



**Model 8001 Automated Canister Sampler**

**Operations and Maintenance Manual**

**Version 1.13**

**February 12, 2010**

©2010 ATEC, Malibu, CA 90265-2112



## **ATEC Model 8001 Canister Sampler**

### **Limited Warranty**

Atmospheric Technology (ATEC) warrants to the original purchaser of the Model 8001 Canister 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.

Any express warranty not provided herein, and any remedy which, but for this provision, might arise by implication or operation of law, is hereby excluded and disclaimed. The implied warranties of fitness for any particular purpose are expressly limited to a term of one year.

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.



<b>1.</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>2.</b>	<b>SYSTEM CONFIGURATION</b>	<b>2</b>
2.1	Hardware	2
2.1.1	System Specification	2
2.1.2	Sampler Components	3
<b>3.</b>	<b>RUNNING THE SYSTEM</b>	<b>7</b>
3.1	Hardware Setup	7
3.2	Display and Function Tabs	7
3.3	Date and Time	8
3.4	Site Identification	8
3.5	Canister Sampling Information	9
3.6	Purge Flow	9
3.7	Abort	9
3.8	Function Tabs	10
<b>4.</b>	<b>PROGRAMMING THE MODEL 8001</b>	<b>11</b>
4.1	Time/Date	11
4.2	Setup	12
4.3	Schedule	14
4.4	Leak Check	15
4.5	Data	16
4.6	Power Failures	17
4.7	SOP	17
4.8	Manual Mode	18
4.9	Advanced Mode	18
<b>5.</b>	<b>MAINTENANCE</b>	<b>21</b>
5.1	Purge Pump	21

5.2	Canister Filter	21
5.3	Mass Flow Controller Calibration	21
6.	MODEL 8001 PARTS LIST	23
	APPENDIX A – PROCEDURE FOR PRESSURE TRANSDUCER AND FLOWMETER CALIBRATION	25
	APPENDIX B INSTRUCTION MANUAL FOR MASS FLOW CONTROLLER	27

## **1. Introduction**

This manual covers the installation, operation and routine maintenance of the ATEC Model 8001 Automated Canister Sampler. This instrument is a microcomputer controlled sampler that can be programmed to draw ambient air into canisters for subsequent analysis of Volatile Organic Compounds (VOC's) according to the methods outlined in EPA Methods TO-14A and TO-15. 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 or 16 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 48 ports by adding the Model 81xx expansion modules.

The sampler has the following major 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.
- Sampling date, start time, stop time, starting pressure, end pressure, average flow rate, minimum flow rate, maximum flow rate, sampling time duration, and error status are stored for all channels. These data can be displayed on the screen or transferred to a computer using a jump drive. In addition, sampling data (i.e. time and pressure) are logged at a minimum of every 5 minutes and are included in the transferred data.
- 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**

Flow Rate: Nominal 10 cc/min (20 cc/min with pressurized option). Optional ranges are also available.  
Accuracy  $\pm 2\%$ FS

Canister Pressure  
Measurement Range: 0-30 PSIA. Accuracy  $\pm 0.25\%$  FS

Maximum Canister  
Filling Pressure: 2 psi below ambient; 30 psia (pressured option)

No. of Channels: 8 ports or 16 ports on Channel 1. Two other single port channels with independent operation are optional. The number of channels can be increased up to 48 with the addition of the Model 81xx 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.

Construction Materials: stainless steel and viton.



## 2.1.2 Sampler Components

This section describes the general operation and major components of the ATEC Model 8001 Automated Sampler. Shown here is a schematic diagram of the sampler. Air enters the sampler and passes through a stainless steel filter. When sampling, the solenoid valve upstream of the manifold is opened. Air passes through the mass flow controller (MFC) to the solenoid valve and into the manifold. When a selected port is activated, the solenoid valve to that port is opened and the air stream passes into the canister. Prior to sampling, the inlet line can be purged for a selected amount of time. Only one port for Channel 1, consisting of two independent solenoid valves and the canister, 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 and data acquisition for the automated sampling.

The Model 8001 can also be ordered with an optional pressurization pump. The pump is equipped with a external pressure gauge and by-pass valve to regulate the pressure. The purge pump is not used in this application because the pressure pump will purge the flow system prior to sampling.

#### 2.1.2.1 **Solenoid Valves**

One 15VDC solenoid valve is used for each port. The normally closed valve is mounted between the sampling manifold and the canister. There is one solenoid valve which isolates the manifold from the inlet line for leak checking and inlet line purging. During normal sampling, both the isolation solenoid valve and the canister solenoid valves are opened. During leak check, the isolation solenoid valve is closed and the manifold and sampling line to an individual canister are checked for leaks. If a small leak exists, the manifold pressure will slowly rise.

#### 2.1.2.2 **Canister Connections**

Canister connections are made to the 1/8" Swagelok fittings labeled "Port 1" through "Port 8" on the rear panel. If the optional collocated Channel 2 and Channel 3 are present, their connections on the rear panels are labeled "Ch. 2" and "Ch. 3".

#### 2.1.2.3 **Pressure Transducers**

For the Channel 1 (mulit-port channel), a precision pressure transducer is used to monitor the absolute pressure in a manifold connected to all the ports. To determine the pressure in one of the canisters, the canister valve for that port must be opened to equilibrate the manifold pressure with the pressure of the canister. The pressure in each canister must be measured individually in this way. If the optional collocated channels are present, there is a pressure transducer for each channel. The pressure transducers have a full-scale range of 0-30 psia. The output of each pressure transducer is interfaced to the internal computer.

#### 2.1.2.4 **Mass Flow Controllers**

A mass flow controller with a nominal range of 0-10 cc/min is used to control the sampling flowrate in each canister. If the optional collocated Channel 2 and Channel 3 are present, each channel would have a dedicated mass flow controller usually in the 0-10 cc/min range. The sampling flow rate is automatically calculated using the starting and end pressure and the sample duration. Operation and maintenance instructions for the mass flow controller are provided in Appendix B.

#### 2.1.2.5 **Purge Pump**

A diaphragm pump is used to purge the sampler inlet line by drawing air through the inlet tubing, mass flow controller, and 3-way isolation solenoid valve and exhausted out. A check valve isolates the exhaust path from the rest of the system. For pressurized sampling, a pressure pump pushes air through the components. The duration of purging prior to sampling can be specified in the Setup screen.

#### 2.1.2.6 **Optional 8-Port or 16-Port Expansion Module**

The Model 8001 can be expanded beyond the base 8 (Model 8001-8) or 16 (Model 8001-16) ports to a total of 48 ports by the addition of an expansion module(s). The Model 8108 adds an additional 8-ports while the Model 8116 adds an additional 16-ports. The expansion module is electrically connected to the Model 8001 by a single ribbon cable attached to the “EXP 1” connector on the rear panel. A pneumatic line is connected by attaching the “Exp Flow” from the Model 8001 to the “Exp Flow” on the expansion module.

The Model 8001 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 8001 is correctly made, the additional ports will be displayed once the Model 8001 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. 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. The display will illuminate in approximately 20 seconds.

The Model 8001 uses a 6.4" VGA 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 4-port USB connector is mounted on the front panel. A jump drive is inserted into the USB port to download data or to upgrade the software. An optional "printer" connector on the rear panel is used to interface a label printer to the Model 8001.

All components, tubing, and fittings have been cleaned prior to assembly. After unpacking the instrument and verifying operation, the Model 8001 should be purged with humidified zero air for a minimum of 24 hours before sampling, as outlined in the EPA TO14 and TO15 compendium methods.

#### 3.2 Display and Function Tabs

Normally the display will show the default main screen as illustrated below. 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 8001 Version 2.00				
Main   Time/Date   Setup   Schedules   Data   Leak Check   SOP   Manual   Advanced				
Monday, November 26, 2001 18:58				
East River Site				
		Flow	Pressure	Status
Canister	Ch. 1 Port 1		11.8	Finished
	Port 2		11.5	Finished
	Port 3	3.67	10.40	Sampling
	Port 4		0.21	Waiting
	Port 5		0.36	Waiting
	Port 6		0.10	Waiting
	Port 7		0.02	Waiting
	Port 8		0.11	Waiting
<input type="button" value="Abort"/>	Channel 2	3.34	4.31	Sampling
	Purge	0.000		

If there are more than 8 ports in the sampler or an expansion unit has been installed, a button on the main screen (not shown above) allows moving between the different ports, eight at a time.

### 3.3 Date and Time

The current date, time, and day of the week is displayed at the top of the screen and is updated every minute.

### 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 Canister Sampling Information

The canister flow rate and pressure are displayed while sampling. 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

*Used Can*—Canister initial pressure above limit

*Press Tol*—Canister pressure did not meet expected pressure within a given tolerance

*Flow Tol*—Canister flow rate tolerance exceeded

*Zero Tol*—Canister MFC required excess zero compensation

*Power Failure*—Sampler restarted due to an input power or CPU failure.

*Errors*—Multiple errors, power outage, or sample aborted

### 3.6 Purge Flow

Prior to sampling, the sampler is purged at the maximum flow controller flow rate. The purge flow rate is displayed on the left side 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. This action does not alter the stored sequence. If power is lost and then restored, sampling will resume.

### **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 canisters, or set-up the sampler using the SOP (Standard Operating Procedure) option. The operation of each tab is described in the Programming Section.



#### 4. Programming the Model 8001

The Model 8001 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, printed to labels, or downloaded to a jump drive using the **Data** tab. Canisters are manually leak checked with the **Leak Check** tab. The **SOP** tab uses a standard operating procedure to install and leak check the canisters and program sampling schedules. **Manual** provides a means to check out the operation of the hardware and **Advanced** allows the changing of operational parameters.

##### 4.1 Time/Date

The time and date that is stored in the Model 8001 can be changed using the **Time/Date** tab. When this tab is touched, the control panel screen will appear which enables the changing of time, date, time zone, and daylight savings time adjustment. This screen is exited by selecting the small “x” in the upper right corner of this window.

## 4.2 Setup

The **Setup** tab is used to input canister operating parameters, enable software updates, and calibrate the touch screen. When the **Setup** tab is touched, a green screen appears labeled “Canister Parameters” will appear. This screen allows the operator to change the following parameters for canister sampling:

### *Pressure Tolerance*

The Model 8001 continuously monitors the canister pressure during sampling and will produce an error flag if the pressure falls outside the pressure tolerance limit specified here. This tolerance is the difference between the expected pressure and the actual canister pressure. The sampler calculates the expected pressure based on the starting pressure, end pressure, and sampling duration.

### *End Pressure*

The final end pressure is the desired canister absolute pressure at the end of sampling. This value is an absolute pressure that should be determined using the atmospheric pressure at the sampling site or a pressure value that is 5 psi below the pump pressure for the pressurized canister option. The end pressure must be at least 2 psia below ambient pressure (or 5 psi below the pump pressure for pressurized sampling) to insure that the canister is filled to the desired pressure at the end of sampling. The sampler uses the specified end pressure to calculate the necessary flow rate to fill the canister to this pressure.

### *Leak Rate Limit*

The leak rate limit is the maximum increase in pressure that is allowed to pass a canister during the manual leak check. This value is normally set to 0.1 psia/min.

### *Canister Volume*

The nominal canister volume in liters is need to determine the flow rate.

### *Used Can Limit*

The Model 8001 checks the pressure of each canister prior to sampling. The pressure specified in the used can limit is used to determine if a used or leaking canister has been installed. If the starting pressure is above this value, a used can error status code will be set and sampling will be not proceed on this canister.

### *Purge Time*

Purge time specifies the duration of purging before the start of sampling.

### *Data Write Interval*

The Data Write Interval specifies the time interval for recording canister pressure 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.

## *Update*

Pressing the **Update** button terminates the sampling software and puts the microcomputer in a mode to accept a software update from the jump drive. To update the software, insert the jump drive and press the update button. The computer will display a message that the software has been successfully updated and the sampler will automatically reboot.

## *TouchScreen*

Pressing the **TouchScreen** button brings up the touch screen 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. The touch screen should be re-calibrated whenever it becomes difficult to activate buttons on the screen.

## *Set*

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

### **4.3 Schedule**

The **Schedule** tab is used to enter sampling schedules for the canisters. 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 canister. This label will appear with the data to identify each sample. If only one canister is to be sampled, the **Done** button is pressed and the sampler will return to the main screen.

If additional ports/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 checking 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 canister connections prior to sampling. The first screen is identified as “Port 1 Leak Check” and is used to leak check the Port 1 canister. Canisters are leak checked by attaching an evacuated canister to a port. The canister valve is then opened and then closed prior to pressing the **Start** button for that port. If a leak is present between the canister valve and the isolation solenoid valve, the manifold pressure will start to rise. A leak is identified if the pressure rate exceeds the leak rate limit set in the setup section.

NOTE: Prior to pressing the **Start** button to begin the leak check on a port, the canister solenoid valve on that port must be opened and then closed.

The **Start** button is pressed to begin the leak check. The leak rate box will show “testing” during the measurement period. The canister leak check runs for 60 seconds. During this time, the pressure and elapsed time will be displayed. If the pressure rate is above the leak rate limit entered in the Setup screen at the end of the test, a “Failed” message is displayed. If a canister fails, the test should be

repeated to verify the first test. After repeated failures, the fittings should be checked and the canister re-tested or replaced. If the test passes, a "Passed" message will appear on the screen and the leak rate is displayed. 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; starting pressure; ending pressure; average, minimum, and maximum flow rate; error status, and elapsed time. The entire data set can be downloaded through the jump drive by inserting the drive in the USB port and pressing the **Store** button. The file names on the jump drive are unique and previously stored files do not have to be deleted before storing new data. The data file name is the port or channel number and the date/time when the data was written to the jump drive. An example of a typical data file is shown here:

```

East River Site
Canister 13249
Port 1 Canister Started at 11/20/00 9:00:06 PM
    Starting Pressure 0.11 psia
    Flow Rate Set Point 3.29 cc/min
    Stopped at 11/21/00 9:00:05 PM
    End Pressure 11.68 psia
    Average Flow Rate 3.29 cc/min
    Minimum Flow Rate 0.94 cc/min
    Maximum Flow Rate 3.47 cc/min
    Error Status Pressure Tolerance Exceeded
  
```

Time	Flowrate	Pressure
11/20/00 9:00:17 PM	0.34	0.26
11/20/00 9:05:26 PM	3.28	0.16
11/20/00 9:10:36 PM	3.29	0.24
11/20/00 9:15:46 PM	3.27	0.24
•	•	•
•	•	•
•	•	•
11/21/00 8:40:15 PM	3.28	11.53
11/21/00 8:45:25 PM	3.29	11.61
11/21/00 8:50:25 PM	3.28	11.63
11/21/00 9:00:05 PM	3.27	11.68

Data for each port is saved until the port is sampled again. The new data is stored in the location of the previous data. All data can be erased after a sampling sequence by answering “Yes” to the query that appears when exiting the Data screen.

The **Next** button on the 8001 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. The data will show a power loss error, and the pressure/time data will show the missing sampling interval during the power outage.

The software also includes a watchdog timer that automatically reboots the CPU if no CPU activity occurs for 30 seconds. If this occurs during sampling, a power failure error will also be generated.

#### **4.7 SOP**

The **SOP** tab provides a Standard Operating Procedure for installing, leak checking, and scheduling the Model 8001. 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 canisters to be sampled. Several screens follow which lead the operator through an automated leak check procedure. Each canister must pass leak check or the program will not continue. After all of the canisters 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 the 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.

When viewing data in manual mode, the software calibration constants are NOT applied to the displayed values.

#### 4.9 Advanced Mode

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 8001. 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 or 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 Controller Range (password control)*

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.

### *Pressure Transducer Calibration*

The calibration of the pressure transducers can be changed by entering the appropriate slope and intercept for each transducer. See Appendix A.

### *Number of Ports (password control)*

The Model 8001 has 8 or 16 ports. If an expansion module is added, the numbers of ports can be increased by 64. The total number of ports must be specified here. If the Model 8001 does not detect the expansion module, the number of ports will default to 8.

### *Pressure Transducer Range and Offset (password control)*

The pressure transducer range and voltage offset are specified here. This data is hardware dependent and only needs to be changed if the type/brand of pressure transducer is changed.

## *Language*

If the sampler has been configured for multi-language capability, a drop down box will be on the screen with the selection of available languages. To change to another language, select the language in the drop down box and then press the ***Exit*** button. When returning to English from another language, the system will automatically reboot.

## **5. Maintenance**

This section describes routine maintenance procedures for the Model 8001 Canister Sampler. All other repair work should be performed by trained personnel.

### **5.1 Purge Pump**

To remove the purge pump from the sampler, remove the top cover. Remove the inlet tube and disconnect the electrical connector. Remove the screws attaching the pump mounting bracket to the sampler and remove the pump.

The pump diaphragm can be replaced by removing the four screws on the top of the pump. Grasp the diaphragm and turn it counter clockwise to unscrew it from the connecting rod.

### **5.2 Canister Filter**

The operator should periodically replace the 2 micron (7 micron for pressurized sampling) sintered stainless steel filter in the canister flow path. The filter must be replaced when the canister flow rate cannot be maintained. Site conditions will determine the replacement frequency. Remove the reducing fitting at the inlet and use a small punch or rod to push the pressed-in filter disk out the end of the fitting and replace with a new disk. The new filter disk may need to be tapped into the fitting with a clean hammer.

### **5.3 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 using a reference flow standard. The potentiometers can be accessed on the side of 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.

## 6. Model 8001 Parts List

Components of the Model 8001 are shown in the following Parts List. This list does not include common parts such as fuses, fittings, or fasteners.

Chassis	8001-100-1
Front Panel	8001-100-2
Rear Panel	8001-100-3
Mass Flow Controller (Specify Range)	8001-200-1
Canister filter (10 micron)	8001-200-8
Purge Pump	8001-200-12
2-Way Solenoid Valve	8001-200-13
Single Board Computer	8001-400-1
GPIO Board	8001-400-2
Interface Board	8001-400-3
Temperature Probe	8001-400-4
Power Supply	8001-300-3
Cooling Fan	8001-300-4
Power Switch	8001-300-5
Fuse Holder	8001-300-6
Cooling Fan Guard	8001-500-2
MFC Cartridge Ch.1 Cable	8001-700-3
MFC Cartridge Ch. 2 Cable	8001-700-4
GPIO Cable Set	8001-700-5
Rear Panel Output Cable Set	8001-700-7
Interface Board Ribbon Cable Set	8001-700-8



## Appendix A – Procedure for Pressure Transducer and Flowmeter Calibration

### Flowmeter Calibration Procedure

1. Enter the **Manual** screen and without the pump running, observe the average flow controller flow rate (the flow rate will oscillate). If it is not  $0.00 \pm 0.02$ , manually adjust the flow controller output by turning the "zero" adjust screw on the side of the flow controller.
2. Go to the **Advanced** screen and enter 0.00 for the intercept for the channel being calibrated.
3. Connect an accurate flowmeter (referenced to the desired temperature and pressure) to the canister inlet for the channel of the flow controller being calibrated.
4. Under **Manual Mode**, set the flow controller set point to its normally operating value, open the 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 **Schedule** screen and program the sampler to start in a few minutes. After the sampler has started, verify that the flow rate displayed on the main screen is the same as the calibrated flow device. If the flow rates agree, then the channel has been calibrated correctly and the flow standard can be removed.

## Pressure Transducer Calibration Procedure

1. For the pressure transducer to be calibrated, set the slope to **1.0** and the intercept to **0.0** in the Advanced option.
2. Attach an evacuated canister (absolute pressure < 0.05 psia) to a port and in Manual mode open the port valve to evacuate the manifold and equilibrate it to the canister pressure. (NOTE: Channels 2 and 3 input fittings are connected directly to the pressure transducers.)
3. Record the pressure and enter the negative of this value for the intercept (e.g. recorded value = -0.1, the intercept = +0.1) in the Advanced screen.
4. Disconnect the evacuated canister from the port.
5. Accurately determine the ambient pressure (P1) within ±0.05 psi.. **P1:**
6. Enter the main screen, and observe the average pressure (P2) displayed. **P2:**
7. The slope is calculated by:  
$$Slope = \frac{P1}{P2}$$
 **Slope:**
8. Enter the slope value for the pressure transducer in the Advanced screen.
9. Repeat Step 6 to verify that the pressure displayed is the same as the atmospheric pressure (P1).
10. If the pressure is different by more than ±0.1 psi, enter **1.0** for the slope in the Advanced option and repeat Steps 5 to 10.



**Appendix B Instruction Manual for Mass Flow Controller**