



Model 8000 Automated Sampler
Operations and Maintenance Manual

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ATEC Model 8000 Toxic Air Sampler

Limited Warranty

Atmospheric Technology (ATEC) warrants to the original purchaser of the Model 8000 Toxic Air Sampler that should it prove defective by reason of improper workmanship and/or material:

Parts and Labor: For one year on all components from the date of original purchase, we will repair or replace, at our option, any defective part without charge for the part. Parts used for replacement are warranted for the remainder of the original warranty period.

To obtain warranty service, return the unit to ATEC. Shipping expenses are your responsibility. This WARRANTY DOES NOT COVER damage caused by: modification, alteration, repair or service of this unit by anyone other than ATEC; physical abuse to, or misuse of the unit; operation in a manner contrary to the instructions which accompany the unit; freight damage; or any damage caused by acts of God such as lightning or fluctuation in electrical power. This warranty also excludes all costs arising from installation, adjustment of user controls, initial technical adjustments (set-up) and user-required maintenance including filter changing.

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Under no circumstances shall ATEC be liable to purchaser or any other person for any incidental, special, or consequential damages, whether arising out of breach of warranty, breach of contract, or otherwise.

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1. Introduction

This manual covers the installation, operation and routine maintenance of the ATEC Model 8000 Automated Sampler. This instrument is a microprocessor controlled sampler that can be programmed to draw ambient air through cartridges, filters, or sorbent tubes for specified time periods. The sampler can be configured with various options to provide up to three independent flow channels. Channel 1 is a multi-port channel containing 8 ports. Each port can be programmed to sample over a specific time period. The optional Channels 2 and 3 consist of single ports that can be activated concurrently or for different time periods than Channel 1. All channels use separate mass flow controllers (MFC) to regulate the flowrate. The number of ports on Channel 1 can be increased in multiples of 8 up to a total of 24 ports by adding the Model 80xx expansion modules.

The sampler has the following features:

- Channel 1 ports and Channels 2 and 3 can be programmed to sample on a specified date (e.g. 06/01/95) for a specified duration.
- All channels are automatically leak checked prior to sampling. If a leak is detected, a leak check error is recorded for that channel or port.
- Sampling date, start time, stop time, average flowrate, minimum flowrate, maximum flowrate, total volume sampled, sampling time duration, and error status are stored for all channels. These data can be displayed on the screen or transferred to a laptop or PC. Sampling data (i.e. time, flowrate, and volume) can be logged at a minimum of every 5 minutes. These items are included in the data transmitted to the PC or laptop.
- The mass flow controllers are auto zeroed prior to sampling.
- A leak check option is provided to manually leak check a port or channel.

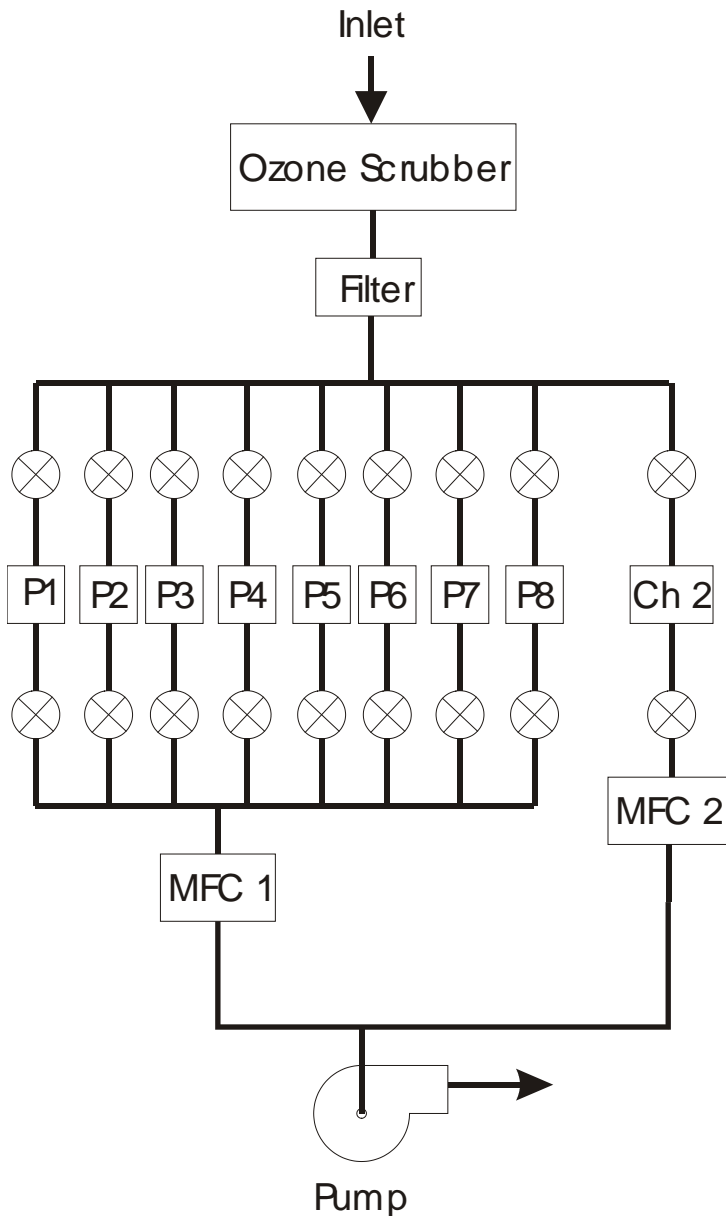
2. System Configuration

2.1 Hardware

2.1.1 System Specification

Flowrate:	Nominal 1.0 lpm with Sep-Pak cartridges. Adjustable between 0-2 lpm depending on cartridge restriction. Optional ranges available. Accuracy: $\pm 1\%$ FS
No. of Channels:	8 ports on Channel 1. Two other single port channels with independent operation are optional. One blank position. The number of channels can be increased up to 24 with the addition of either the Model 8008 or Model 8016 expansion modules.
Size:	17" (width) x 19" (depth) x 7" (high)
Weight:	Approximately 50 pounds
Power:	115VAC, 7 amps maximum.
Inlet:	$\frac{1}{4}$ " tubing connector.
Cartridge Connections:	Polypropylene Luer fittings.
Construction Materials:	Teflon filter (optional) and PFA Teflon internal tubing, copper coated with KI ozone scrubber (optional), stainless steel solenoid valves with viton seals.

2.1.2 Sampler Components



This section describes the general operation and major components of the ATEC Model 8000 Automated Sampler. Shown here is a schematic diagram of the sampler. Air enters the sampler and passes through the ozone scrubber and filter, and then enters a solenoid manifold. When a selected port is activated, the air stream passes through the inlet solenoid, through the cartridge, and returns to the outlet solenoid valve. Two solenoids are used to isolate the cartridge when sampling is not occurring. The flow from the outlet solenoid valve passes through the outlet manifold to a mass flow controller (MFC) and is exhausted with a vacuum pump. Only one port for Channel 1, consisting of two solenoids and the cartridge, can be activated at a given time. However, two optional channels can be used to obtain concurrent or co-located samples. A microcomputer with a touchscreen display provides control for the automated sampling.

2.1.2.1 Inlet Filter Option

A Teflon PFA filter holder contains a 47mm Teflon filter to remove particulates from the air stream prior to entering the flow lines. The filter should be periodically changed; the frequency will depend on conditions at the sampling site.

2.1.2.2 Temperature Controlled Ozone Scrubber

A temperature controlled copper tube coated with KI is used to remove ozone during carbonyl sampling with DNPH cartridges. The microcomputer maintains a constant heater temperature inside the ozone scrubber enclosure. The heater temperature can be set using the Setup Option on the sampler display. The heater temperature in Celsius is shown on the display. The controller is factory set to 50°C. An alarm is displayed if the temperature exceeds +/- 5°C.

2.1.2.3 Solenoid Valves

Two 15VDC solenoid valves are used for each port. The normally closed valves are mounted upstream and downstream of the cartridge. During normal sampling, both solenoid valves are opened. A leak check is performed during the first 30 seconds of each sampling interval. During leak check, the upstream solenoid is closed and the entire sampling line, downstream solenoid valve, cartridge, and flow controller are evacuated by the vacuum pump. If a small leak exists, the flowmeter will detect the flow. During automatic operation, the microcomputer will set a flag if the flow exceeds 0.03 lpm (other values can be selected by the operator) at the end of the 30 second leak check.

2.1.2.4 Cartridge Connections

Inlet and outlet tubes are connected using male Luer fittings that have been swaged on the end of the PFA Teflon flow lines attached to the solenoid valves. Some types of cartridges have a male fitting on one end that requires a female connector to adapt the sample lines. Excess tubing has been provided to accommodate different length cartridges. Pushing or pulling the tubing at the point where it emerges from the front panel can change the tubing length extending from the front panel. Make sure that the tubing and not the Luer connection is pulled; excess force may separate the fitting from the PFA Teflon tubing.

2.1.2.5 Mass Flow Controllers

Mass flow controllers with a range of 0-2 liters/min (other ranges available) are used to control the sampling flowrate in each channel. Operation and maintenance instructions are provided in Appendix A. Using the Setup option on the display sets the flowrate.

2.1.2.6 Vacuum Pump

A diaphragm pump is used to draw air through the instrument. The pump is mounted inside the sampler. It is rated for continuous duty and can maintain a maximum vacuum level of 24 in Hg. using two MFCs flowing at 1 lpm.

2.1.2.7 Optional 8-Port or 16-Port Expansion Module

The Model 8000 can be expanded to a total of either 16 ports or 24 ports by the addition of an expansion module. The Model 8008 adds an additional 8-ports while the Model 8016 adds an additional 16-ports. The expansion module is electrically connected to the Model 8000 by a single ribbon cable attached to the “EXP 1” connector on the rear panel. Inlet and outlet pneumatic lines are connected by attaching the “Flow 1” and “Flow 2” lines from the Model 8000 to the “Flow 1” and “Flow 2” on the expansion module.

The Model 8000 looks for the expansion unit when power is turned on. If the expansion module is not connected or there is a communication problem, the software will not display the additional ports. If the connection between the expansion module and the Model 8000 is correctly made, the additional ports will display once the Model 8000 is turned off and then turned back on.

3. Running the System

3.1 Hardware Setup

Upon arrival, check all shipping containers for damage and notify the shipper if damage has occurred. Retain the shipping container because the sampler must be returned in the original packaging if warranty repairs are required. Plug the main power cord into a 115VAC outlet. Turn the main power on by using the power switch on the rear of the sampler. When power is applied, the display will illuminate in approximately 20 seconds.

The Model 8000 uses an WVGA LCD color touch screen display to show current operating status and to enter information into the computer. The computer is accessed using the tabs which are displayed on the screen and can be activated by finger touch or stylus. A pencil eraser also works well. The touch level of the screen can be calibrated by using the **TouchScreen** button in the **Setup** function.

A USB connector is mounted below the touchscreen. This can be used to connect a mouse, keyboard, label printer, or jump drive for retrieving data and updating the sampler software.

All components, tubing, and fittings have been cleaned prior to assembly. The completed sampler has been purged with clean humidified air prior to shipment. After unpacking the instrument and verifying operation, the Model 8000 should be purged with humidified zero air for a minimum of 24 hours before sampling.

3.2 Display and Function Tabs

Normally the display will show the default main screen as illustrated here. This screen displays current sampling information and provides function tabs for the operator to enter operating parameters and retrieve data. The main screen displays the following:

Model 8000 Version 2.00				
Main Time/Date Setup Schedules Data Leak Check SOP Manual Advanced				
Monday, November 26, 2005 18:58				
East River Site				
		Flow	Volume	Status
Cartridge	Ch. 1 Port 1		11.8	Finished
	Port 2		11.5	Finished
	Port 3	1.001	10.4	Sampling
	Port 4		0.0	Waiting
	Port 5		0.0	Waiting
	Port 6		0.0	Waiting
	Port 7		0.0	Waiting
	Port 8		0.0	Waiting
	Channel 2	0.992	4.3	Sampling
Abort				Temp 50.2

3.3 Date and Time

The current date, time, and day of the week is displayed at the top of the screen

3.4 Site Identification



A site identification label can be displayed below the time and date to identify the sampler. For example “East River Site” could be shown to identify this sampler from others used in a sampling network.

3.5 Cartridge Sampling Information

The cartridge flow rate and total volume are displayed. These values are continuously updated every 10 seconds. One of the following status indicators will also be shown in each status box, depending upon the sampling conditions:

Sampling—Indicates a channel is sampling

Waiting—Indicates a channel has been programmed to sample

Purging—Indicates a channel is purging prior to sampling

Idle—Indicates a channel has not been programmed to sample

Aborted—Operator terminated sampling

Finished—A successful sample has been collected without errors

Leak Err—Cartridge failed specified leak rate tolerance on start-up

Post Leak Err—Cartridge failed auto leak check at the end of sampling

Temp Tol—Ozone scrubber temperature exceeded $\pm 5^{\circ}\text{C}$

Flow Tol—Specified cartridge flow rate tolerance exceeded

Zero Tol—Cartridge MFC required more than 1% zero compensation

Errors—Multiple errors, power outage, or sample aborted

3.6 Ozone Scrubber Temperature

The temperature of the ozone scrubber is displayed in the lower right hand corner of the screen.

3.7 Abort

The **Abort** button is used to terminate sampling after purging has started. Pressing the **Abort** button will require the operator to enter a new sampling sequence to resume sampling.

3.8 Function Tabs

Several function tabs are located along the top of the screen to enable the operator to interact with the sampler to set the date and time, enter operating parameters, input a sampling schedule, retrieve data, leak check cartridges, set-up the sampler using the SOP (Standard Operating Procedure) option, manually operate the hardware, and input advance system parameters. The operation of each tab is described in the Programming Section.

4. Programming the Model 8000

The Model 8000 uses eight function tabs to allow the operator to enter or retrieve information from the sampler: **Time/date**, **Set-up**, **Schedules**, **Data**, **Leak Check**, **SOP**, **Manual**, and **Advanced**. **Time/date** is used to enter the current time and date. **Set-up** is used to configure the sampler and store sampling parameters. Sampling schedules are entered through the **Schedules** tab. Data can be displayed or downloaded to a jump drive using the **Data** tab. Cartridges are manually leak checked with the **Leak Check** tab. The **SOP** tab uses a standard operating procedure to install and leak check the cartridges and program sampling schedules. In **Manual** mode, the hardware can be uniquely activated to allow checkout and troubleshooting. The system configuration and advance parameters are entered using the **Advanced** tab.

4.1 Time/Date

The time and date that is stored in the Model 8000 can be changed using the **Time/Date** tab. When this tab is touched, the operating system data and time selection screen will appear. Once the changes have been made, pressing the **OK** button in the upper right corner of this window will bring back the main screen that should show the correct day of the week, date, and time.

4.2 Setup

The **Setup** tab is used to input cartridge operating parameters, , enable software updates, and calibrate the touch screen. When the **Setup** tab is touched, a green screen appears which allows the operator to change the following parameters for cartridge sampling:

Setup Parameters

Ch.1 MFC Set Point

The sampling flow rate for the Channel 1 cartridge is specified in this box.

Ch.2 MFC Set Point

The sampling flow rate for the Channel 2 cartridge is specified in this box

Flow Leak Limit

The flow leak limit is the maximum flow rate that is allowed for a cartridge to pass either manual or automatic leak check. This value has the same units as the flow rate.

Flow Tolerance

The cartridge flow rate is continuously monitored during sampling. If the flow rate specified in Ch.1 MFC or Ch.2 MFC Set Point box is outside this tolerance, an error status for flow tolerance will be generated. This value has the same units as the flow rate.

Data Write Interval

The Data Write Interval specifies the time interval for recording canister pressure and cartridge flow rate data. The minimum time interval is 5 minutes.

Site Label

Touching the site label box brings up an alphanumeric keypad that can be used to input a site specific label (e.g. East River Site No. 2) that appears on the main screen.

TouchScreen

Pressing the **TouchScreen** button brings up the touchscreen calibration routine. The screen is calibration by touching five crosses that appear at different places on the screen. After all the crosses have been touched, touch the middle of the screen to terminate the routine and to save the new settings.

Set

Pressing the **Set** button saves the data that was entered in the Set-up screens and returns the program to the main screen.

Update

If the **Update** button is pressed, the sampler searches for the presence of a jump drive in the USB connector below the screen. If the jump drive is present and has the proper updating files, the sampler software will be updated. If the update is successful, a message will appear on the screen instructing that file transfer was successful and that the system will reboot. If the jump drive cannot be recognized or it does not have the proper update files, a message will be display warning of an incomplete update and no software changes will be made.

4.3 Schedule

The **Schedule** tab is used to enter sampling schedules for the cartridges. Ccartridge channels can run independently or together (co-located sampling). When the **Schedule** tab is pressed, a yellow screen appears which shows the start date, start time, and sample duration for Port 1. The values in each box can be changed by touching the text box and using the keypad to enter the appropriate values. All times are military times with midnight as 00:00. A 24-hour sample would be entered with a start time of 00:00 and a duration of 24:00 hours for the date entered in the “date” box. An identification label (e.g. Can 13420, Cart A6672) can also be entered for each cartridge. This label will appear with the data to identify each sample. If only one cartridge is to be sampled, the **Done** button is pressed and the sampler will return to the main screen.

If additional channels are to be sampled, The **Next** button must be pressed to display the schedule for the next port. For each subsequent port, the start date, start time, and duration can be entered. If the port sampling time is to follow immediately after the previous port and is of the same duration, the information can be entered automatically by check the box labeled “Follow the previous port”. After all the ports are displayed, the data for Channel 2 can be entered. The **Done** button can be used to return to the main screen at any time. The Prev button will show the previous screen.

4.4 Leak Check

The **Leak Check** tab is used to verify the cartridge connections prior to sampling. The first screen is identified as “Port 1 Leak Check” and is used to leak check the Port 1 cartridge. Cartridges are leak checked by turning on the vacuum pump and closing the upstream isolation solenoid valve. The downstream solenoid valve remains open to evacuate the cartridge, mass flow controller and tubing to the pump. If a leak is present, the flow controller will show a small flow. A leak is identified if the flow rate exceeds the flow rate tolerance set in the setup section.

The **Start** button is pressed to begin the leak check. The leak rate box will show “testing” during the measurement period. The cartridge leak check runs for 30 seconds. During this time, the vacuum pump is started and the flow rate is monitored. If the flow rate is above the leak limit at the end of the test, a “Failed” message is displayed and the leak flow rate is displayed in red. If a cartridge fails, the test should be repeated to verify the first test. After repeated failures, the fittings should be checked and the cartridge re-tested or replaced. If the test passes, the rate will appear in green. The test can be repeated by pressing the **Start** button, or the **Next** button can be used to advance to the next port or Channel 2.

4.5 Data

The **Data** tab is used to display or download data. After sampling has been completed, the **Data** tab is touched and the “Port 1 Data” screen is displayed. The stored data includes: start time; stop time; average, minimum, and maximum flow rate; collected volume; error status, and elapsed time.

NOTE: The start time is when the sampling cycle starts. This includes 20 seconds of leak check prior to allowing flow through the cartridge. The end time is when the sampling cycle is completed after a thirty second leak check. Therefore, the total time for flow through the cartridge is the end time minus the start time minus 50 seconds.

If the label printer option has been installed, a label can be printed for each port by pressing the **Label** button. On each label the following information will be printed: start date/time, end date/time, total sampled volume, average flow rate, and error flag. The error flag is the sum value of all errors that occurred during the sample period. The error values are:

0	No Errors
2	Leak Check Flow Limit Exceeded
4	Temperature Tolerance Exceeded
16	Flow Rate Tolerance Exceeded
32	Flow Rate Zero Exceeded
64	Power Failure
128	Aborted
256	Post Run Leak Check Flow Limit Exceeded

The entire data set can be downloaded to a jump drive inserted into one of the USB connectors below the screen. The following jump drives are known to work with this sampler:

Lexar JumpDrive Sport 256MB

Lexar JumpDrive Sport 512MB

SanDisk Cruzer Micro 256MB

Other jump drives may work with the samplers, but only those shown above have been verified.

It takes approximately 20 seconds for the operating the system to recognize the jump drive. Pressing the **Store** button will cause all available data to be transferred. If data has already been transferred to the jump drive, it must be deleted from the jump drive before the drive can be used again to store data. Once all the files have been received, a message will appear confirming completion of the transfer. An example of transmitted data is shown below:

```

Southern County Site
Cartridge A312
Ch. 1 Cartridge Started at 11/25/01 8:15:06 PM
      Flow Rate Set Point 1.000 lpm
      Stopped at 11/26/01 8:15:36 PM
      Total Volume 1428.05 liters
      Total Sample Time 24.00 hours
      Average Flow Rate 0.996 l/min
      Minimum Flow Rate 0.984 l/min
      Maximum Flow Rate 1.017 l/min
      Pre Start Leak Rate 0.000 l/min
      Ending Leak Rate -0.003 l/min
      Error Code 4
      Error Status Temperature Tolerance Exceeded
  
```

Time	Flow Rate	Volume	Temp
11/25/01 8:15:28 PM	1.902	0.35	48.8
11/25/01 8:20:36 PM	0.997	5.47	50.1
11/25/01 8:25:36 PM	0.996	10.45	49.7
•	•		
•	•		
•	•		
11/26/01 7:50:35 PM	0.998	1403.48	49.8
11/26/01 7:55:45 PM	0.994	1408.62	49.8
11/26/01 8:00:45 PM	0.995	1413.60	50.0
11/26/01 8:05:55 PM	0.996	1418.75	49.9
11/26/01 8:11:05 PM	0.994	1423.90	50.1

The **Next** button on the 8000 Data screen will advance to the next data screen or **Exit** can be used to return to the main screen.

4.6 Power Failures

If a power failure occurs during sampling, the sampler will resume sampling based on the programmed sampling schedule. The sampling schedule and data will not be lost during a power failure. The actual sampling time will be shorter than programmed because of the power loss. Data will show a power loss error, and the volume/time data will show the missing sampling interval during the power outage.

4.7 SOP

The **SOP** tab provides a Standard Operating Procedure for installing, leak checking, and scheduling the Model 8000. The SOP software guides the user through the required procedures and enables inexperienced operators to successfully program the sampler.

Pressing the **SOP** tab initializes the program. The **Back**, **Next**, and **Exit** buttons are used to advance through the procedure or return to the main screen.

Initially, the program brings up a screen that requires the user to check the number of cartridges to be sampled. Several screens follow which lead the operator through an automated leak check procedure. Each cartridge must pass leak check or the program will not continue. After all of the cartridges have been installed and leak checked, the SOP leads the user through a scheduling procedure to program the sampling times. When scheduling has been completed, the **Next** button returns the program to the main screen. After sampling has been finished, the operator uses the **Data** tab to retrieve the collected data.

4.8 Manual Mode

A **Manual** tab is provided to allow the operator to activate any solenoid valve or pump. This mode is useful in troubleshooting and testing individual components. In addition, the flow set point of each mass flow controller can be individually set. Upon leaving the manual mode screen, all settings revert to the values used in automatic mode.

NOTE: *All values displayed in Manual Mode are raw signal values and are NOT corrected by the calibration constants entered in the Set-Up screen.*

4.9 Advanced

Additional settings can be stored in the Advanced Setup section that is accessed through the **Advanced** tab. This portion of setup should only be used by individuals familiar with the operation and calibration of components used in the Model 8000. Changing the values in the Advanced Setup will alter the accuracy of the instrument. Several of the parameters are hardware dependent. These are set at the factory and require a password to be entered to be changed.

Mass Flow Controller Calibration

The calibration of the mass flow controllers can be changed by entering the appropriate slope and intercept for each mass flow controller. See Appendix A.

Mass Flow Meter Range (password controlled)

If the full scale range of a mass flow controller is changed, the corresponding full-scale range must be entered in the MFC Range box.

Heater Set Point

The set point of the ozone scrubber heater may be changed by replacing the value in the box marked Heater Set Point. The normal set point is 50 °C.

5. Maintenance

This section describes routine maintenance procedures for the Model 8000 Automated Sampler. All other repair work should be performed by trained personnel.

5.1 Vacuum Pump

To remove the vacuum pump from the sampler, remove the top and side covers. Remove the inlet tube and disconnect the electrical connector. Remove the four screws attaching the pump mounting bracket to the side of the sampler and remove the pump.

Inspect the pump but DO NOT at any time lubricate any of the parts with oil, grease, or petroleum products nor clean with acids, caustics or chlorinated solvents. Be very careful to keep the diaphragm from contacting any petroleum product or hydrocarbons. It can affect the service life of the pump.

WARNING: To prevent explosive hazard, do NOT pump combustible liquids or vapors with these units. Personal injury and or property damage would result.

To clean or replace the filters and/or rubber gasket, remove the five screws in the top of the unit. The filters and gasket are located beneath this top plate. Remove the filters and wash them in a solvent and/or blow off with air and replace. The gasket may be cleaned with water. Replace the filters in proper position and replace the gasket. Note that the gasket and top plate will fit in one position only.

To replace the diaphragm, remove the socket cap screws from the head of the pump. The diaphragm is held in place by two Phillips head screws. Remove screws, retainer plate, and the diaphragm. The diaphragm will fit in any position on the connecting rod. Replace the plate and the two Phillips head screws. Torque to 17- inch-pounds.

CAUTION: Do not raise any burrs or nicks on the heads of these screws. These burrs could cause damage to the inlet valve.

For replacing the inlet and outlet valve, remove the slotted machine screw that holds each valve in place. The stainless steel inlet and outlet valves are not

interchangeable. Clean them with water. When replacing the outlet valve, place the new valve in location and note there is a retaining bar near the machine screw hole. This retaining bar holds the valve in position. When replacing the inlet valve, note that the valve holder is marked with an X in one corner. This X should be in the lower right hand corner toward the inlet of the air chamber. Replace the head and tighten the socket head screws. Torque to 30 inch-pounds.

WARNING: The motor may be thermally protected and can automatically restart when the overload resets. Always disconnect the power source before servicing. Personal Injury and/or property damage could result.

Do not attempt to replace the connecting rod or motor bearings. If after cleaning the unit and/or installing a new Service Kit, the unit still does not operate properly, contact your representative, the factory, or return the pump to an authorized Service Center.

5.2 Cartridge Filter

The operator should periodically replace the Teflon filter located in the cartridge sample path. The replacement frequency will depend on site conditions. The filters must be replaced when the flow rate through the cartridges cannot be maintained. However, it is recommended that the filter be replaced before this condition exists. The operator should periodically check the filter and determine when it needs to be replaced. To replace the filter, turn off the main power to the sampler, remove the four screws that fasten the top to the sampler, slide the top towards the rear of the instrument and remove. Loosen the tubing nuts on each end of the filter housing and remove the housing. Remove the filter by removing the retaining ring on the filter using the hand wrenches supplied with the sampler. Replace the filter with a 10 micron Teflon filter and replace the filter housing in the sampler. Perform the Sampler Leak Check described in Section 5.3.

5.3 Ozone Scrubber

The ozone scrubber should be replaced after approximately 100,000 ppb ozone hours of either sampling or purging at 1 lpm. This is generally every 6-12 months

depending on the sampling frequency. The operating life in hours can be estimated by:

$$\text{Life (hrs)} = 100,000 / \text{Average Ozone concentration at site.}$$

The ozone scrubber is replaced by removing the top cover on the sampler and removing the ¼" stainless steel sample line with fittings and the Teflon filter holder on each side of the scrubber. Remove the two retaining knobs on the heater cover and remove the cover, exposing the heater block and copper tube denuder. Remove the insulation surrounding the heater block and carefully remove the denuder. Install a new denuder and replace the insulation and heater cover. Replace the sample lines and Teflon filter.

Perform a Sampler Leak Check by disconnecting the sampling line at the rear of the instrument and capping the inlet. Use either the manual mode screen or schedule button to start sampling through one of the ports and additional channels.. During sampling, the cartridge flow in all channels should be very close to zero after several minutes of sampling. If a flow is indicated (usually 0.03 slp or larger), the interior lines should be checked for the presence of a leak.

5.4 Mass Flow Controller Calibration

Each mass flow controller should be calibrated on an annual schedule. The mass flow controllers can be calibrated either electronically or manually. Manual calibration consists of adjusting the zero (no flow) and span potentiometers on the side of the mass flow controller using a reference flow standard. The potentiometers can be accessed through holes in the flow controller housing. Electronic calibration can be performed by inserting the appropriate calibration constants into the advanced portion of the setup screen. Appendix A provides a worksheet to calculate these constants using a calibrated flow reference standard.

NOTE: *The mass flow controllers are factory calibrated and referenced to the standard conditions of 0°C and 760 mmHg. These standard conditions are*

maintained if the MFC slope and intercept values in the Set-Up screen are 1.0 and 0.0 respectively. If the calibration drifts slightly, new calibration constants can be entered using the procedure in Appendix A.. The mass flow controllers can be referenced to other standard conditions (e.g., 25°C and 760 mmHg) by changing the constants using the Ideal Gas Law or by determining their value using a flow standard calibrated to the desired reference conditions and the procedure outlined in Appendix A.

6. Model 8000 Parts List

Components of the Model 8000 are shown in the following Parts List. This list does not include common parts such as fuses, fittings, or fasteners.

Chassis	8000-100-1
Front Panel	8000-100-2
Rear Panel	8000-100-3
Mass Flow Controller (Specify Range)	8000-200-1
Cartridge Tubing Set	8000-200-4
Cartridge Filter Holder	8000-200-5
Cartridge Filter (47mm Teflon)	8000-200-6
Canister Filter Assembly	8000-200-7
Canister filter (20 micron)	8000-200-8
Ozone Scrubber Heater (Complete)	8000-200-10
Ozone scrubber (KI copper coil)	8000-200-11
Heater Relay	8000-300-1
Vacuum Pump	8000-200-12
Vacuum Pump Relay	8000-300-2
2-Way Solenoid Valve	8000-200-13
Single Board Computer	8000-400-1
GPIO Board	8000-400-2
Interface Board	8000-400-3
Temperature Probe	8000-400-4
Power Supply	8000-300-3
Cooling Fan	8000-300-4
Power Switch	8000-300-5
Fuse Holder	8000-300-6
Pump Fan Guard	8000-500-1
Cooling Fan Guard	8000-500-2
Vacuum Line Tubing Set	8000-200-16

MFC Cartridge Ch.1 Cable	8000-700-3
MFC Cartridge Ch.2 Cable	8000-700-4
GPIO Cable Set	8000-700-5
Rear Panel Output Cable Set	8000-700-7
Interface Board Ribbon Cable Set	8000-700-8
Vacuum Pump Relay Cable	8000-700-10

Appendix A - Appendix A for the Flowmeter Calibration Procedure

Flowmeter Calibration Procedure

1. For the flow controller to be calibrated, set the slope to **1.0** and the intercept to **0.0** on the **Advanced** screen.
2. Enter the Manual screen and without the pump running, observe the flow controller flow rate (the flow will vary). If it is not 0.00 ± 0.02 lpm, manually adjust the flow controller output by turning the “zero” adjust screw on the side of the flow controller.
3. Disconnect the Luer coupler on the front panel and connect an accurate flowmeter (referenced to the desired temperature and pressure) to the outlet tube of the channel being calibrated.
4. Under Manual Mode, set the flowmeter set point to its normally operating value, open the port/channel solenoid valve, and turn on the pump. Read the flowmeter value from the screen (X) after the flow has stabilized. **X:**
5. Read the calibrated flow unit value (Y). **Y:**
6. The slope is calculated by:

$$Slope = \frac{Y}{X}$$

Slope:

7. Go to the **Advanced** screen, enter the new value for the slope.
8. Go to the **Manual** screen, check the “Calibrated Values” checkbox. Start the pump and open the port/solenoid valve. Verify that the displayed flow rate is the same as the calibrated flow device.

Appendix B Instruction Manual for Mass Flow Controller