transfer Standard with certification equation

2. 0-20" differential pressure gauge or slack tube manometer

3. Tygon tubing for static pressure connections

4. Faceplate adapter with "C" clamps

5. Flow charts for continuous recorder

6. Calibration report forms

7. Plastic cap for constant volume sampler sensor

E.2.0.2 "AS IS" CALIBRATION

"AS IS" CALIBRATION - Other than routine daily checks, sampler repairs or adjustments (brush changes, motor replacement, flow recorder changes, etc.) should not be made prior to the "as is" calibration. The sampler should be calibrated after each

800 hours of operation, if the sampler is moved to a different site or if the initial flow meter reading falls outside of specified tolerance limits (shown on the Monthly Checksheet, see Figure E.1.2.1).

NOTE: Some samplers use a closed loop control system to provide constant blower speed and sample flow. The flow sensor is located in the throat of the filter holder assembly. Before calibrating this type of sampler, disable the controller and connect the motor directly to the AC power source. After calibrating, reconnect as before.

1. Open the high volume sampler shelter and remove the filter holder. With the appropriate clamping device ("C" clamp, spring clips, etc.), secure the faceplate adaptor and orifice calibrator; then, tighten down the orifice calibrator. If using a variable resistance calibrator, simply secure the calibrator to the faceplate adaptor and turn the restrictor control fully counterclockwise so that the maximum flow will be obtained. Connect a section of tygon tubing from the orifice tap on the calibrator to one leg of the manometer. Open the other leg so that it is open to the atmosphere. A schematic diagram of a typical sampler flow calibration is shown in Figure E.2.G.1.

2. After the sampler has warmed up, turn the motor off and then on, and allow the static pressure (ΔP) and indicated flow reading (Qind) to stabilize. Then, read the static pressure (ΔP) and indicated flow readings (Qind). The static pressure is read as the total displacement, in inches, of the manometer water column. Record the static pressure and the indicated flow readings on the High Volume Sampler Calibration Datasheet (see Figure E.2.0.3). Repeat this step twice so that you perform a total of three test runs.

3. Repeat Step 2 for each of the remaining four load plates. When using the variable resistance calibrator, select four additional points equally spaced around the flow rate setpoint determined in E.1.1.2, 3 (two points above and two points below; see example in Figure E.2.0.4).

4. Remove the orifice calibrator from the sampler. Measure the indicated flow with a clean filter installed in the high volume sampler and record this value on the bottom of the Calibration Datasheet.

5. On the left side of the Calibration Datasheet, sum the ΔP readings for each line (Runs 1-3) and record the sum under "SUM ΔP"; then, calculate and record

the average ΔP for each line (Points 1-5). On the right side of the datasheet, sum the Qind readings for each line (Runs 1-3) and record the sum under "SUM Qind"; then calculate and record the average Qind for each line (Points 1-5).

6. Record the elevation of the sampler on the Calibration Datasheet. If the elevation is less than 1,000 feet, proceed to Step No. 7, as no altitude correction is required. If the elevation is 1,000 feet or greater, apply the altitude correction factor as follows:

   a. Using Table E.2.0.1, find the appropriate correction factor corresponding to the elevation of the sampler, or calculate the factor using the equation given in the Calibration Datasheet.

   b. Record the altitude correction factor on the Calibration Datasheet.

   c. Multiply the average ΔP's on the left side of the Calibration Datasheet by the altitude correction factor, and record these values under "Corrected ΔP".

7. Referring to the certification equation and using the corrected ΔP values calculated in 4, above, (or average ΔP values for locations less than 1,000 feet elevation), determine and record Qstd (transfer standard) for each point, where

   $$Qstd = factor \sqrt{Corr\ \Delta P}$$

8. Using the data from the Calibration Datasheet, plot a Calibration Graph Qstd (transfer standard) vs. Qind. Draw a straight line through the plotted points, or, if facilities are available, obtain a linear regression computer plot.

   This line represents the working sampler calibration graph for the particular sampler elevation. A sample plot is shown in Figure E.2.0.4.

9. Using the tabulated values of average Qind, determine Qprev (High Volume Sampler) by referring to the previous sampler calibration curve (Qstd vs. Qind). Find the appropriate value of Qprev from the y-axis corresponding to Qind on the x-axis. Record Qprev on the Calibration Datasheet for each line (points 1-5).

10. Sum the column Qstd (transfer standard) tabulated on the left side of the Calibration Datasheet. Record this sum as "S_1".

11. Sum the column Qprev (High Volume Sampler), determined in Step 9; record this sum as "S_2".

12. Calculate the percent deviation from previous calibration using the equation listed on the bottom of the Calibration Datasheet. Record the result.

13. Using the sampler calibration graph, convert the clean filter indicated air flow rate to standard air flow rate and record the result on the bottom of the Calibration Datasheet.

14. Complete a Calibration Report (see Figure E.2.0.2). Send in to the instrument files. Return a copy to the sampling site for inclusion in the station file.

E.2.0.3 "Final" Calibration - A final calibration is required after specified maintenance is performed (brush changes, motor replacement, flow recorder changes--see paragraph paragraph E.1.2.3, 9), including maintenance to correct the average initial flow meter reading being out of tolerance, or to repeat a sampler calibration graph which is non-linear. Repeat the calibration beginning with Step E.2.0.2.1.

E.2.0 4 Blank Forms and Assistance - A supply of blank Calibration Datasheets, as well as assistance in calibration procedures, can be obtained by contacting:

STATE OF CALIFORNIA
Air Resources Board
Monitoring and Laboratory Division
Quality Assurance Section
P.O. Box 2815
Sacramento, CA 95812

Table E.2.0.1
Elevation vs. Altitude Correction Factor and Standard Flow Rate
High Volume Air Sampler

Elevation (Feet Above Sea Level)	Altitude Correction Factor	Flow Rate Setpoint (SCFM)
0-999	1.000	45.0
1000	.965	43.4
1250	.556	43.0
1500	.947	42.6
1750	.938	42.2
2000	.930	41.9
2250	.921	41.5
2500	.913	41.1
2750	.504	40.7
3000	.896	40 3
3250	.888	40.0
3500	.879	39.6
3750	.871	35.2
4000	.863	38.8
4250	.855	38.5
4500	.847	38.1
4750	.840	37.8
5000	.832	37.4
5250	.824	37.1
5500	.817	36.8
5750	.805	36.4
6000	.802	36.1
6250	.794	35.7
6500	.787	35.4
6750	.750	35.1
7000	.772	34.7
7250	.765	34.4
7500	.758	34.1
7750	.751	33.8
8000	.744	33.5
8250	.737	33.2
8500	.731	32.9

(MLD 4/87)

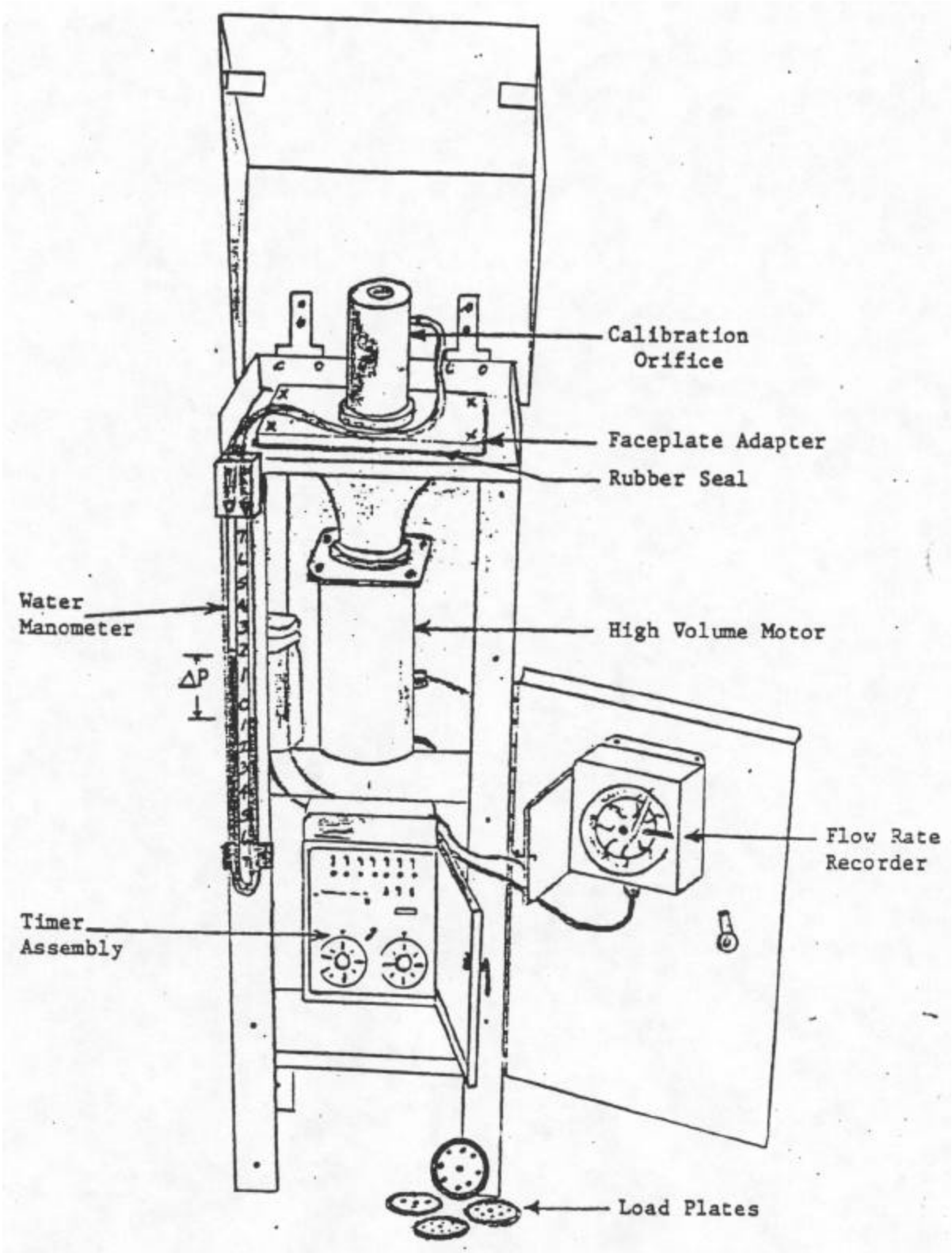


Figure E.2.0.1
High Volume Sampler Flow Calibration

CALIFORNIA AIR RESOURCES BOARD
CALIBRATION REPORT

TO: Manager, Air Monitoring Section - North

FROM: J. Jones

LOG NUMBER:
CALIBRATION DATE: 9-4-84
REPORT DATE: 9-30-84

IDENTIFICATION

Instrument General Metals High Volume Sampler	Site Name Stockton - Hammer Lane
Model Number ---	Site Number 39-265
Property Number 5481	Site Location Stockton
Serial Number ---	
Previous Calibration Log Number	Instrument Property of ARB
Elevation 450' | Site Temperature °C	Barometric Pressure " Hg

CALIBRATION STANDARDS

Standard	I.D. Number	Certification Date	Certified Value Or Factor

CALIBRATION RESULTS

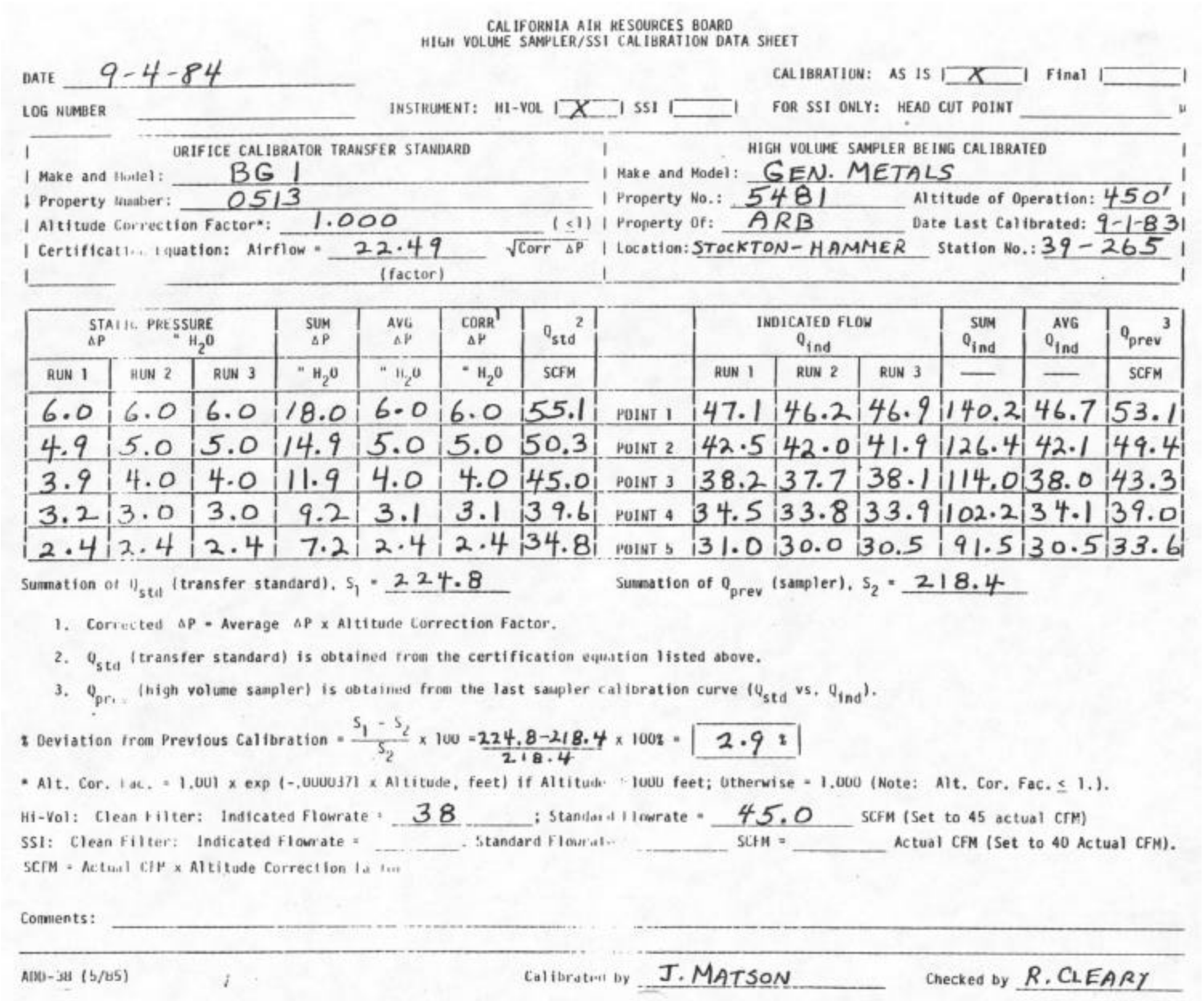
Component				
Instrument Range, ppm				
Initial Zero Setting				
Initial Span Setting				
Air Flow Rate, SLPM				
Air Flow Setting				
Reagent Flow Rate, SCCM				
Reagent Flow Setting				
Converter Efficiency				
Best Fit Linear Regression (x = True; Y =	Slope			
	Intercept			
"As Is" Deviation from True				
"Final" Deviation from True				
Change from Previous Calibration, % (date 9/1/83)		+2.9		
Final Zero Setting				
Final Span Setting				

Comments: Clean filter indicated flow rate: 38.0

Calibrated By J. Matson
ADD-25 (11/84)

Checked By R. Cleary

Figure E.2.0.2
Calibration Report



CALIFORNIA AIR RESOURCES BOARD
HIGH VOLUME SAMPLER/SSI CALIBRATION DATA SHEET

DATE 9-4-84 CALIBRATION: AS IS [X] Final [ ]

LOG NUMBER _____ INSTRUMENT: HI-VOL [X] SSI [ ] FOR SSI ONLY: HEAD CUT POINT _____ µ

ORIFICE CALIBRATOR TRANSFER STANDARD	HIGH VOLUME SAMPLER BEING CALIBRATED
Make and Model: BG 1	Make and Model: GEN. METALS
Property Number: 0513	Property No.: 5481 Altitude of Operation: 450'
Altitude Correction Factor*: 1.000 (≤1)	Property Of: ARB Date Last Calibrated: 9-1-83
Certification Equation: Airflow = 22.49 (factor) $\sqrt{Corr\ \Delta P}$	Location: STOCKTON-HAMMER Station No.: 39-265

STATIC PRESSURE ΔP " H_2O			SUM ΔP	AVG ΔP	CORR[1] ΔP	Q_{std}[2]		INDICATED FLOW Q_{ind}			SUM Q_{ind}	AVG Q_{ind}	Q_{prev}[3]
RUN 1	RUN 2	RUN 3	" H_2O	" H_2O	" H_2O	SCFM		RUN 1	RUN 2	RUN 3	——	——	SCFM
6.0	6.0	6.0	18.0	6.0	6.0	55.1	POINT 1	47.1	46.2	46.9	140.2	46.7	53.1
4.9	5.0	5.0	14.9	5.0	5.0	50.3	POINT 2	42.5	42.0	41.9	126.4	42.1	49.4
3.9	4.0	4.0	11.9	4.0	4.0	45.0	POINT 3	38.2	37.7	38.1	114.0	38.0	43.3
3.2	3.0	3.0	9.2	3.1	3.1	39.6	POINT 4	34.5	33.8	33.9	102.2	34.1	39.0
2.4	2.4	2.4	7.2	2.4	2.4	34.8	POINT 5	31.0	30.0	30.5	91.5	30.5	33.6

Summation of Q_{std} (transfer standard), S_1 = 224.8 Summation of Q_{prev} (sampler), S_2 = 218.4

1. Corrected ΔP = Average ΔP x Altitude Correction Factor.
2. Q_{std} (transfer standard) is obtained from the certification equation listed above.
3. Q_{prev} (high volume sampler) is obtained from the last sampler calibration curve (Q_{std} vs. Q_{ind}).

% Deviation from Previous Calibration = $\frac{S_1 - S_2}{S_2} \times 100 = \frac{224.8-218.4}{218.4} \times 100\% =$ 2.9 %

* Alt. Cor. Fac. = 1.001 x exp (-.0000371 x Altitude, feet) if Altitude > 1000 feet; Otherwise = 1.000 (Note: Alt. Cor. Fac. ≤ 1.).

Hi-Vol: Clean Filter: Indicated Flowrate = 38 ; Standard Flowrate = 45.0 SCFM (Set to 45 actual CFM)

SSI: Clean Filter: Indicated Flowrate = _____, Standard Flowrate = _____ SCFM = _____ Actual CFM (Set to 40 Actual CFM).

SCFM = Actual CFM x Altitude Correction Factor

Comments: _____

AIRD-38 (5/85) Calibrated by J. MATSON Checked by R. CLEARY

Figure E.2.0.3
High Volume Sampler Calibration Datasheet

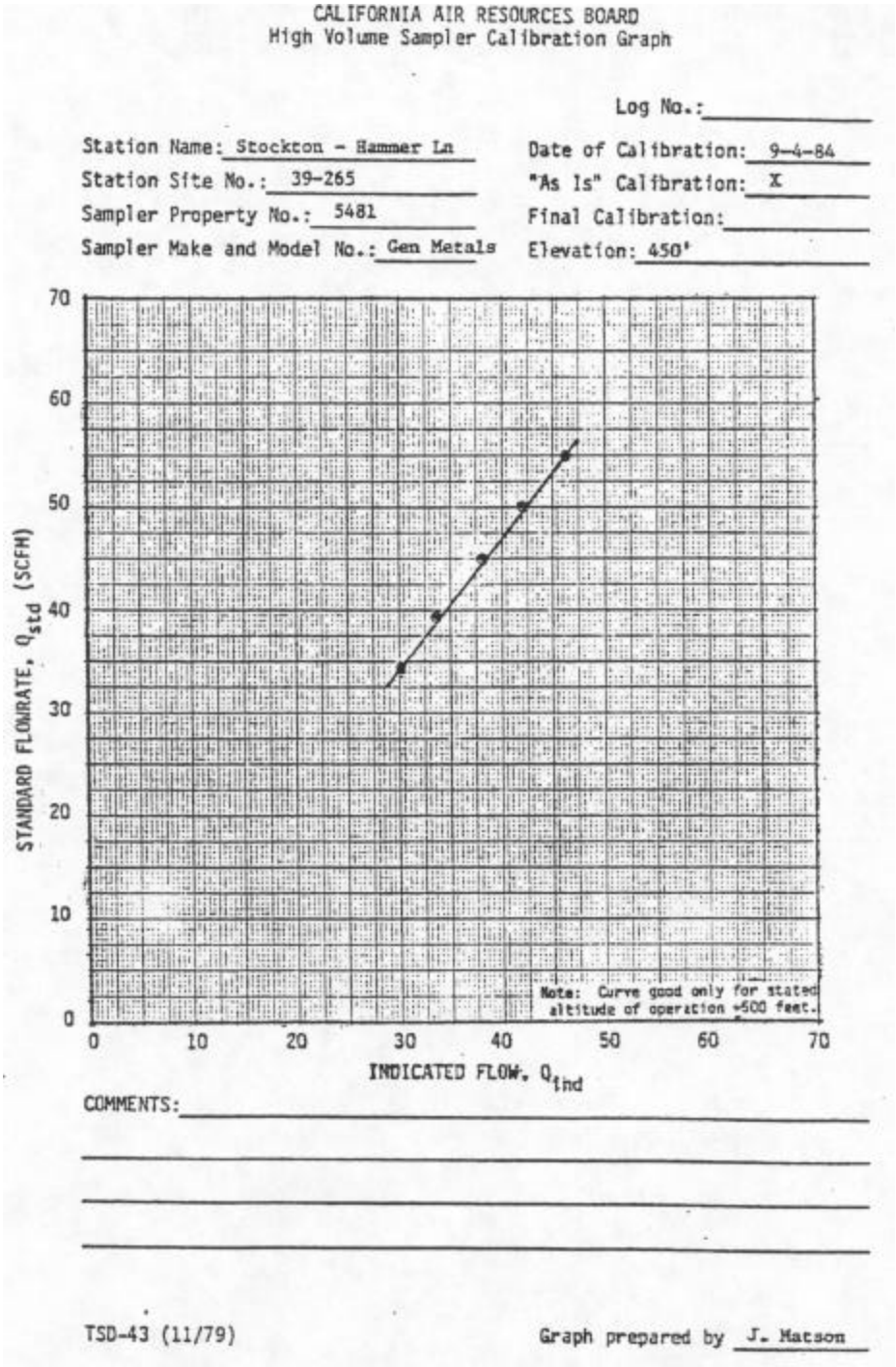


Figure E.2.0.4
High Volume Sampler Calibration Graph