

STATE OF CALIFORNIA
AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL
FOR
AIR QUALITY MONITORING

APPENDIX L

PERFORMANCE AUDIT PROCEDURES
FOR
XONTECH 920 AND 924 TOXIC AIR SAMPLERS

MONITORING AND LABORATORY DIVISION

AUGUST 2004

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VOLUME V

AUDIT PROCEDURES MANUAL
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APPENDIX L.1

PERFORMANCE AUDIT PROCEDURES
FOR
XONTECH 920 AND 924 TOXIC AIR SAMPLERS

MONITORING AND LABORATORY DIVISION

AUGUST 2004

L.1.0 INTRODUCTION

L.1.0 SAMPLER INFORMATION

The XonTech 920/924 Toxic Air Sampler is a modular unit designed to collect ambient air samples on a variety of sampling media. The XonTech 920 sampler is comprised of three modules: the control module, the sampling assembly, and the pump module, each contained in separate enclosures (see Figure L.1.0.1). The XonTech 924 sampler contains the same modules in one unit (see Figure L.1.2.1)

The sampler may contain up to eight sampling channels, each consisting of an individual sampling head, a mass flow controller (MFC), a solenoid valve, and associated tubing. Two types of sampling heads are used: one holds filters (see Figure L.1.0.2), and the other holds sorbent tubes (see Figure L.1.0.3). The heads are equipped with slider valves to protect the sampling media between runs.

Each mass flow controller is individually calibrated, and the flow rate of each channel is set with a thumbwheel switch as a percent of full scale for the XonTech 920 and with a programmable slope and intercept for the XonTech 924. The sampler operation is controlled by a microprocessor in the control module.

L.1.0.2 AUDIT OBJECTIVE

Performance audits of the XonTech 920 and XonTech 924 Toxic Air Samplers are conducted annually by Quality Assurance Section staff. The purpose of the audit is to assure the flow accuracy of each sampling channel in the sampler. The audit is conducted by comparing the indicated flow on each sampling channel against the true flow as measured by a certified flow transfer standard.



Figure L.1.0.1
Main Modules of the XonTech 920 Toxic Air Sampler

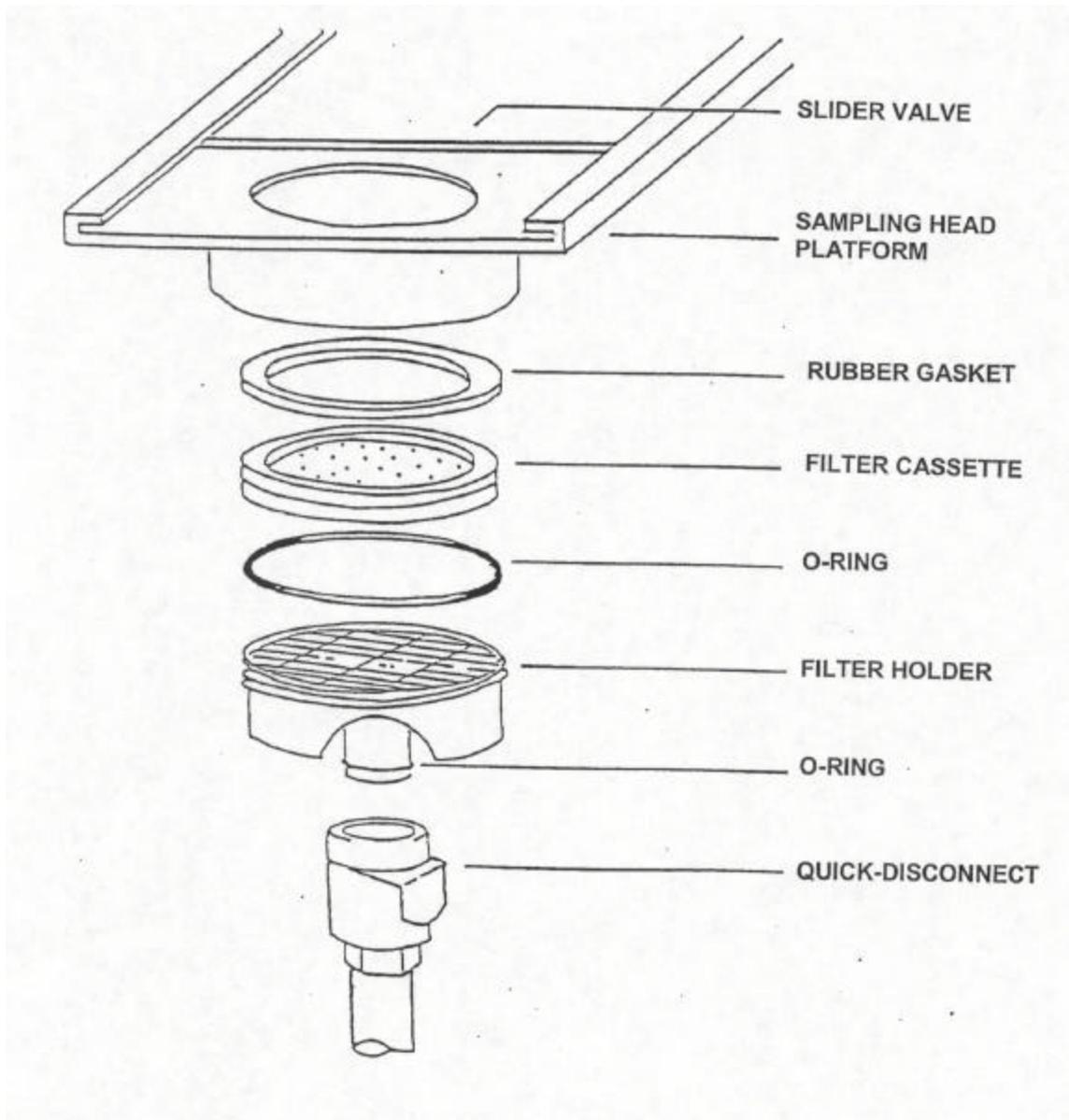


Figure L.1.0.2
Filter Sampling Head

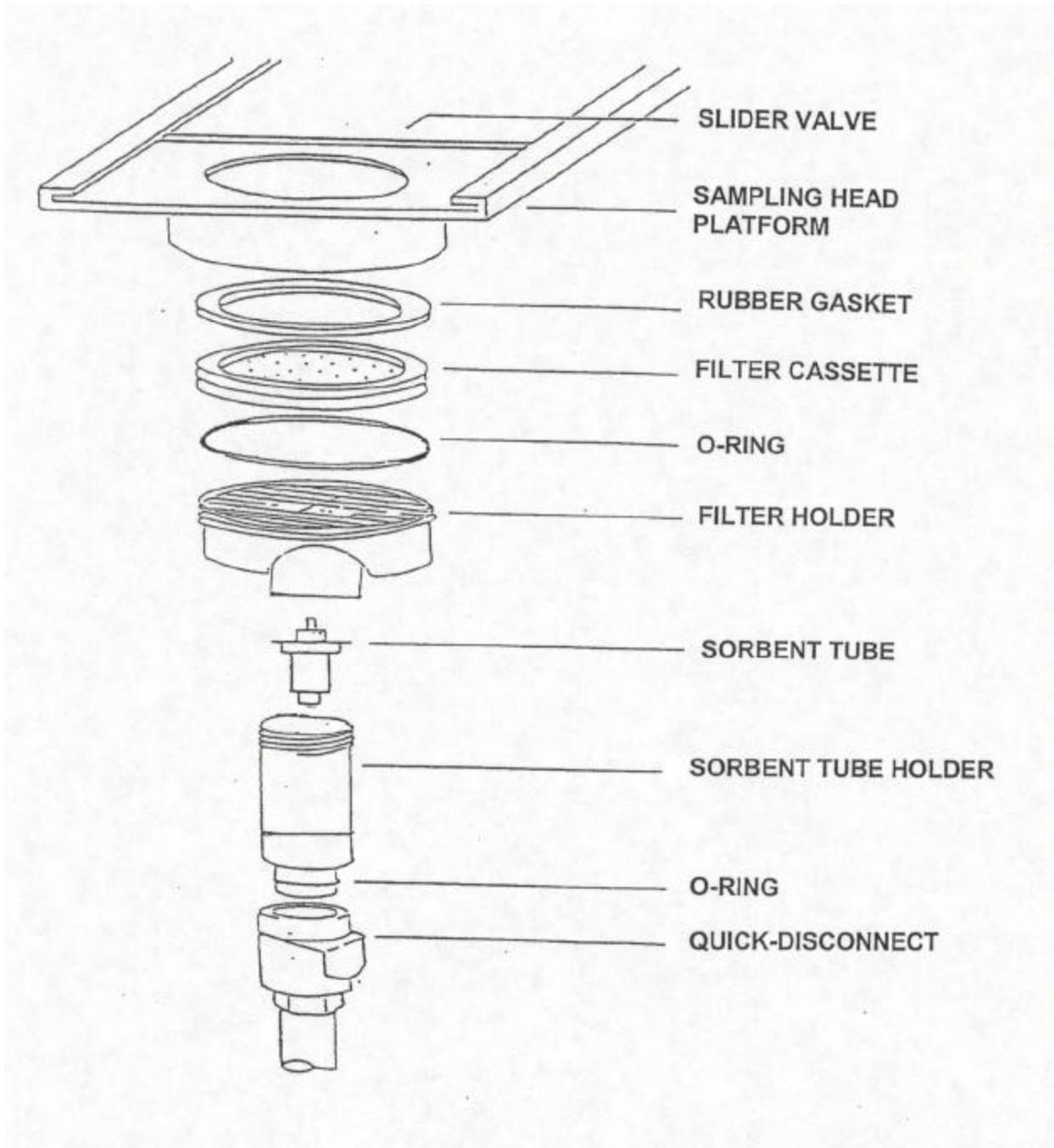


Figure L.1.0.3
Sorbent Tube Sampling Head

L.1.1 **AUDIT PROCEDURES**

L.1.1.1 FIELD NOTIFICATION

One week to ten days before the tentative audit date, contact the air monitoring station operator to schedule the audit, and notify the respective Air Quality Monitoring section manager. Make sure that the audit will not interfere with a scheduled sampling period or calibration for any of the channels in the sampler.

L.1.1.2 MATERIALS

1. NIST traceable mass flow meter (MFM).
2. Flow rate calibration adapters.
3. Formaldehyde collection tubes.
4. 1/4" O.D. Teflon tubing.
5. Swagelock fittings and caps.
6. Two adjustable wrenches.
7. 1/8" Allen wrench.

L.1.1.3 PRELIMINARY PROCEDURES

1. Connect the audit device to a 110 V AC outlet, and turn the power switch to the ON position. Allow at least ten minutes to warm up.

CAUTION: Always use properly grounded electrical cords and extensions. Avoid standing in water when working with electrical equipment.

2. On the top portion of the audit worksheet (see Figure L.1.1.1), record the site name, audit date, site number, agency responsible for operating the station, sampler identification number, audit device identification number, station operator, and auditor.
3. Loosen the two large knobs on the sides of the weather cover on the sampling module. Raise the cover, and tilt it to one side.

L.1.1.4 SAMPLING ASSEMBLY PREPARATION

Open the front door of the control module and select a sampling channel to be audited. Record the number assigned to the channel, the thumbwheel setting, and the set flow rate on the audit worksheet. If the channel holds filters, follow the procedures in 1 below. If it holds sorbent tubes, follow the procedures in 2.

1. Filter Holders

- a. Using a 1/8" Allen wrench, remove the peg that attaches the slider valve to the opening mechanism. Remove the valve by sliding it forward.
- b. Press the metal tab on the quick-disconnect at the bottom of the sample holding assembly, and pull down to disconnect.
- c. Unscrew the bottom of the filter holder.
- d. Remove the filter (if present) from the holder and place it in a clean container.
- e. Remove the protective cover from the bottom of the calibration adapter, and place the adapter in the sample holder (see Figure L.1.1.2). Be sure that the adapter is seated flat against the o-ring and rubber gasket.
- f. Reconnect the sample holder assembly so that the inlet to the calibration adapter protrudes through the sampling platform. Be sure to reconnect the quick-disconnect.

NOTE: Step 1A (and 2A below) prevent the accidental damage of the slider valve if the pump is shut off while the calibration adapter is in the instrument.

2. Sorbent Tube Holders

- a. Using a 1/8" Allen wrench, remove the peg that attaches the slider valve to the opening mechanism. Remove the valve by sliding it forward.
- b. Press the metal tab on the quick-disconnect at the bottom of the sample holding assembly, and pull down to disconnect.
- c. Unscrew the bottom of the sample holder.
- d. Remove the sorbent tube from the assembly.

- e. Insert a new sorbent tube in the sample holder.
- f. Reconnect the sample holder assembly and the quick-disconnect.
- g. Remove the protective cover from the bottom of the calibration adapter, and place the adapter in the sample holder (see Figure L.1.1.3). Be sure that the adapter is seated flat against the O-ring and rubber gasket.
- h. Reconnect the sample holder assembly so that the inlet to the calibration adapter protrudes through the sampling platform. Be sure to reconnect the quick-disconnect.

L.1.1.5 SAMPLING CHANNEL ACTIVATION

1. Press "**CHANNEL MENU**" on the control panel keyboard. "**1 CHANNEL ONLINE**" will be displayed on the screen.

NOTE: If channel 1 is inactive, the display will read "**1 CHANNEL OFFLINE**".

2. If necessary, press "**STEP**" repeatedly until the channel to be audited is displayed on the screen as "**X CHANNEL ONLINE**", where X represents the channel number. You may also press the desired channel number followed by "**ENTER**" (e.g., press "5" "**ENTER**" to advance to channel number 5)

NOTE: The "**STEP**" and "**BACKSTEP**" commands allow the user to move back and forth in a menu. Pause about one second between commands.

3. Press "**ENTER**". The display will show the current sample number.
4. Press "**STEP**" three times. "**X SYSTEM TEST OFF**" will be displayed.
5. Press "**SET**" to start the system test. The display will read "**X SYSTEM TEST ON**", and the controller will start the pump, actuate the slider valve mechanism in the sampling head, and open the solenoid valve associated with the activated sampling channel.

NOTE: For the remainder of the audit, the channel must be left in the "**X SYSTEM TEST ON**" mode.

L.1.1.6 FLOW RATE AUDIT

1. Turn the selector switch on the audit device to the MFM that most closely accommodates the sampling channels set flow rate. Record the position on the worksheet.
2. Connect the outlet port of the MFM to the inlet of the calibration adapter with Teflon tubing.
3. Press '**STEP**' five times to display the MFC's voltage output (V) and flow rate (LPM)
4. Allow the readings to stabilize for 2 to 3 minutes, and record the flow rate indicated on the sampler and the corresponding audit device response.
5. Take 2 more reading of the XonTech's flow rate and the corresponding audit device's response at 2 to 3 minute intervals and record on the worksheet.

L.1.1.7 LEAK TEST

1. Remove the line from the calibration adapter to the MFM and install a cap on the inlet to the calibration adapter.
3. Allow the readings on the XonTech's display to stabilize, and record the MFC's voltage output and flow reading on the audit worksheet. The readings should be low (e.g., 0.1 volts).

NOTE: If the channel leak test value is high (e.g., greater than 10% of the flow for that channel) check for leaks between the adapter and the sampling head platform and repeat the test. If it is determined that the seal between the adapter and the sampling head platform is secure, continue with the audit and perform any troubleshooting later. It can be determined if the leak is from the sample holder by disconnecting the 3/8 inch nut (opposite the quick-connect going into the sample holder) and replacing it with a 3/8 inch cap. Note the voltage and flow rate on the display.

4. Uncap the calibration adapter, then remove the calibration adapter.
5. Re-position the slider valve and re-install the slider valve actuator peg.
6. Press '**BACKSTEP**' five times. The display will read '**PUMP ON**'.
7. Press '**SET**' to turn the pump off.

NOTE: If the display shows an error or freezes up, turn off the power switch. Turn on the power and wait a few minutes for the time and Julian date to reappear and repeat Section L.1.1.5.

8. Repeat sections L.1.1.6 and L.1.1.7 for the remaining 2 channels.

L.1.1.8 POST-AUDIT PROCEDURES

1. Press **"BACKSTEP"** on the keyboard eight times. The display should read **"X SYSTEM TEST ON"**.
2. Press **"SET"** to turn the system test off. The display will read **"RESET VALUES?"**
3. Press **"ENTER"**. The display will read **"X SYSTEM TEST OFF"**.
4. Press **"SYSTEM MENU"** on the keyboard twice. The display will show the time and Julian date.
5. Press the metal tab on the quick-disconnect and pull down to disconnect.
6. Unscrew the bottom of the sample holder.
7. For filter and tube sampling heads, remove the calibration adapter from the sample holder, and place the protective cover back on the adapter.
8. Check for deterioration of the rubber gasket and the o-rings on the sample holder and quick-disconnect (see Figures L.1.0.2 and L.1.0.3)
9. Replace the original filter or sorbent tube in the sample holder. For filter holders, make sure that the filter is seated properly on the o-ring and flat against the fine grid on the sample holder. For sorbent tube holders, replace original tube in the sample holder. The sorbent tube can only be installed one way--wide tube end down into sample holder.
10. Reassemble the sample holding assembly.
11. Reposition the slider valve, and attach it to the opening mechanism by snugly fastening the actuator peg.
12. If another channel is to be audited, repeat the procedures outlined in Sections L.1.1.4 through L.1.1.8. Otherwise, return the weather cover to its original position.
13. Disconnect the Teflon tubing from the audit device.
14. Turn the MFM audit device off, and disconnect the power cord.

XONTECH 920/924 AUDIT WORKSHEET

AUDITOR _____ DATE _____

SITE NAME _____

SITE NUMBER _____ TECHNICIAN _____ AGENCY _____

SAMPLER ID # _____ CALIBRATION DATE _____ MFM ID # _____

CAL. EQUIP. CERT. DATE _____

AMBIENT TEMPERATURE _____ AMBIENT PRESSURE _____

TEMP. SENSOR ID # _____ BAROMETER SENSOR ID # _____

CHANNEL # _____ HEAD TYPE: TUBE [] FILTER [] POLLUTANT _____

THUMBWHEEL/SLOPE-INTERCEPT _____ SET FLOW RATE _____ LPM

LEAK TEST: VOLTAGE|FLOW _____ SAMPLER FLOW _____ AUDIT FLOW _____ COMMENTS _____

LPM
 RUN 1 _____
 RUN 2 _____
 RUN 3 _____

CHANNEL # _____ HEAD TYPE: FILTER [] TUBE [] POLLUTANT _____

THUMBWHEEL/SLOPE-INTERCEPT _____ SET FLOW RATE _____ LPM

LEAK TEST: VOLTAGE|FLOW _____ SAMPLER FLOW _____ AUDIT FLOW _____ COMMENTS _____

LPM
 RUN 1 _____
 RUN 2 _____
 RUN 3 _____

CHANNEL # _____ HEAD TYPE: FILTER [] TUBE [] POLLUTANT _____

THUMBWHEEL /SLOPE-INTERCEPT _____ SET FLOW RATE _____ LPM

LEAK TEST: VOLTAGE|FLOW _____ SAMPLER FLOW _____ AUDIT FLOW _____ COMMENTS _____

LPM
 RUN 1 _____
 RUN 2 _____
 RUN 3 _____

Figure L.1.1.1
 Audit Worksheet

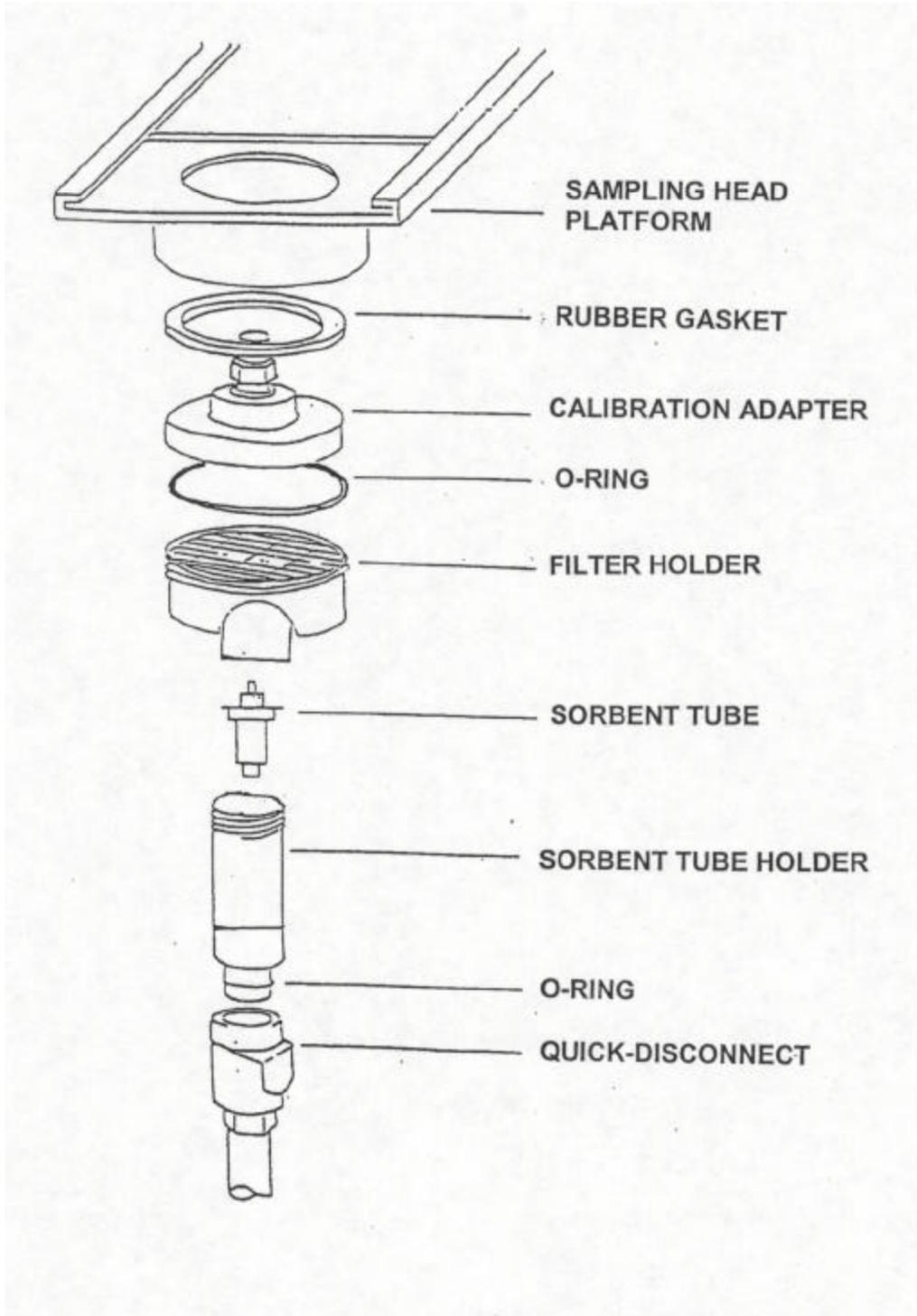


Figure L.1.1.2
Position of Calibration Adapter During Audit of a Filter Sampling Head

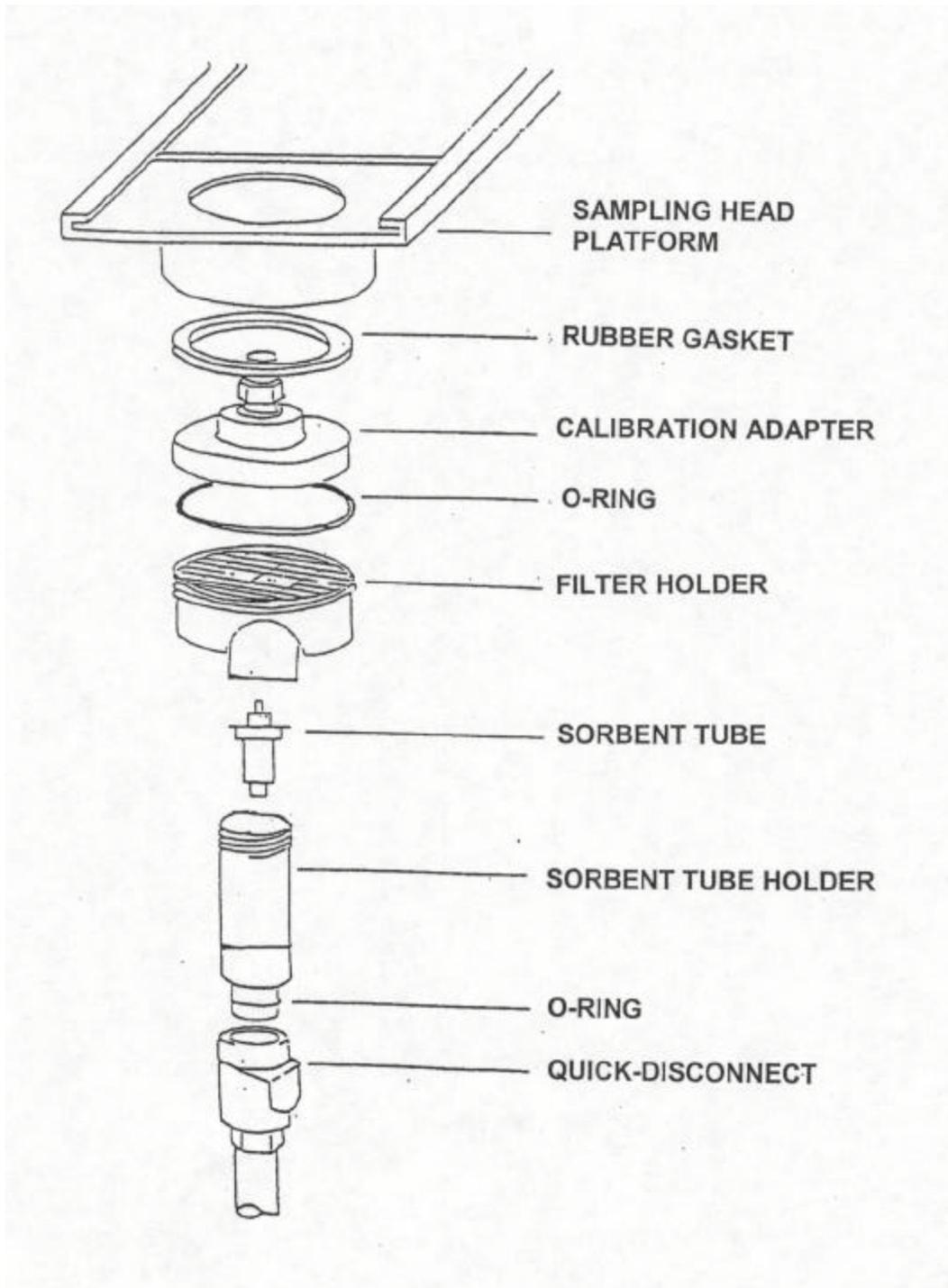


Figure L.1.1.3
Position of Calibration Adapter During Audit of a Sorbent Tube Sampling Head

CALIFORNIA AIR RESOURCES BOARD

FLOW CERTIFICATION REPORT

TO : JOHN KATO
 QUALITY ASSURANCE

LOG NUMBER : 2002 030

FROM: BRIAN SPREADBOROUGH
 Program Evaluation & Standards

CALIBRATION DATE: 02/19/2002
 REPORT DATE : 03/01/2002

IDENTIFICATION

Instrument : MATHESON 4 in 1 MFM
 Property No. : 6853
 Serial No. : BA 309112
 Previous Log No. : 2001 273
 Bar Code No. : 20003930
 Elevation : 25.00'
 Instr. Prop. Of : QUALITY ASSURANCE

Site Name : MLD Standards Lab
 Site Number : 34-299
 Location : 1309 T-Street
 Sacramento, CA 95814

CALIBRATION STANDARDS	ID NUMBER
BROOKS FLOW STANDARD	2856
SIERRA FLOW STANDARD	20000560

CALIBRATION RESULTS

MFM / MFC Position	Pos 1	Pos 2	Pos 3	Pos 4	
Instr. Range	100 cc	10 L	30 L	3 L	
Maximum Display	100	100	100	100	
Linear Regression	Slope	0.9052	9.7201	3.1203	32.379
	Intercept	3.0916	-.1591	-2.353	0.4973
Change From Prev. Slope	-0.36	0.30	-1.00	0.35	
Prev. Calibration Date	10/26/2001	10/23/2001	10/22/2001	10/24/2001	

Certification Equation: _____ Certification Expires: 05/21/2002

Position 1, Range 100 cc Std. Air Flow = 1.1065 * (Display)- 3.3018
 Position 2, Range 10 L Std. Air Flow = 0.1027 * (Display)- 0.0009
 Position 3, Range 30 L Std. Air Flow = 0.3241 * (Display)+ 0.8858
 Position 4, Range 3 L Std. Air Flow = 0.0309 * (Display)- 0.0127

Comments:

Calibrated By Tyler Jacob

Checked By BTS.

Figure L.1.1.4
 Certification Report for Mass Flow Meters



Figure L.1.2.1
Main Modules of the XonTech 924 Toxic Air Sampler

L.1.2 XONTECH 924 AUDIT PROCEDURES

L.1.2.1 FIELD NOTIFICATION

One week to ten days before the tentative audit date, contact the air monitoring station operator to schedule the audit, and notify the respective Air Quality Monitoring section manager. Make sure that the audit will not interfere with a scheduled sampling period or calibration for any of the channels in the sampler.

L.1.2.2 MATERIALS

1. NIST traceable mass flow meter (MFM).
2. Flow rate calibration adapters.
3. Formaldehyde collection tubes.
4. 1/4" O.D. Teflon tubing.
5. Swagelock fittings and caps.
6. Two adjustable wrenches.
7. 1/8" Allen wrench.

L.1.2.3 PRELIMINARY PROCEDURES

1. Connect the audit device to a 110 V AC outlet, and turn the power switch to the ON position. Allow at least ten minutes to warm up.

CAUTION: Always use properly grounded electrical cords and extensions. Avoid standing in water when working with electrical equipment.

2. On the top portion of the audit worksheet (see Figure L.1.1.1), record the site name, audit date, site number, agency responsible for operating the station, sampler identification number, audit device identification number, station operator, and auditor.
3. The weather cover on the XonTech should not be removed. If better access to the sample holders is needed, the "T" pin on the support shaft can be removed by depressing the button on the top of the "T" and pulling the pin out. This will allow the lowering of the entire sampling module.

L.1.2.4 SAMPLING ASSEMBLY PREPARATION

Open the front door of the control module and select a sampling channel to be audited. The main menu for the XonTech 924 has the date in the upper left-hand corner, the time in the upper right-hand corner, and "**Idle**" in the lower left-hand corner. The channels for the 924 are different than the 920: aldehydes are channel #1, total metals channel #2, and Cr+6 channel #3.

In order to get the slope and intercept (equivalent to the thumbwheel setting on the 920), go to the "**Calibrate**" screen, from the main menu screen, by pressing the right-pointing arrow 3 times. It should indicate channel #1 with the MFM's full scale range, its slope, and intercept. Write these values on the worksheet. Press "**Select**" to underline the channel number. Press "**Select**" again to get the channel number to blink. Press the right-pointing arrow to change the channel to #2. Press "**Exit**" to stop the channel number from blinking. The full scale range of MFM #2, the slope, and the intercept should be displayed. Write these on the worksheet. Press "**Select**" to underline the channel number. Press "**Select**" again to get the channel number to blink. Press the right-pointing arrow to change the channel to #3. Press "**Exit**" to stop the channel number from blinking. The full scale range of MFM #3, the slope, and intercept should be displayed. Press "**Exit**" twice to return to the main menu screen ("**Idle**" displayed in the lower left-hand corner).

1. Filter Holders

- a. Using a 1/8" Allen wrench, remove the peg that attaches the slider valve to the opening mechanism. Remove the valve by sliding it forward.
- b. Press the metal tab on the quick-disconnect at the bottom of the sample holding assembly, and pull down to disconnect.
- c. Unscrew the bottom of the filter holder.
- d. Remove the filter (if present) from the holder and place it in a clean container.
- e. Remove the protective cover from the bottom of the calibration adapter, and place the adapter in the sample holder (see Figure L.1.1.2). Be sure that the adapter is seated flat against the o-ring and rubber gasket.
- f. Reconnect the sample holder assembly so that the inlet to the calibration adapter protrudes through the sampling platform. Be sure to reconnect the quick-disconnect.

NOTE: Step 1A (and 2A below) prevent the accidental damage of the slider valve if the pump is shut off while the calibration adapter is in the instrument.

2. Sorbent Tube Holders

- a. Using a 1/8" Allen wrench, remove the peg that attaches the slider valve to the opening mechanism. Remove the valve by sliding it forward.
- b. Press the metal tab on the quick-disconnect at the bottom of the sample holding assembly, and pull down to disconnect.
- c. Unscrew the bottom of the sample holder.
- d. Remove the sorbent tube from the assembly.
- e. Insert a new sorbent tube in the sample holder.
- f. Reconnect the sample holder assembly and the quick-disconnect.
- g. Remove the protective cover from the bottom of the calibration adapter, and place the adapter in the sample holder (see Figure L.1.1.3). Be sure that the adapter is seated flat against the O-ring and rubber gasket.
- h. Reconnect the sample holder assembly so that the inlet to the calibration adapter protrudes through the sampling platform. Be sure to reconnect the quick-disconnect.

L.1.2.5 SAMPLING CHANNEL ACTIVATION

1. In order to check the flows, press the right-pointing arrow 6 times to get to the "**Manual Run**" screen from the main menu screen.
2. Press "**Select**" to underline "**Off**" for channel #1. Press "**Select**" again to get "**Off**" to blink.
3. Press the right-pointing arrow to change "**Off**" to "**Man**" (manual mode). "**Man**" should be blinking. Press "**Exit**" to start the pump. Press "**Exit**" again to remove the underline from "**Man**".
4. Press the right-pointing arrow four times to get to "**Instrument Flow**" screen.

L.1.2.6 FLOW RATE AUDIT

1. Turn the selector switch on the audit device to the MFM that most closely accommodates the sampling channels set flow rate.
2. Connect the outlet port of the MFM to the inlet of the calibration adapter with Teflon tubing.

3. Allow the readings to stabilize for 2 to 3 minutes, and record the flow rate indicated on the sampler and the corresponding audit device response.
6. Take two more readings at intervals of 2-3 minutes.

L.1.2.7 LEAK TEST

1. Remove the line from the MFM to the calibration adapter and install a cap on the inlet to the calibration adapter. Wait for the flow rate to stabilize. The flow should drop to less than 2% of full scale (0.6 lpm for 30 lpm FS and 0.04 lpm for 2 lpm FS). Record the value on the worksheet.
2. Slowly uncap the calibration adapter to allow air into the system.
3. Remove the calibration adapter and re-install the slider activation pin.
4. Press "**Exit**" to return to the main menu screen. This screen now displays the date in the upper left-hand corner and "**Channel 1**" in the lower left-hand corner.
5. Press the right-pointing arrow 6 times to return to the "**Manual Run**" screen.
6. Press "**Select**" to underline "**Man**". Press "**Select**" again to get "**Man**" to blink. Press the left-pointing arrow to get "**Man**" to change to "**Off**". Press "**Exit**" to shut the pump off. The slider is activated when the pump goes off. "**Off**" for channel 1 should still be underlined.
7. Unscrew the bottom of the sample holder.
8. For filter and tube sampling heads, remove the calibration adapter from the sample holder, and place the protective cover back on the adapter.
9. Check for deterioration of the rubber gasket and the o-rings on the sample holder and quick-disconnect (see Figures L.1.0.2 and L.1.0.3)
10. Replace the original filter or sorbent tube in the sample holder. For filter holders, make sure that the filter is seated properly on the o-ring and flat against the fine grid on the sample holder. For sorbent tube holders, replace original tube in the sample holder. The sorbent tube can only be installed one way - wide tube end down into sample holder.
11. Reassemble the sample holding assembly.
12. Reposition the slider valve, and attach it to the opening mechanism by snugly fastening the actuator peg.

13. Press the right-pointing arrow to move the underline from channel 1 "**Off**" to channel 2 "**Off**". Follow Sections L.1.2.4 through L.1.2.7 to get the leak check values and flows for channel 2 and 3.

L.1.2.8 POST-AUDIT PROCEDURES

1. After completing the flow checks for channels 2 and 3 you should be at the "**Manual Run**" screen. Press "**Select**" to underline "**1:Off**". Press the right-pointing arrow until the underline is below the active channel. Press "**Select**" to get "**Man**" to blink.
2. Press the left-pointing arrow to change "**Man**" to "**Off**".
3. Press "**Exit**" to stop the pump. Press "**Exit**" to remove the underline from "**Off**".
4. Press the right-pointing arrow twice to return to the main menu screen which should display "**Idle**".
11. Raise the sampling module to the original position and insert the "T" pin, if necessary.
12. Disconnect the Teflon tubing from the audit device.
13. Turn the MFM audit device off, and disconnect the power cord.

L.1.3 CALCULATIONS

1. Calculate the averages of the three observations of the indicated sampler flow and the corresponding audit device readings.
2. Determine the true flow rate through the transfer standard mass flow meter using the following relationship:

$$\text{True Flow} = \% \text{ of Range} \times \text{Slope} + \text{Intercept}$$

Since MFM's and MFC's are dependent only on the specific heat of the gas, corrections for altitude or temperature are not necessary.

NOTE: The slope and intercept of each MFM are calculated quarterly by the Standards Lab. Refer to the latest certification report for the correct slope and intercept values (see Figure L.1.1.4)

3. Calculate the percent difference between the sampler indicated flow and the true flow with the following equation, or enter all flow readings into the field lap top computer which will automatically calculate the percent differences.

$$\% \text{ Difference} = \frac{\text{Indicated Flow} - \text{True Flow}}{\text{True Flow}} \times 100 \%$$