California Environmental Protection Agency

AIR RESOURCES BOARD

AIR QUALITY SURVEILLANCE BRANCH

ACCEPTANCE TEST PROCEDURE (ATP)

FOR

RM ENVIRONMENTAL SYSTEMS INC
MODEL 924 TOXICS SAMPLER

AQSB ATP 801

First Edition

MONITORING AND LABORATORY DIVISION

June 2007

California Environmental Protection Agency
AIR RESOURCES BOARD

Approval of Acceptance Test Procedure

Title:	RM Environmental Systems Inc Model 924 Toxics Air Sampler
ATP:	AQSB ATP 801, First Edition
Section:	Operation Support Section (OSS)
Branch:	Air Quality Surveillance Branch (AQSB)
Division:	Monitoring and Laboratory Division (MLD)
Prepared by:	Richard Michaud/John Latham
Approval:	This SOP has been reviewed and approved by:

//s//
Reginald L. Smith, Manager
Operation Support Section
Air Quality Surveillance Branch

Date

//s//
Kenneth R. Stroud, Chief
Air Quality Surveillance Branch

Date

TABLE OF CONTENTS

RMESI 924 Toxics Air Sampler

		Page(s)	Rev. Date
1.0	**ACCEPTANCE TEST PROCEDURE**	**6**	**06/07**
1.1	General Information	4	
1.2	Physical Inspection	4	
1.3	Pre Acceptance Test Procedures	4	
1.4	Physical, Performance Operational Checks	5-6	
1.5	Environmental Chamber Temperature and Voltage Checks	6	
1.6	Post Acceptance Checks	6	

APPENDIX

RMESI 924 Instrument Lab Test Report …….Appendix A

Instrument Lab Test Log …….Appendix B

Physical Specifications …….Appendix C

Performance Specifications …….Appendix D

1.0 ACCEPTANCE TEST PROCEDURE

1.1 General Information:

The following outlines the California Air Resources Board's Air Quality Surveillance Branch (AQSB) acceptance test procedures for the RM Environmental Systems Inc (RMESI) Model 924 Toxics Air Sampler, hence referred to as RMESI 924.

Before beginning acceptance testing of the RMESI 924, read the operating manual thoroughly to become familiar with the theory of operation, hardware, software and basic assembly of the instrument. Initiate an instrument lab test log and an instrument lab test report (Appendix A and B). Record the dates of the individual tests, problems, and contacts with the manufacturer, and any other pertinent information on the acceptance test log.

1.2 Physical Inspection:

Inventory all the parts noted in the shipping document. Check for any shipping damage and incorrect or damaged parts or sub-assemblies. If problems are noted, contact the Monitoring and Laboratory Division warehouse personnel. Assemble all parts as necessary for proper operation of the instrument.

1.3 Pre Acceptance Testing Procedures:

Prior to beginning acceptance testing of the RMESI 924, procure all necessary testing apparatus and refer to the AQSB's specifications used to purchase the equipment. (Appendix C and D)

1. Record serial number, model number, manufacturer and date on the instruments lab test log.

2. Ensure that all parts are installed including: sampling heads, tubing and electrical connectors are connected to the proper ports. (All tubing and cables are marked according to which port they should be connected).

3. Turn on power using front panel switch and note start up sounds such as: internal cooling fan, printer feed and pump. The RMESI 924 display should show the samplers software version followed by the main menu screen.

4. Begin the physical, performance and operational checks listed in section 1.4 of this procedure. Refer to the instrument manual section noted for more details.

1.4 Physical, Performance and Operational Checks:

The physical, performance and operational checks of the RMESI 924 are designed to verify that the instrument meets or exceed the specifications required by the AQSB. The RMESI 924 physical and performance specifications are listed in Appendix C and D respectively. The AQSB's Operations Support Section uses the following operational checks to acceptance test the RMESI 924:

Operational Checks:

1. At start up (see section 1.3 step 3 above), note software version on the instrument lab test form. Verify that the unit has the latest software update. Current software version as of June 2007 is version 1.5 (see operating manual section 6.1, Main Menu).

2. Program system clock to correct Pacific Standard Time (PST) and date. Verify and check Julian date in display (see operating manual section 6.1, Main Menu).

3. Perform a short printer test by pressing 0 and clear simultaneously (printer will print main screen).

4. Program the control unit serial number as the unit I.D. number (see operating manual section 5.2.1).

5. Scroll through all eight main menu screens and note any discrepancies (from Main Menu, use RT arrow key →).

6. Conduct a manual run check of each channel to check for proper pump operation, slider valve operation and vacuum and flow rate (displayed). (See operating manual section 5.2.7, Manual Run).

7. Perform a leak test on each channel using the manual run menu (see operating manual section 5.2.7, Manual Run). While plugging the air inlet at the filter holder tubing, by disconnecting the tubing at the filter holder to tubing quick disconnect and plug tubing with a quick disconnect cap plug. Leak check results for 30 Liter mass flow controllers (MFC's) should be less than 0.05 liters per minute (LPM) and less than 0.005 LPM for 2 Liter MFC's channels. If leaks are present, check fittings, and perform test again.

8. Set and verify the flow rate of each channel using a certified mass flow meter. Standard AQSB configuration for the REMSI 924 recommends a flowrate of 12.0 LPM for 30 LPM flow channels, and 700 CCM for 2 LPM

flow channels (see manual section 5.2.3). The flow accuracy for each channel must be within 2 percent at these set points.

9. Perform a complete 5 point multi-point flow check on each mass flow controller channel and perform calculations IAW operating manual (see operating manual section 6.2, Calibration). Enter slope and intercept generated from multi-point check into each channel and perform a one point verification flow check at 12 LPM or .7 LPM. Complete instrument lab test report and attach them to the final test documentation.

10. Program unit to operate all operational channels concurrently for approximately one hour each and print out full report of schedule and settings (see operating manual Section 5.2.6, Reschedule Menu and Section 5.1.5, Print Screen Function).

11. Review printout of scheduled run. If sampler passes step 10 above, program unit to operate all operational channels concurrently for at least eight hour sample runs for at least four successive days. Print full report at end of four day period.

12. If sampler passes step 11 above, verify operation of the samplers re-schedule run function. Program unit to perform a sample run after six days (see operating manual Section 5.2.6, Reschedule Menu).

13. If sampler properly operates re-scheduled runs, review printout showing unit will repeat sample run on next six day schedule.

14. Connect unit to PC and modem and test the remote operation capability. Perform various functions such as setting the clock time, running a manual run, changing MFC flow rates, programming a sample run, etc. (See operating manual Section 7, Remote Operation).

1.5 Environmental Chamber Temperature and Voltage Stability Tests**:**

Set unit up in the Instrument Lab's environmental chamber and monitor flow using certified mass flow meter outside the chamber. Run the standard temp/voltage profile and note whether the RMESI 924 flow rates remained within specifications for the entire test.

1.6 Post Acceptance Test:

Review AQSB specifications, complete test log, test report and other test data. Attach printer tapes from all tests to the log and report and submit for review and signatures. Barcode the unit and ship to stockroom for field use.

INSTRUMENT TEST REPORT
REMSI Model 924 Toxics Air Sampler

Serial Number: _____
Software Version: _____
Date Started: _____
Date Completed: _____
Pass or Fail _____

ARB Barcode Number _____
Tested By: _____
Reviewed By: _____
Date: _____

Physical Inspection	Notes	Initials
1. Unpack and inventory parts	_____	_____
2. Check for shipping damage	_____	_____
3. Assemble instrument	_____	_____
4. Check correct power phasing	_____	_____

Pre Acceptance Test Checks

1. Record Serial Number and Model Number	_____	_____
2. Power on. Check operation of valves, controls, meters, pumps, switches, indicator lamps, etc.	_____	_____
3. Set Instrument Test Configurations	_____	_____

Operational Tests

1. Note software version	_____	_____
2. Program system clock	_____	_____
3. Printer test	_____	_____
4. Program unit ID number	_____	_____
5. Check all main menus	_____	_____
6. Manual system checks	_____	_____
7. System leak checks	_____	_____

Operational Tests (Cont.)

8. Perform multi-point flow check and verification
9. Perform 1 hour test run on all channels
10. Perform 8 hour test runs on successive days
11. Reprogram 6-day sample schedule
12. Review all test
13. Verify remote operation

Environmental Chamber Test

1. Set-up chamber at prescribed flow
2. Run standard Temp/pressure profile
3. Annotate flow rates on charts

Post Acceptance Test

1. Set field operational parameters
2. Complete test report, log and data sheet
3. Submit test report(s) for review

INSTRUMENT LAB TEST LOG

Manufacturer _____ Model # _____

S/N _____

Date	Action

RMESI 924 Toxics Air Sampler Physical Specifications

1. Each sampler shall be constructed in a complete, professional and safe manner. All operational components shall be completely enclosed with no exposed wiring, printed circuitry boards or electrical components.

2. All replaceable mechanical and electrical component parts such as printed circuit boards (except a motherboard), mass flowmeters, valves, pumps, pressure gauges, integrated circuits, and panel meters shall be readily accessible so they can be removed and reinstalled in 20 minutes time or less.

3. The modules and sampling assembly for each sampler shall be housed in a rugged, weatherproof white or anodized aluminum cabinet suitable for operation on the roof of a building, exposed to severe weather conditions. All exterior screws, bolts, washers, nuts and pins shall be stainless steel.

4. Each sampler shall be modular in construction consisting of a pump module, a control module, and a sampling assembly.

   a. The control module shall contain the mass flow controllers and their support circuitry, the microprocessor, the display and printer and all the controls necessary to program, calibrate, and operate the sampler.

   b. The pump module shall contain the pump or (pumps).

   c. The sampling assembly shall consist of the sampling heads, weather protection assembly and support assembly.

5. The weight of each modular unit of the sampler shall not exceed 60 pounds.

6. All cases or cabinets shall have handles on the top and/or ends for carrying.

7. The control and pump modules shall each have a minimum of four (4) rubber support feet, each at least one inch in diameter.

8. The control module shall also be equipped with four removable legs to support the module at least 30 inches from the surface. The legs shall have feet with 3/8 inch diameter holes for securing the control module to a platform.

9. Wire wrap electrical connections of any kind are not acceptable.

10. The A.C. input power cord(s) shall be 3 conductor and at least 8 feet in length. The connectors shall be wired so that the "hot" terminal (black wire) is connected to the brass terminal throughout. Any interconnecting power cable shall be 3 conductor and at least 8 feet in length. The connector for each module shall be a watertight, twist lock-type connector.

11. Printed circuit boards to edge card connectors or plugs to socket connections shall be provided for all components and printed circuit boards.

12. The control module shall have easily accessible output jacks with 0-5 VDC analog voltage output terminals for monitoring the operation of each mass flow controller. The voltage shall be proportional to flowrate through the mass flow controller.

13. The samplers shall be operated from a front panel of the control module. This panel shall include the main power switch, the alphanumeric display, the printer, the "Print" button, the keyboard, and all controls, switches, indicators, lights and controls necessary for "set-up", calibration and normal operation of the samplers.

14. All exposed electrical lines and vacuum tubing shall be ozone and radiation resistant. Material used for exposed electrical wiring and pneumatic tubing shall be subject to approval by the ARB. All tubing connections shall be 1/4 inch and/or 3/8 inch Swagelock or equivalent fittings.

15. Flowrate through each mass flow controller shall be set by individual digital selector switches on each channel from 00.0 to 99.9 (represents percent of range). These switches shall be on the front panel in the control module.

16. Heating strips and cooling fans shall be provided to maintain the temperature inside the pump and control modules above 5°C, or within 5°C of the ambient temperature, whichever is greater.

17. A microprocessor shall control the various timing, scanning and data logging functions of the sampler. The following specifications apply to the microprocessor:

    a. microprocessor shall control the start and stop intervals of a minimum of four (4) channels (independently).

    b. The microprocessor shall have a scanner controller for multiplexing a minimum of four (4) signals.

c. The microprocessor shall control a liquid crystal display at least 3/8 inch in height with a minimum of 16 alphanumeric characters, for annunciating results, displaying voltage and for programming.

d. The microprocessor shall control an alphanumeric static-discharge, impact or thermal printer, with a minimum of 16 characters, for recording results.

e. A keyboard, with a minimum of 20 numeric or function keys, shall be provided for complete operator programming.

f. The microprocessor shall have a digitizer range of 0-5.000 VDC.

g. Each channel's condition or processed results shall be displayed on the display and/or printed on the printer.

18. The front panel of the control module shall be equipped with a spring loaded "Print" button. When the "Print" button is depressed the data in the alphanumeric display shall be printed by the printer.

19. In the case of a power failure during a sampling period a flag shall appear in the alphanumeric display and on the printout for each channel operation during the affected sampling period.

20. The sampler shall have a battery back-up system to protect the electronic timer(s) and/or the microprocessor memory functions when there is a power failure. This back-up system must be able to maintain the correct time and memory programming for a minimum of 7 days.

21. An internal charging circuit shall be provided to maintain a charge on the back-up battery.

22. Each sampling channel shall be equipped with a solenoid valve to isolate the sampling media before and after the sampling period.

23. The solenoid valve shall be located in the flow stream between each mass flow controller and each sampling head.

24. The solenoid valve shall be closed when the sampling channel is not active and open when the sample is being collected.

25. The sampling apparatus shall be capable of accommodating four sampling heads, each of which is designed to accept sampling filters of 37 millimeters in diameter and/or 1 sorbent tube holder.

26. The sampling heads shall be anodized aluminum and modular in design.

The sampling heads shall be designed to be easily removed, replaced and interchanged. All electrical connections shall be plug to socket connections to allow easy removal and replacement. All exterior screws, bolts, washers, nuts, and pins shall be stainless steel.

27. The sampling heads shall be designed so the filter or sorbent tubes can be easily removed and replaced and no air leaks may be present where the filters or tubes connect to the head.

28. The replacement of all sorbent tubes or filter media used in sampling shall require 15 minutes or less to accomplish.

29. The sampling heads shall be designed so the air sample directly impacts the collection media without passing through any tubing or passages. The system shall not leak. With the pump on at the sample inlet, measured at the head, the flowrate through the sealed channel shall go to 0.00 (or a minimum number as calibrated) as measured by the digital readout for the mass flow controller.

30. Each sampling head shall be designed to provide for the quick and easy connection of flowrate calibration instrumentation at the sample inlet. Adapters or special hardware to connect flowrate calibration instrumentation to both types of sampling shall be provided if they are necessary to perform calibrations. One adapter for each two (2) samplers purchased shall be provided.

31. The exposed end of each absorbent tube and filter holder shall be protected by a motorized slider valve (shutter) assembly. When an absorbent channel is not being used the valve will be closed. When sampling on that channel is initiated the shutter will open exposing the absorbent tube of filter to the ambient air. The motor drive for the shutter assembly shall use 24 volts or less for electrical power.

32. The collection media and sampling apparatus shall be protected from the elements by a weather protection assembly consisting of a moveable weather shield. The weather protection assembly shall be designed so (1) wind and the direction of the wind does not affect or bias the sample, (2) rain does not impact the collection media, and (3) the assembly does not create a particulate cutpoint (i.e., the weather protection assembly shall not cause particles of a certain size from being excluded from any sample).

33. Handles or knobs shall be provided on the weather shield to move the assembly during servicing.

34. Any screws, wing nuts or pins used to secure the weather shield in its

operations position shall be secured to the sampling module by chains or cables. Spin-tite, quick disconnect, or "Zues" type fasteners shall be used wherever possible.

35. The sampling head base and assembly shall be a minimum of 1.2 meters above ground level and supported by at least three legs with a base circle diameter of at least three feet. These legs shall be removable by set screws or by threaded fittings. The legs shall have feet with 3/8 inch holes for securing the sampler to a platform.

36. The pump module shall be designed to contain one pump. The pump will be connected to one manifold. The pump shall be Gast, Model#1022-V103-G272X, or equivalent.

REMSI 924 Toxics Air Sampler Performance Specifications

Each sampler shall use mass flow controllers to control the flowrate through each sampling channel. The following specifications apply to each mass flow controller (MFC):

a. Adjustable full scale range ability from 20 SCCM to 30 SLPM.

b. Response to within +/-2% of set point is six seconds.

c. Accuracy of +/-1 % of full scale

d. Linearity of 0.5% of full scale based upon the full scale response.

e. Ability to repeat within +/-0.2% of full scale.

f. Ability to maintain the present mass flow to within +/-0.25% of full scale.

g. The D.C. control voltage shall not exceed 20 mV peak to peak ripple.

h. The MFC's shall operate within a temperature range of 5°C to 45°C.

i. Temperature coefficient: 0.1% of full scale per °C. The flowrate shall not vary more than 0.1% of full scale per °C while operating in a temperature range between 5°C to 45°C.

j. Pressure coefficient: The flowrate shall not vary more than 0.01 % of full scale while experiencing a pressure change of 1 pound-per square inch.

k. The power consumption shall not exceed 4.0 watts.

l. Flowrate through each mass flow controller shall remain constant when the flow controller is tilted 45° from the horizontal in any direction.

2. Each sampler shall be equipped with an electronic time clock, with battery back-up, that shall be able to maintain time to within +/-1 second per day.

3. If a sampling period is interrupted by a power failure, when power is restored the sampler shall restart and the sampling period will continue for the pre-selected allotted time period.

(Appendix D)

4. Each sampler shall be equipped with a microprocessor. The following specifications apply to the microprocessor and the digitizer contained in the microprocessor.

   a. Accuracy of +/-0.2% of reading, +/-0.1 % count whichever is greater over the specified operating temperature range.

   b. The scan rate shall have a minimum reading speed of 1 reading per second.

   c. The programming functions shall be under two menus: 1) Channel and 2) System.

5. The channel menu program shall consist of the entry of channel specific information for each channel as follows:

   a. Filter identification number (eight digit number).

   b. Channel start time and day. (This function will open the shutter and the solenoid valve, turn on the MFC. and start the pump.)

   c. Channel stop day and time. (This function will close the shutter and the solenoid valve, turn off the MFC and turn off the pump, if no other channel is operating from it.)

   d. Units of flowrate; cc/min or LPM.

   e. Slope and intercept equation ($Y = mX \pm b$) to calculate all flowrates and volumes. Where m=slope and b=intercept.

   f. A "manual" function to cause the simultaneous, direct output of the mass flow controller feedback voltage and the calculated flowrate ($Y = mX \pm b$) to the printer and the digital display. The display will update instantaneously and the printer will print each time the "Print" button on the front panel of the control module is depressed.

Note: Each channel's flowrate will be set by separate digital selector switches.

6. The system Menu programming shall consist of entering the following data or instructions into the program:

   a. Time clock set functions, using Julian day and 2400 hour clock.

   b. Station identification number (eight digit number).

c. System print function. This function shall cause the complete channel and system programming data and instruction to be printed by the printer.

7. The data output to the printer at the end of each sampling period shall include the following data for each channel:

   a. Station identification (eight digit number).

   b. Filter identification number (eight digit number).

   c. Start day and time.

   d. Stop day and time.

   e. Number of scans.

   f. Initial flowrate.

   g. Final flowrate.

   h. Average flowrate.

   i. Total sampling time in minutes.

   j. Total flow volume.

   k. Power failure indicator flag.

8. Vacuum Pump System - The system shall be composed of single vacuum manifold. The system will operate with the following requirements:

   a. The total combined amperage shall not exceed 12 amps.

   b. The pump shall operate on standard 110 VAC 60 cycle single phase power.

   c. The pump system shall have the ability to maintain 20" Hg vacuum at a flowrate of 2.0 SCFM.

9. Electrical - The sampler shall operate on 115 VAC, 60 Hz and single phase. The sampler shall operate within all specifications listed while experiencing line voltage variations from 105 V AC to 125 V AC and frequency variations from 57 Hz to 63 Hz.

10. Environmental - When the ambient temperature varies from -5°C to 45°C, the sampler shall operate within all the specifications listed herein.

The sampler shall operate, while experiencing ambient temperature variations

from -5°C to 55°C, without damage to any component in the sampler.

(Appendix D)