

**Mercury**

# App K

**APEX INSTRUMENTS, INC.**

---

Appendix K Automated Mercury Source Sampler –  
Model XC-6000EPC

# Operator's Manual

# Operator's Manual

---



**Apex Instruments, Inc.**  
204 Technology Park Lane  
Fuquay-Varina, NC 27526  
Phone 919-557-7300 • Fax 919-557-7110  
Web: [www.apexinst.com](http://www.apexinst.com)  
E-mail: [info@apexinst.com](mailto:info@apexinst.com)

Published 05/15/2009

**Introduction..... 3**

    MercSampler Console Description..... 3

        Plumbing Subsystem .....6

        Electrical Subsystem.....7

        Console Connection Diagrams .....8

    MercSampler Software..... 10

        Loading Software .....10

        Driver Installation .....10

        Upgrading Firmware .....15

        Important Notes About Upgrading Firmware:.....16

        Programming the XC6000 Firmware.....17

        After a successful upgrade:.....20

        Software Operation .....22

        Software Communication.....23

    Test Profile ..... 26

        Alarm Actions.....28

        Test Setup.....30

        Test Parameters: .....30

        External Flow and External Moisture: .....31

        Pre-Test Leak Check .....32

        Set Probe .....33

        Mechanical DGM Volume Input .....34

        Test Start .....35

        Stat Screen .....36

        Pause Test.....36

        Adjust Screen.....37

        End Test.....38

        Post-Test Leak Check.....39

        Export Data .....40

        Export Data Cont. ....41

        Multi-File Export .....41

        Multiple File Export (cont.) .....42

        Set Clock.....42

        Sorbent Traps .....43

**Appendix 1 .....44**

**REPLACEMENT PARTS.....44**

    CONSOLE..... 44

    COOLER ..... 49

    PROBE ..... 51

**CONSUMABLES.....53**

    CONSOLE..... 53

    COOLER ..... 53

    PROBE ..... 55

## Introduction

The purpose of this manual is to provide a basic understanding of the Apex Instruments automated sampling console available for Appendix K Mercury Sampling. The MercSampler Model XC-6000EPC console is applicable for Mercury Emissions Sampling Using Iodinated Charcoal Traps. For additional information on the applicable Appendix K method, please visit <http://www.epa.gov/air/mercuryrule/>.

## MercSampler Console Description

The MercSampler Console is the operator's control station that controls and captures data necessary for paired sorbent tube sampling according to Appendix K. The basic principle of the console is to control the sample flow rate proportionally to the stack gas flow rate and determine the standardized volume extracted through each sorbent trap. To capture the samples, a pair of diaphragm vacuum pumps work in concert with proportional valves and mass flow sensors. Optical encoders are mounted inside the gas meters to provide digital feedback for the volume sampled. From additional temperature and pressure measurements the sample volume at standard conditions (USEPA 20°C and 760mmHg) is calculated. Figure 1-1 illustrates the Apex Instruments Model XC-6000EPC.



**Figure 1-1. Model XC-6000EPC MercSampler Console – 8U Rackmount Version**

Depending on the application and stack configuration, three versions of the XC-6000EPC MercSampler are available.

8U rackmount – robust, portable enclosure with a separate Stirling Cooler.

Portable weathertight case – Highly portable MercSampler housed in ABS molded case (wheeled enclosure with telescoping handle) for use with a separate Stirling Cooler.

Environmental enclosure – permanent, weathertight enclosure with room for a rackmount Stirling Cooler.



**Figure 1-2. Model XCP-6000EPC MercSampler Console – Portable version**



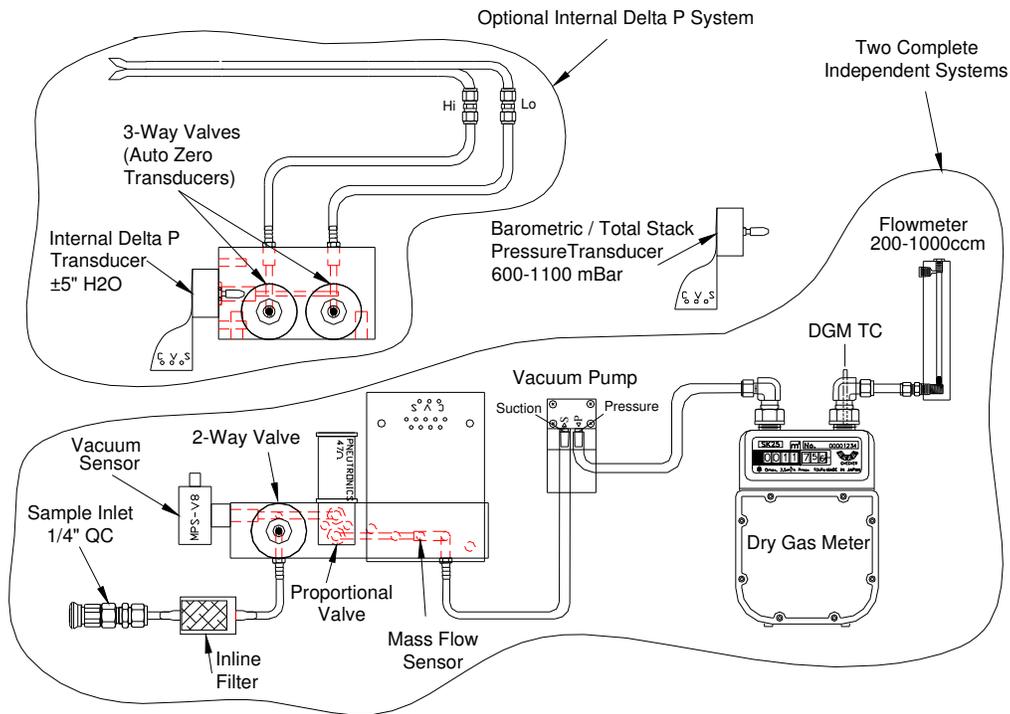
**Figure 1-3. Model XC-6000EPC MercSampler Console & SGC-4000HG – Outdoor Case version**

**Table 1-2. Features and Specifications of Apex Instruments  
Model XC-6000EPC MercSampler Console**

Features	XC-6000EPC MercSampler Console
Gas Meter	Positive displacement diaphragm meter, 45 Lpm maximum and 0.17 Lpm starting flow rate, 0.7L/revolution
Meter Display	Direct-read index or electronic totalizer with 9999.9999 cubic meter capacity, 0.2 Liter resolution (direct read) or 0.001 Liter (totalizer.) Optical encoder with quadrature pulse output to CPU increases volumetric resolution to 1 cubic centimeter or 0.001 Liters.
Sample Pump	Internal Hargraves miniature diaphragm pump. Brushless DC (BLDC) Motor rated at 12VDC. >20inHg Maximum Vacuum. ~4Lpm maximum unrestricted flow.
Proportional Valve	Pneutronics Voltage Sensitive Orifice (VSO) Series. 47ohm, 12VDC
Mass Flow Sensor	Honeywell AWM Series. 100-4000ccm.
Barometric Sensor	AllSensors 600-1000mBar, 5VDC Supply
Vacuum Sensor	Vaccon 0-30”Hg
Flow Meter	Dwyer 100 – 2500 ccm
Umbilical Connections	<u>Electrical:</u> 4-pin locking Amphenol connectors  <u>Sample Line:</u> ¼” Stainless Steel Quick-Connect or Swagelok fittings
Dimensions	17 in x 14 in x 17 in (W x H x D)
Power Requirements	120VAC/60Hz standard 2 or more 15A circuits depending upon configuration (230VAC/50Hz optional)
Weight	35 lbs (16 kg) not including enclosure

The MercSampler Console is comprised of plumbing and electrical (including thermocouple and electronic circuits) subsystems that work together to give appropriate control and feedback.

## Plumbing Subsystem



**Figure 1-4. Plumbing Flow Diagram of XC-6000EPC MercSampler Console.**

# Electrical Subsystem

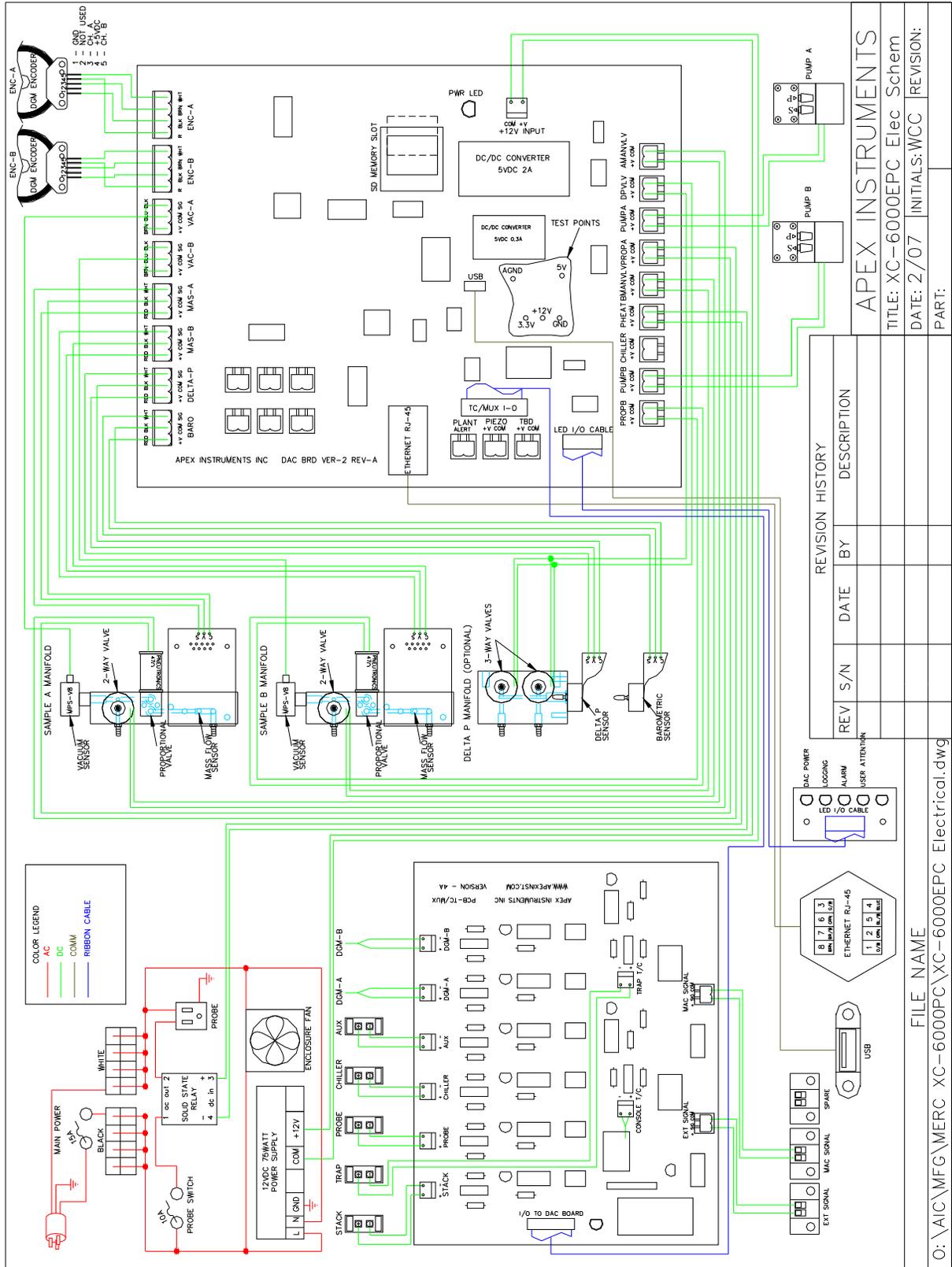


Figure 1-5. Electrical Diagram of XC-6000EPC MercSampler Console.

## Console Connection Diagrams

### XC6000 System I/O Diagram 8U Portable

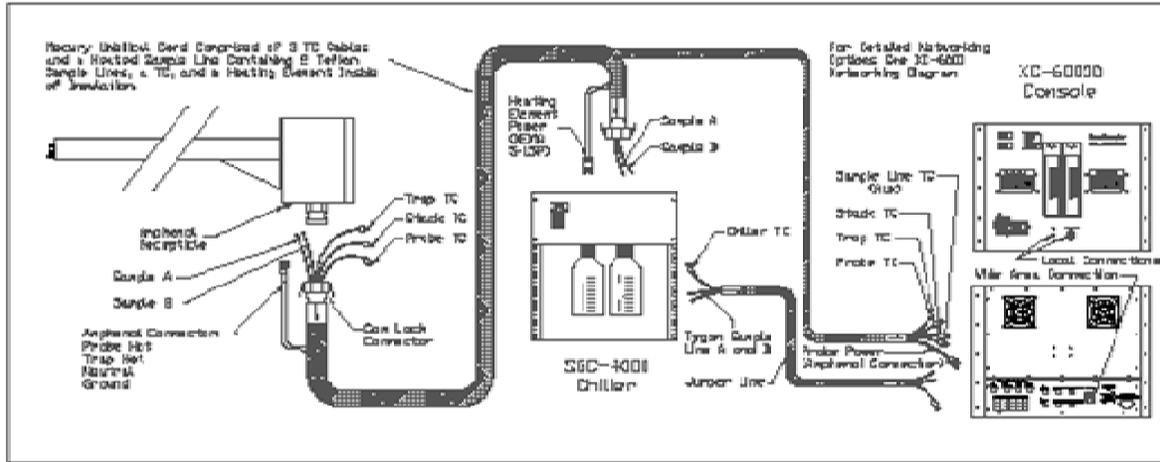


Figure 1-5a. Connection Diagram for XC-6000 EPC in Portable Enclosure

### XC6000 System I/O Diagram Bud Cabinet

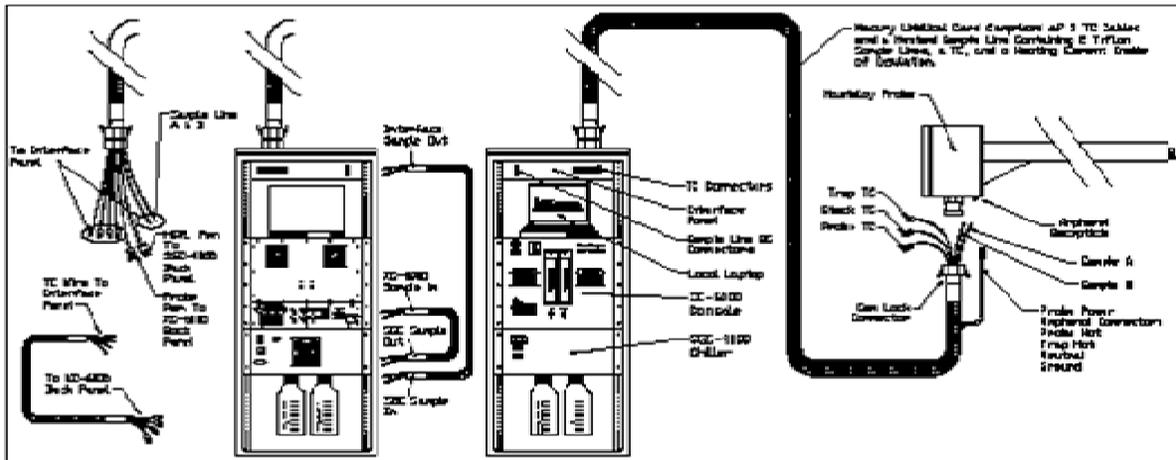
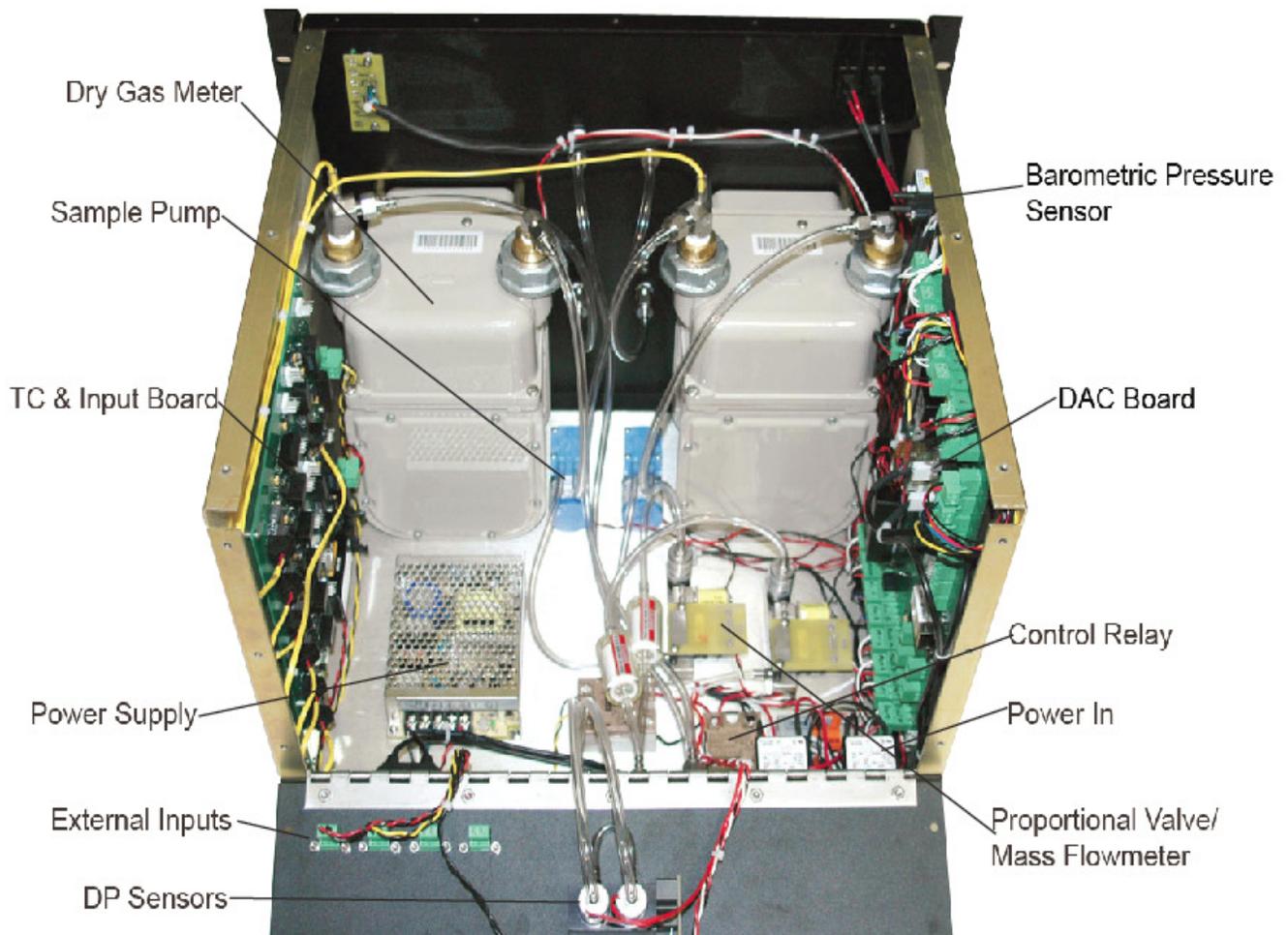


Figure 1-5b. Connection Diagram for XC-6000 EPC in Permanent / Environmental Enclosure

## AUTOMATED MERCURY SOURCE SAMPLER

- The Source Sampler Console is factory-configured for 115 VAC / 60 Hz electrical power. Configuration for 220 VAC / 50 Hz operation is an available option.
- The AC electrical subsystem provides switch power to each circuit, controlled by two switches: MAIN and PROBE.
- All circuits are protected by a MAIN 15 Amp (10 Amp 220V) circuit breaker. Additionally, the probe is protected by a 10 Amp breaker. These circuit breakers detect and interrupt overload and short circuit conditions, providing an important safety factor. If the circuit breaker opens, or “trips,” indicating interruption of the circuit, investigate and repair the electrical fault, and then reset the breaker by pressing the circuit breaker switch. The Electrical Schematic for the Source Sampler Console is presented in Figure 1-3.
- Two custom-designed and manufactured circuit boards, a Data Acquisition and Control (DAC) board and Thermocouple (TC-MUX) board, are utilized.



## MercSampler Software

The MercSampler includes firmware preloaded on its DAC and TC/MUX boards. Also included is Windows-based interface software. Apex Instruments recommends the purchase of a laptop or desktop computer directly through Apex to ensure computer compatibility and proper loading of software. However, if you prefer to use or purchase your own computer please ensure your computer has, as a minimum, the following specifications.

Item	Description	Capacity
CPU	Processor Speed	1GHz+
RAM	Random Access Memory	>512MB
HDD	Hard Drive Capacity	~12MB for Software. Data file storage varies.
O/S	Operating System	Windows XP SP2 or Vista

## Loading Software

To load MercSampler software on your laptop or desktop computer, follow these steps:

Insert the Apex XC-6000 MercSampler CD-ROM into your computer CD-ROM drive. Open the drive letter of the CD-ROM drive (sometimes D:\ or E:\) and copy the “Apex” folder to the root directory of your system drive (C:\).

If installing from an electronically distributed copy (email, web, etc.) please unzip the xc6000.zip file to C:\Apex.

The software must be installed in the C:\Apex directory on your computer. Please delete any files currently in the C:\Apex directory, then copy the files from the CD-ROM or .zip file to the C:\ drive.

The software is now installed correctly.

## Driver Installation

The Apex XC-6000EPC includes a USB connection functionality, which is implemented using a virtual serial port on the connected PC. To install drivers for this serial port, please perform the following steps:

Power down the XC-6000EPC MercSampler if it is not already powered off by switching the main Power switch to the “off” position.

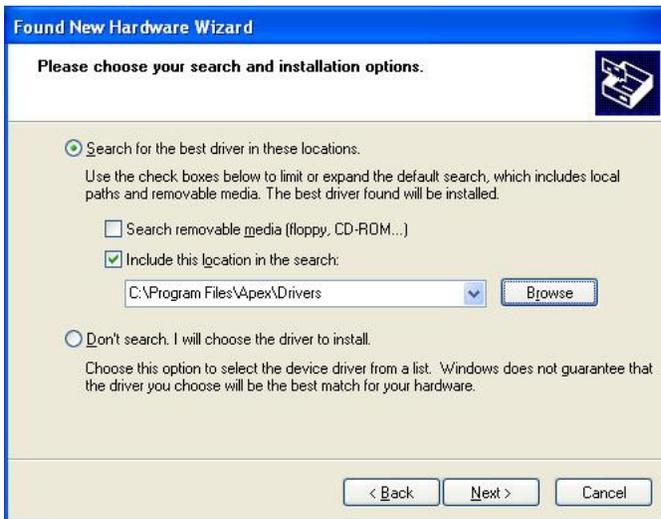
Connect the XC-6000EPC to the PC using the included USB cable. For XC-6000EPC units with two USB connectors on the rear panel, please connect to the port nearest the edge of the unit (left port when facing the rear panel.)



Windows will discover the XC-6000EPC. The Windows “Found New Hardware Wizard” will appear onscreen.



Please select “Install from a list or specific location (Advanced.)”



Use the “Browse” button to find the folder where the XC6000 application is installed (usually C:\Apex) and then navigate to the “FT232\_UART\_Driver” subfolder. (C:\Apex\FT232\_UART\_Driver) Click “Next.”



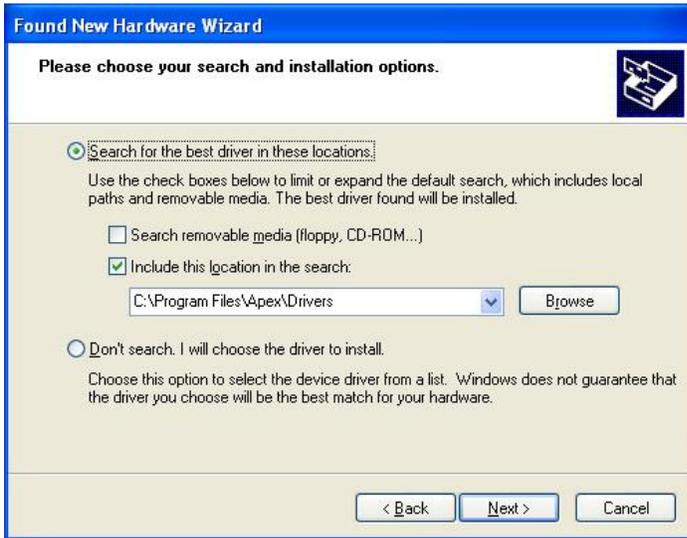
The drivers for the serial converter (UART) will be installed. Press “Finish.”



Windows will then discover the virtual serial port. The installation for the serial port drivers is the same as for the serial converter. The “Found New Hardware Wizard” will start:



Select “Install from a list or specific location (Advanced,)” and press “Next.”



Select the driver location (same as for the serial converter installed previously) and press “Next.”

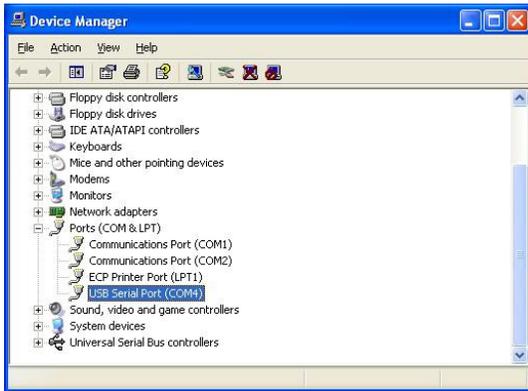


The wizard will complete. Press “Finish.”

Open the System Properties control panel (either open Control Panel > System or right click on My Computer and select “Properties.”)



Click the “Hardware” tab, then click “Device Manager.”



When the Device Manager opens, open up the “Ports (COM & LPT)” item and make sure that a “USB Serial Port” is installed. Please make a note of the COM number (in this case, it is COM4, but your installation may vary.)

## Upgrading Firmware

From time to time, Apex Instruments may release updated device firmware for the XC6000EPC console. These firmware upgrades may add additional functionality or capabilities to the console, and may be required in order to use the latest version of the monitor / control client software. If the XC6000 software displays a message regarding your firmware revision number, please contact Apex Instruments to get more information.

The XC6000EPC firmware may be programmed using a PC and the Apex Firmware Programming Cable. PLEASE NOTE: The drivers for the programming cable and the version of the XC6000 firmware most current at the time of shipment are installed along with the Apex software. Please install the Apex XC6000EPC software before attempting to upgrade the firmware.

The Apex Firmware Programming Cable uses a USB Serial Converter similar to the one in the main console. When connecting the Firmware Programming Cable to the PC for the first time, the Found New Hardware Wizard may appear.

Early revision program cables have a 6-pin Molex connector on one end, and a 9-pin D-sub connector on the other. These cables are supplied with a USB serial adaptor (usually made by Belkin.) Please follow the same directions as detailed above in Software Installation, directing the wizard to the “C:\Apex\F5U109 USB Serial Port Driver” folder. Once the drivers are installed, please re-open the Device Manager and note the COM number of the new serial port installed by the Apex Firmware Programming Cable.



**DB-9 Serial Plug**



**USB-A Plug**

For later revision programming cables with the 6-pin Molex connector and a 4-pin USB A connector on the other, please use the same steps as for connecting the XC6000 to the PC via USB. The later programming cables use the same USB converter as the XC6000 so no additional drivers are necessary. The COM port installed may not be the same as the XC6000 virtual COM port, so please re-open the Device Manager and note the COM number of the new serial port installed by the Apex Firmware Programming Cable.

## Important Notes About Upgrading Firmware:

The older versions of the XC6000 firmware lack several important new features of the current consoles. These include the ability to set alarms based on test conditions, the optional ability to sample at flow rates above 1Lpm, and the provision for communication with the optional ModBus module. In addition, the calibration tables for the older versions may not be immediately compatible with the newer versions, and some conversion must be performed. Before upgrading your XC6000 firmware, please connect the console to your current software and make a note of the application and firmware version.

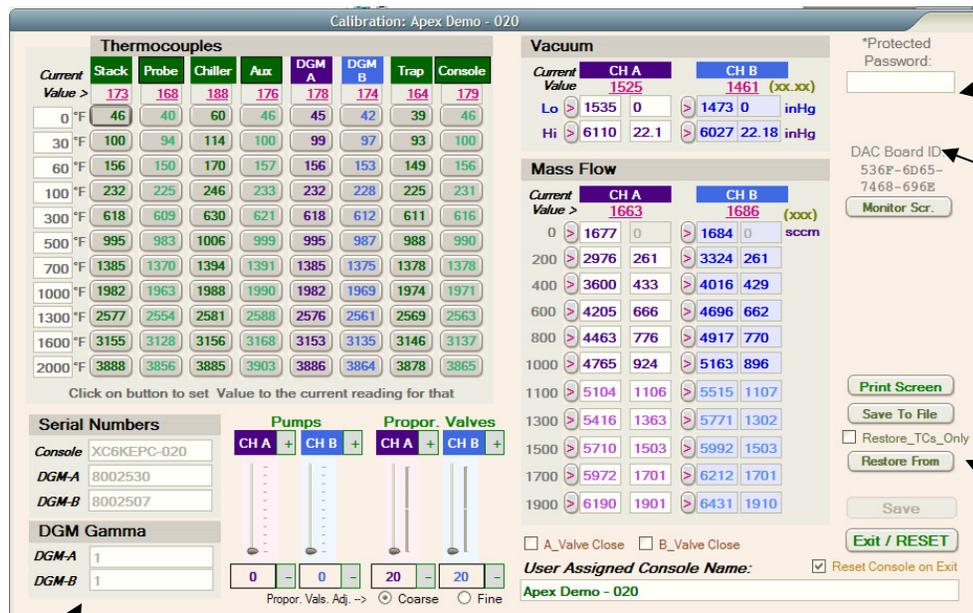


The application version is visible before the console is connected. Once the console makes connection, the firmware revision is displayed to the right of the application version number, separated by a dash: “081031-99.” Make a note of these version numbers.

Once connected, enter the Config / Utilities screen and then the Calibration screen. Enter the word “enable” (no quotes) into the protected password space on the Calibration screen. Press the “Save to File” button. Choose a location for your saved table, and give it a unique name.

**IMPORTANT NOTE:** Always save the XC6000 calibration table to a file before upgrading the console firmware.

# AUTOMATED MERCURY SOURCE SAMPLER



DGM Gamma

Calibration Screen

Password

Calibration Screen 2

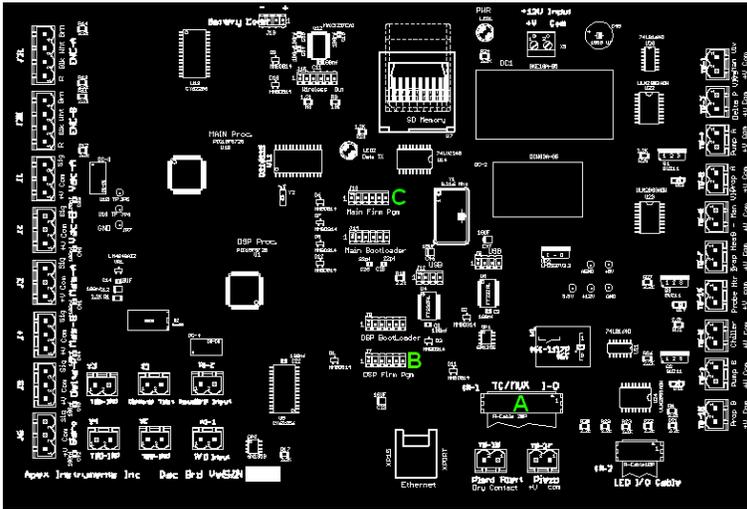
Save To File Restore from File

## Programming the XC6000 Firmware

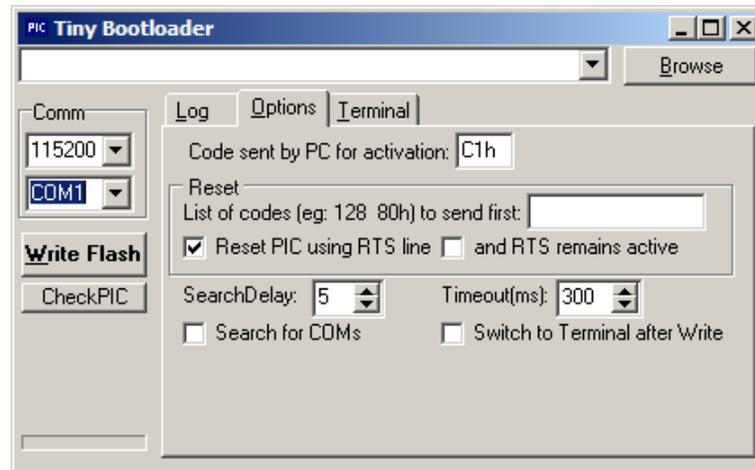
1. Ensure XC6000EPC console is powered off. Disconnect any connecting cables from the console, and remove the console from its rack enclosure. Remove the nine (9) screws from the top of the unit and the six (6) screws from the outside left and right edges of the rear panel, and open the lid of the console by lifting it up from the front. Please note: portable case units must unlatch the front panel retaining screws and fold down the front panel to access the DAC board.
2. Units installed in an environmental enclosure may have a separate firmware programming connector located on the front panel of the unit. For units in an environmental enclosure, please connect the programming cable to the front-panel connector, and proceed to Step 4.
3. Upgrading the XC6000EPC console *from* version 070904x-46 or similar to a higher firmware revision (above 46) will require the DSP processor to be programmed as well as the Main processor. If your console does not require a DSP firmware upgrade, please skip to step 15.

### Programming the DSP Processor – SKIP THIS STEP UNLESS UPGRADING FROM v46 or lower!

4. Remove the 20-pin ribbon cable from the XC6000EPC TC/MUX board.  
*Reference: Figure DAC-1 below, item A.*
5. Connect the 6-pin Molex connector on the end of the programming cable to the DAC board header labeled **DSP Firm Pgm**  
*Reference: Figure DAC-1 below, item B.*



6. Power on XC6000EPC console
7. Navigate to the install location  
*default: C:\Apex\Firmware*
8. Execute **dl.exe**
9. The Tiny Bootloader window will launch



**DL.EXE - Tiny Bootloader**

10. Click Browse and select ApexDSP.hex from the current directory
11. Select the following options:
  - Comm: 115200
  - Comm (use the COM number noted earlier)
  - Enable Options -> Reset PIC using RTS line
12. Click Write Flash
13. When update is complete, Log window will read **Write OK**. The writing process should take between 3 and 6 seconds.
14. Power off XC6000EPC console and remove 6-pin Molex connector on the end of the programming cable from the DAC board.

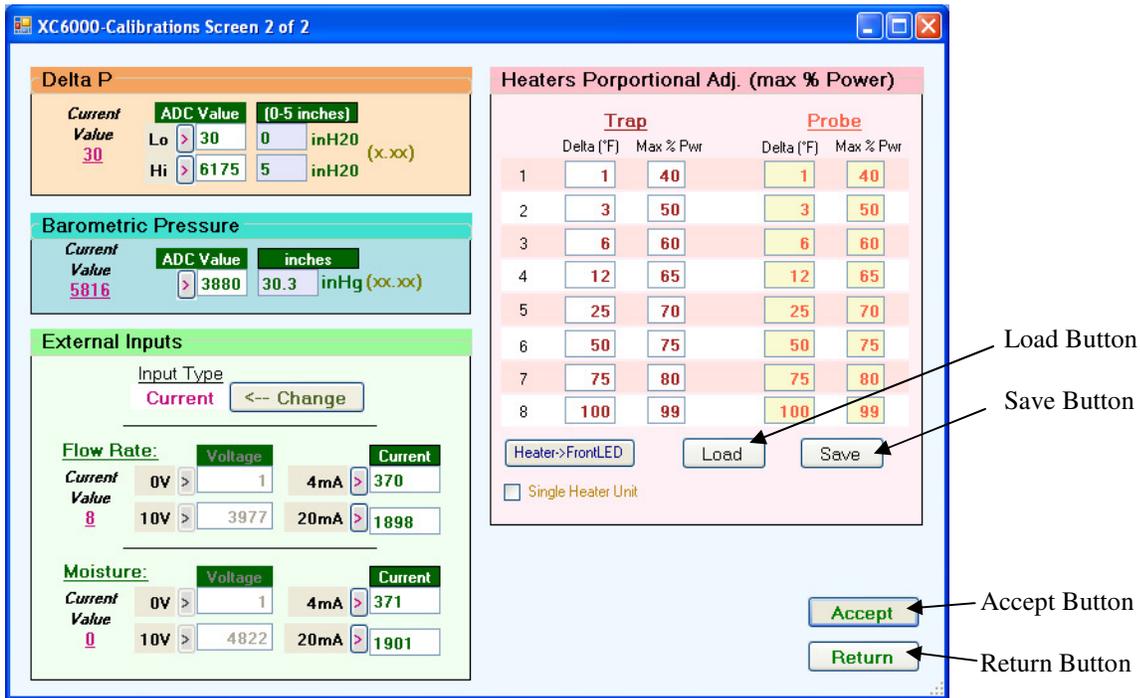


24. Power off XC6000EPC console and remove 6-pin Molex connector on the end of the programming cable from the DAC board.
25. Replace the 20-pin ribbon cable from the TC/MUX board (item A above)
26. Power on the XC6000EPC console and connect using the XC6000EPC MercSampler application. The version number of the console should appear in the upper right of the application window once connected. Ensure that the version number that the console reports matches the version number of the supplied firmware update.

**After a successful upgrade:**

Once the console has been upgraded, the calibration table will need to be converted to the new format. Connect to the console and enter the Config / Utilities screen. Press the “Set Clock” button to ensure that the XC6000 has the correct time and date set. Close the Config / Utilities screen and observe the date and time on the Main screen to make sure the time and date are correct and that the time is advancing. Then re-enter the Config / Utilities screen and go to the Calibration screen.

On the Calibration screen, enter “enable” (no quotes) into the protected password screen. Immediately proceed to Calibration Screen 2.



**Calibration Screen 2**

Press the “Load” button on the Heaters Proportional Adj. box. Load the heater table provided to you in the update location (the filename will have a .cal\_heaters extension.) Press “Accept” and then “Return” to go back to the first page of the calibration screen.

## AUTOMATED MERCURY SOURCE SAMPLER

On the first page, press the “Restore From” button and load the previously saved calibration table. The application will fill in mass flow calibration values greater than 1 liter per minute. Please keep in mind that the flow rate may not be accurate above 1 liter per minute unless a calibration is performed on the console. However, if the console is used for lower flow rates (such as the typical flow rates used in Appendix K sampling) then the previous calibration values will be correct for these flow rates.

Once the calibration table is loaded, enter “Gamma” (no quotes, capital G) into the password field. On the lower left of the calibration screen, enter the dry gas meter gamma (“Y”) from the dry gas meter calibration sheet. The XC6000 will correct for the meter error automatically.

Enter “enable” (no quotes) in the password field and press the “Save” button. Once the table is saved, press “Save to File” and save a copy of the new table with a new filename. Press the Exit / Reset button to reset the console and apply the new calibration factors.

Older test profiles may cause errors when used with newer firmware. To avoid this, create new profiles for performing sample runs. If an older profile must be used, please step through the profile one screen at a time (press the “Next” button) and save the profile with a new filename. The profile should be automatically converted to the newest version.

In addition, connecting a console with *older* firmware to a PC with a *newer* version of the XC6000 application may cause errors. For best results, please ensure that console firmware and interface application versions match.

## Software Operation

To start the MercSampler software on your laptop or desktop computer follow these steps: Double click the “XC-6000” icon on your desktop. The following screen should appear. Please take a moment to note the version number of the software, which is printed on-screen in the center-right of the menu, near the top of the smokestack.



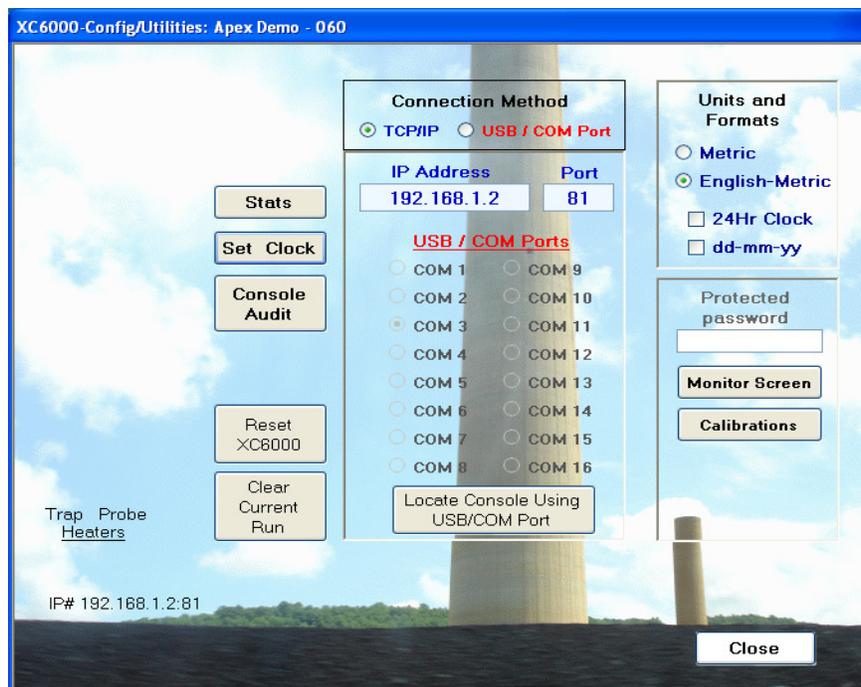
**Figure 1-6. Initial Main Screen**

If you have already setup the communication method single click the “Connect” button and skip the following section and go to the Test Profile section, otherwise follow the instructions that follow to setup the communication between the console and the computer.

## Software Communication

The MercSampler software communicates via USB or Ethernet (optionally wireless Ethernet). To connect single click the “Config/Utilities” button.

The following screen should appear.



**Figure 1-7. Config & Utilities Screen**

To connect via USB follow these steps:

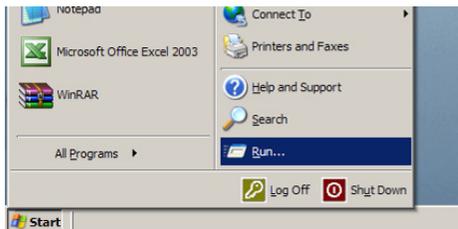
1. Select the “COM Port” button under the Connection Method.
2. Single click the “Locate COM Ports”.
3. Select an available COM Port – make sure that this COM number is the same as the COM number for the USB Serial Port installed previously.
4. Single Click “Return” and the Main Screen will appear.
5. “End” the program and reopen the program by double-clicking the desktop icon.
6. Single click the “Connect” button. The screen should indicate the console ID, communication method and console date/time.

To connect via Ethernet follow these steps:

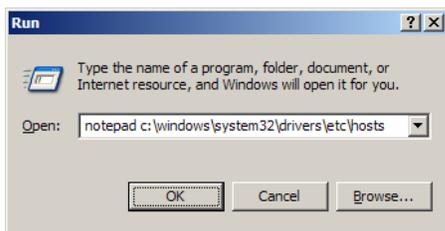
1. Select “TCP/IP” button under the Connection Method.
2. Type in the IP address 192.168.1.2 and Port 81.
3. Single Click “Return” and the Main Screen will appear.
4. “End” the program and reopen the program by double-clicking the desktop icon.
5. Single click the “Connect” button. The screen should indicate the console ID, communication method and console date/time.

**Important note:** If you experience errors in TCP/IP connection, please follow the steps below:

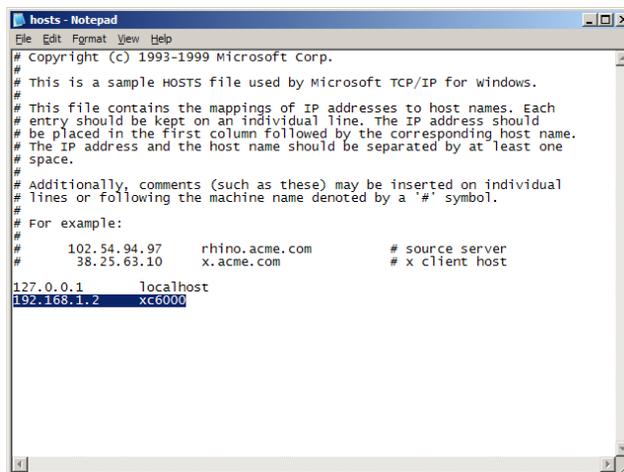
1. Click the Windows Start button (located in the lower left corner of the screen.)
2. Click the Run... button



3. Type “notepad c:\windows\system32\drivers\etc\hosts” into the Run... window.



4. The Notepad text editor window should appear, with the Windows HOSTS file loaded.
5. This file enables the user to specify a DNS entry for a static IP address, which is needed for some system configurations.



6. Add the text highlighted above: 192.168.1.2      xc6000
7. Save the HOSTS file by selecting File -> Save from Notepad’s top menu.
8. If you require additional assistance in configuring your TCP/IP settings, including configuring the XC6000EPC console to join a plant-wide network, please contact Apex Instruments for further technical support.

**PLEASE NOTE:**

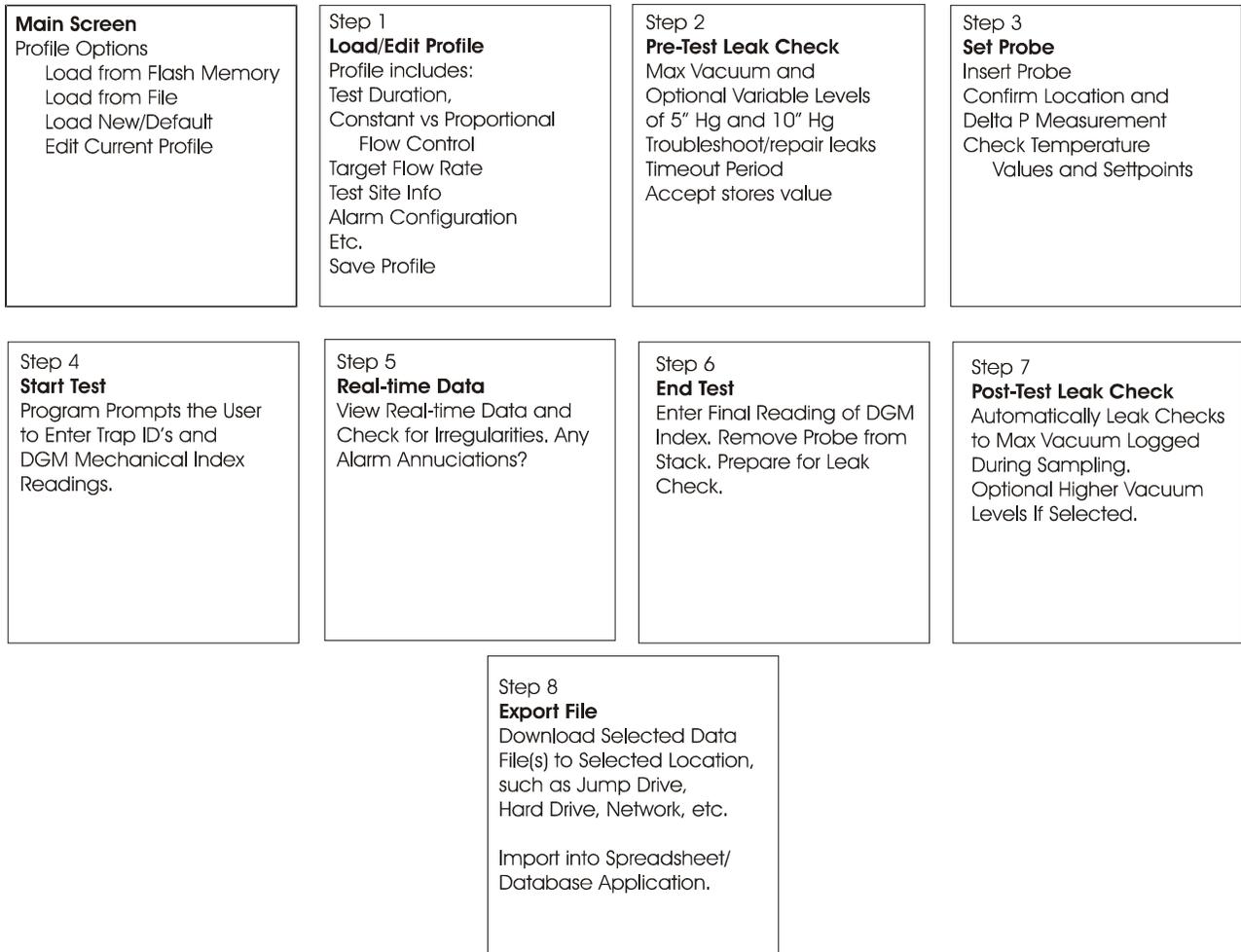
**The rear-panel Ethernet connection is designated for use with a plant-wide network. Local connections should be made using the front-panel Ethernet connector only. For rear-panel Ethernet configuration, please consult the Apex XC-6000 Advanced Network Configuration Guide.**

When connected the main screen identifies the console and the communication method as shown below:



**Figure 1-8. Main Screen Communication Connected**

The following summarizes the steps involved in configuring and running a complete test with the MercSampler console.



**Figure 1-9. Software Flow Summary**

## Test Profile

The Test Profile is how we configure the console for running a test. A profile can be loaded from the internal flash memory on the DAC board inside the console. This is done by single clicking the “From Memory” button on the Main screen

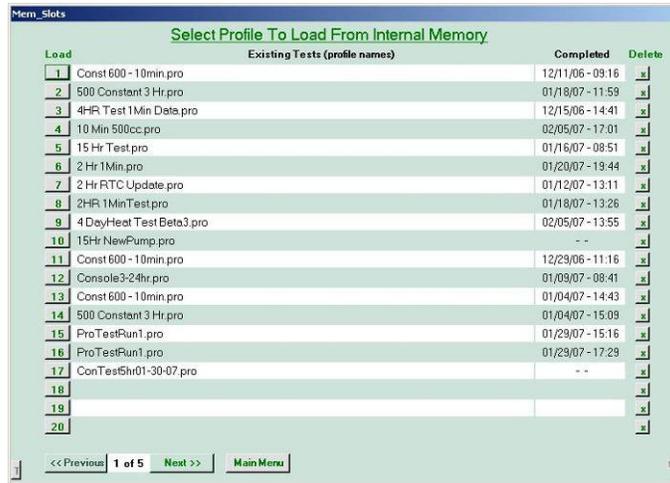


Figure 1-10. Load Profile from Internal Memory Screen

Once loaded this filename is visible in the lower left corner of the Main screen. This can be edited by single clicking the “Edit Profile” button. The first screen to appear is the General Information screen shown below. This allows the user to enter the Client’s and their information. There are several optional screens in this profile. The user has the option to enter the data and click “Next” to cycle through or this information is optional and can be bypassed by clicking the “Test Setup” Screen.

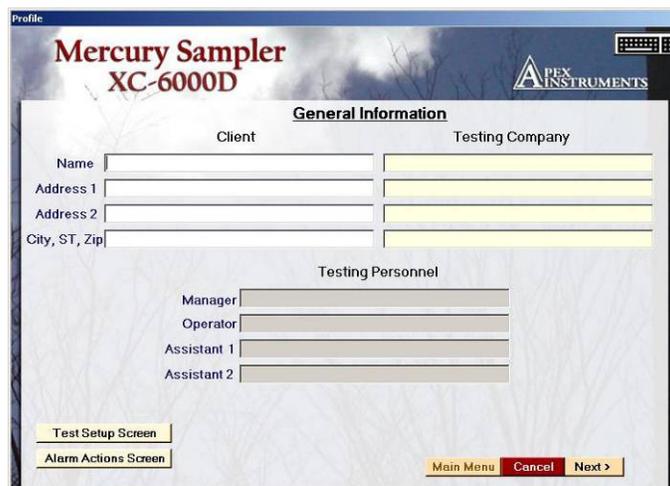
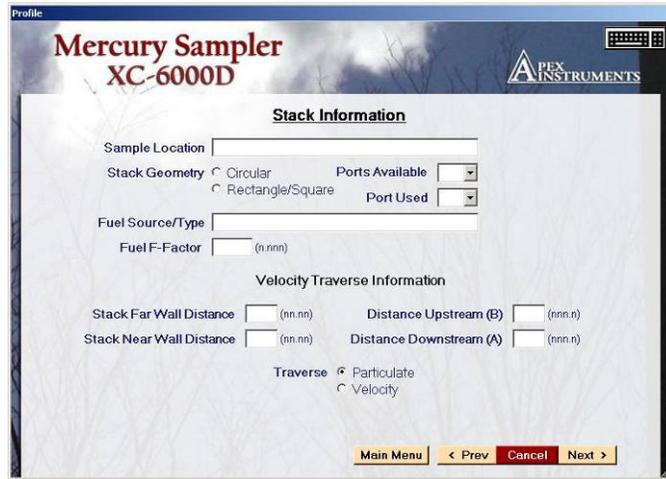
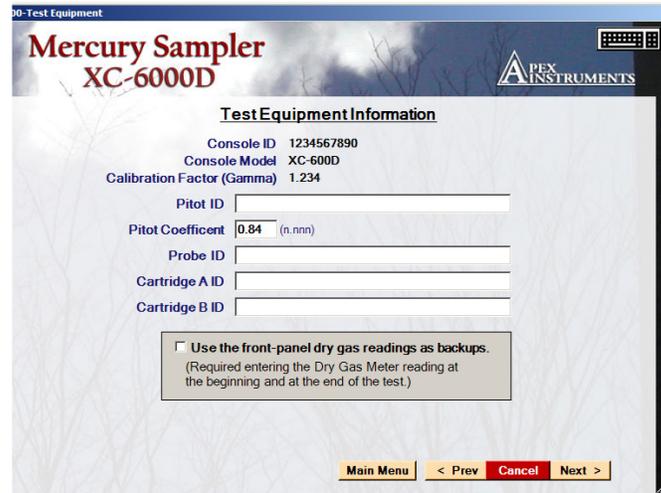


Figure 1-11. General Test Information Screen



**Figure 1-12. Stack Information Screen**

The Stack Information data is optional and is not used in any calculations. It is for descriptive or reporting purposes only.



**Figure 1-13. Test Equipment Information Screen**

The Test Equipment information is also optional. However, the Cartridge or Trap IDs are highly recommended to enter. It is optional here because the user is prompted later to enter. If the console has a pitot transducer installed, the pitot coefficient should be entered here.

By selecting the check box the user may choose to use the front-panel dry gas meter readings as backups. If the console is equipped with digital totalizers on the front panel, using the DGM readings is not recommended.

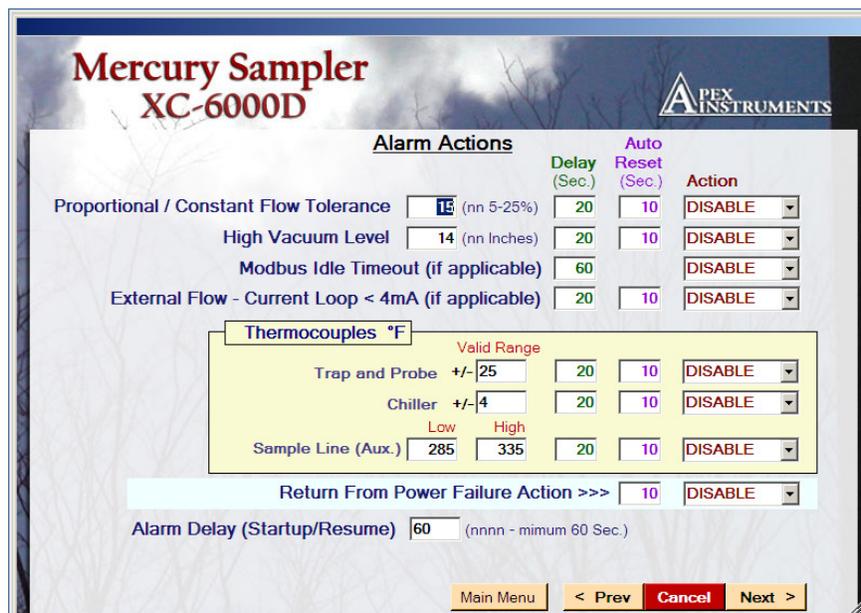


Figure 1-14. Alarm Actions Screen

## Alarm Actions

The Alarm Actions screen is only available in later software versions (071127-69 or later.) If your software version has the Alarm Actions screen, then you may configure the XC6000 to trigger an alarm condition based on several available parameters.

Each alarm condition has several parameters that may be set. For each sensor input on the Alarm Actions screen, a valid range or upper limit may be set, depending on the sensor type. Additionally, most alarms feature an auto-reset function, which serves to return the XC-6000 to a non-alarm state in the case of a non-critical alarm condition.

**DELAY (sec.)** Length of time alarm condition must continue before alarm action is performed. For an instant alert, set to zero (0.)

**AUTO-RESET (sec.)** Length of time elapsed before alarm condition resets. When alarm condition resets, Alarm Piezo output and dry contact will deactivate.

**ALARM ACTION:** Action performed by XC6000 upon reaching an alarm condition. See table below

**RETURN FROM POWER FAILURE ACTION:** When the XC6000 returns from a power failure, the unit may trigger an alarm. Any available Alarm Action may be used, including END TEST or PAUSE. If ALERT is used, the alarm may be Auto-Reset after a specified interval.

**ALARM DELAY (Startup / Resume)** When a test run is started or resumed from a pause condition, the alarms will be disabled for a minimum of 60 seconds, in order to prevent false alarm conditions when establishing the flow baseline. This delay may be extended at the user’s discretion.

<b><i>ACTION</i></b>	<b><i>Description of Action</i></b>
<b><i>ALERT</i></b>	XC6000 Alarm dry contact output will close XC6000 Alarm Piezo output will engage May be Auto-Reset or reset manually by operator
<b><i>PAUSE</i></b>	XC6000 Alarm dry contact output will close XC6000 Alarm Piezo output will engage Test will pause until manually resumed by operator May not be Auto-Reset
<b><i>END TEST</i></b>	XC6000 Alarm dry contact output will close XC6000 Alarm Piezo output will engage Test will end and unit will wait for post-leak test May not be Auto-Reset
<b><i>DISABLE</i></b>	No action

## Test Setup

The Test Setup screen is the meat of the Test Profile. This is where the user selects the test duration, averaging period, target flow rates, flow control method, etc. The External Pause parameters may be selected on this screen.

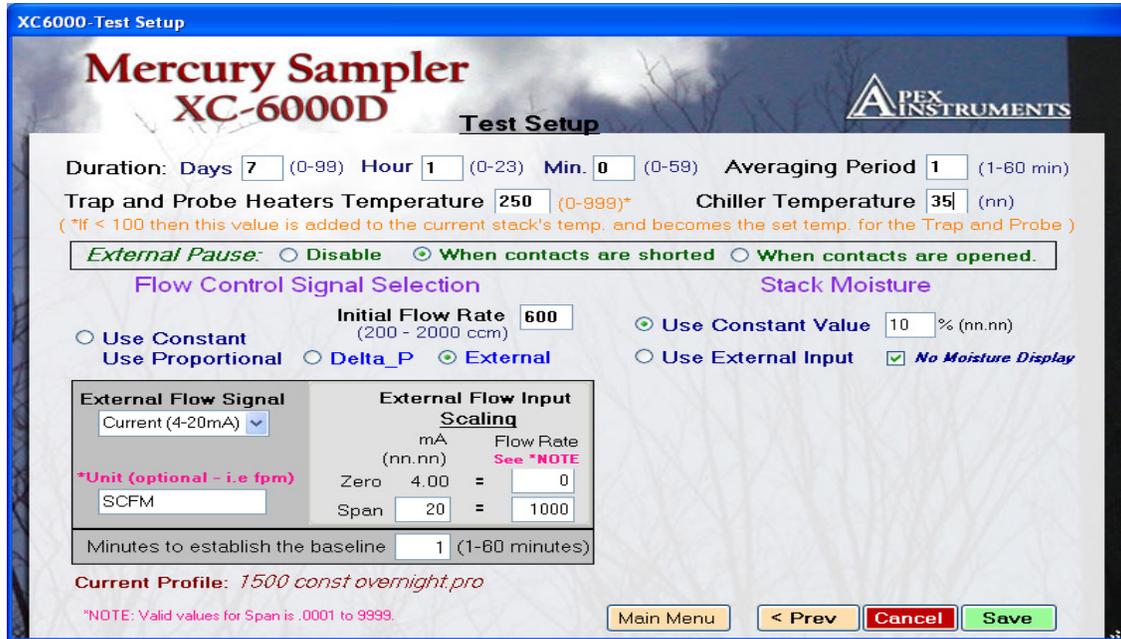


Figure 1-15. Test Setup Screen

### Test Parameters:

**Duration:** Length of time the test is run. Note that this is the total run time, not calendar or clock time. If a test is paused, the unit will ignore the pause time and will continue the test until the entire duration has elapsed. Entered in Days / Hours / Minutes.

**Averaging Period:** Duration of block average points stored in the XC6000 internal memory. If a 15-minute averaging period is specified, the unit will average all appropriate data and write data points to storage memory every fifteen minutes. 1-minute averaging times are recommended for shorter runs. For longer runs (greater than 24 hours) longer averaging times may be used.

**Trap and Probe Heaters Temperature:** Setpoint for the console-controlled heaters in the sample probe. This should be set high enough to keep any water vapor or other moisture entrained in the stack gas without condensing. In a “wet” stack (more than 10% moisture,) trap and probe heaters should be set to well above stack temperature.

**Chiller Temperature:** This parameter does not control the sample conditioner, but it does provide a reference temperature used in setting the alarm values. Typically 35° F.

**External Pause:** Determines whether the unit will enter a pause state when the External Pause input is activated. **Disable** will never pause, **When contacts are shorted** and **When contacts are open** will pause when their conditions are met. When the unit is paused, the sample pumps are turned off and the elapsed time counter is not incremented.

## External Flow and External Moisture:

The XC6000 is designed to operate with a proportional flow input, which is used to change the target flow rate of the console. The XC6000 can accept an analog input signal (0-10V or 4-20 mA,) a  $\Delta P$  signal from a pitot transducer, or a digital flow input over Modbus.

In order to use proportional flow, select an initial flow rate and an external flow signal source.

**Flow Control Signal Selection**

Initial Flow Rate   
(200 - 2000 ccm)

Use Constant  
 Use Proportional  
 Delta\_P  
 External

External Flow Signal		External Flow Input Scaling	
<input type="text" value="Current (4-20mA)"/>		mA	Flow Rate
*Unit (optional - i.e fpm)		(nn.nn)	See *NOTE
<input type="text" value="Kscfm"/>	Zero	4.00	= <input type="text" value="0"/>
	Span	20.00	= <input type="text" value="1000"/>

Minutes to establish the baseline  (1-60 minutes)

Current Profile: 7 Day 500 Const.pro

\*NOTE: Valid values for Span is .0001 to 9999.

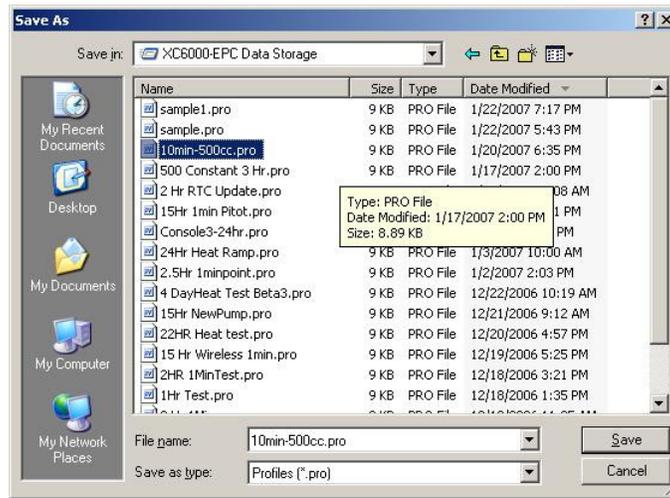
In this example, we have selected 500 cc / min. and 4-20mA for our external flow signal. The **External Flow Input Scaling** fields are designed to make the XC6000 exported data agree with the stack flow data obtained by the plant stack flow monitor. If known, input the correct stack flow value observed when the external flow signal is a nominal zero (0V or 4mA.) Then input a known current / voltage and its corresponding stack flow rate. The **Unit** field is optional but will be shown in the data. If the exact stack flow is not known, the **Span mA** may be set to the current external signal and the **Span Flow Rate** may be set to the current load percentage. If this is done, the **Unit** field should be set to “percent load” to indicate this situation in the data.

The final field is **Minutes to establish the baseline**, and should be left at 1 minute unless directed otherwise.

When the XC6000 begins sampling, the console will monitor stack flow during the **baseline** time period and will store the average stack flow in memory. The initial flow rate will be maintained as long as the stack flow is equal to the baseline stack flow. If the stack flow increases, the console sampling flow rate will also increase proportionally.

**EXAMPLE:** The initial flow rate is set to 500 cc/min. The external signal is set to 4-20mA, zero = 0.0001, span 20.00 = 1000 as pictured above. The unit is set to Kscfm (thousands of standard cubic feet per minute.) When the test begins, the stack flow is 875 Kscfm. The XC6000 sets its initial flow rate of 500 cc/min to be equivalent to 875 Kscfm. Over the course of the next hour, the load of the station increases from 87.5% to 91%. The stack flow increases from 875 Kscfm to 910 Kscfm (a 4% increase,) and the XC6000 increases its sample flow rate from 500 cc/min to 520 cc/min (also a 4% increase.) In this way, the XC6000 maintains proportionality during a sample run.

Click “Save” to save this to a location on your hard drive. Please note that selecting “Save” does not write any information to the memory of the XC6000. The XC6000 profile is not updated until all pre-test preparations are complete. Click “Main Menu” to start the testing protocol.

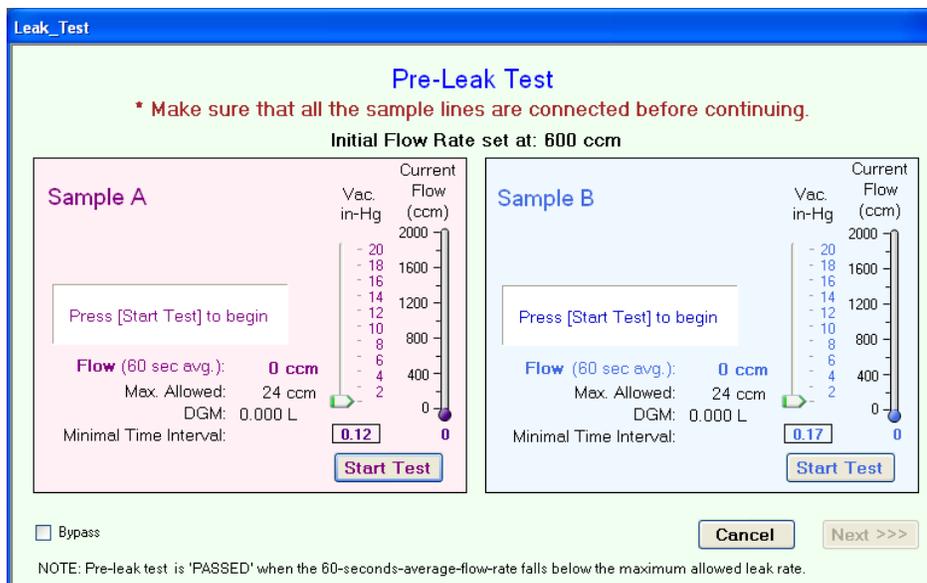


**Figure 1-16. Save Profile Screen**

## Pre-Test Leak Check

Once back at the “Main” screen single click the “Pre-Test Leak Check” button. The following screen will appear. Ensure the sorbent test tubes are inserted in the probe trap receptacles. Plug the ends of the sorbent tubes with clean stoppers. Click the two “Start Test” buttons to individually leak check Side A and B. This is a required leak check done at maximum vacuum. The leak check vacuum level and flow rate are stored with each test run. The test can be bypassed by checking the “Bypass” button and then selecting “Next>>>”. However, this bypass will be logged and stored with the data.

**Figure 1-17. Pre-Leak Test Screen Running**



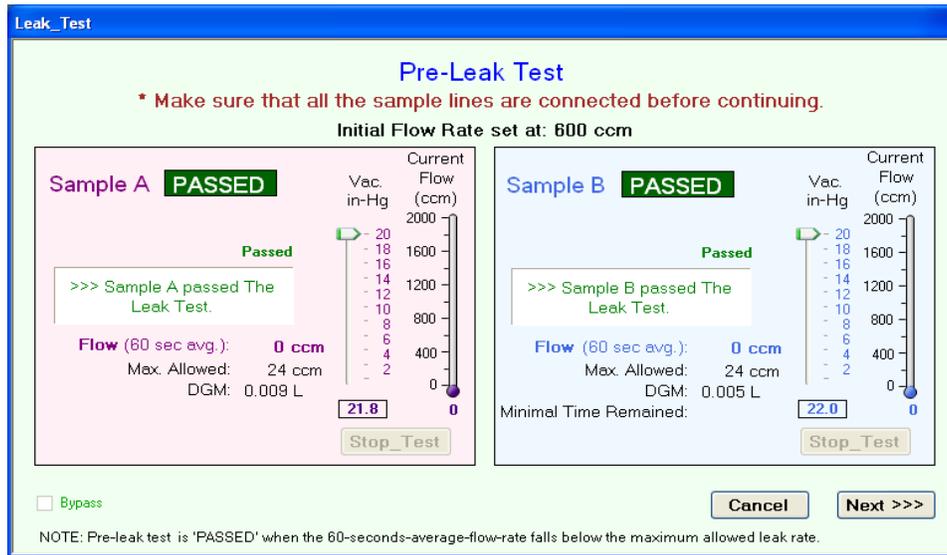


Figure 1-18. Passed Pre-Leak Test Screen

Once the test has passed click the “Next” button. The system prompts you to switch the pumps off using the “Pump Off” button on the screen. Click next to continue. The system will automatically switch these off prior to starting the test.



Figure 1-19. Pre-Leak Test Pump Off Prompt

## Set Probe

The next screen to appear prompts the user to insert the probe when the temperatures are at/near set point. If the internal pitot is being used the current/live delta p reading is shown.

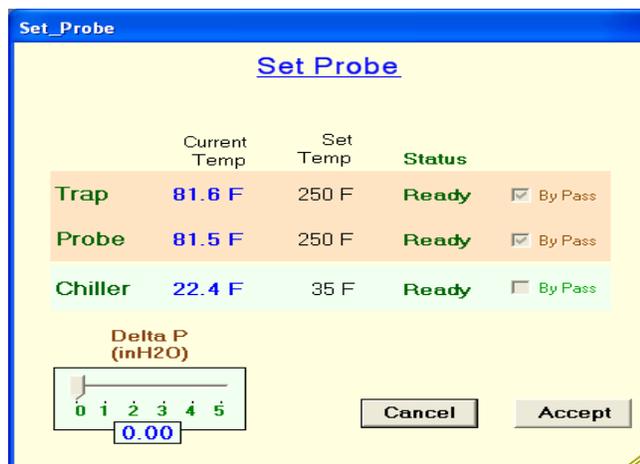


Figure 1-20. Set Probe Screen

### Test Data Storage Location

The following prompts the user to select a storage location on the flash memory drive inside the box. Single click the number in the left column corresponding to where you want to store the data file. The user can select one of up to 99 slots. Click the “<<Previous” or “Next>>” buttons to scroll through the list. The system will prompt to confirm the case of overwriting data.



Figure 1-21. Memory Slot Selection for Data Storage Screen

### Mechanical DGM Volume Input

The following prompts the user to enter or confirm the trap ID s and enter the initial dry gas meter mechanical readings. This is used as a redundant backup and functionality check of the metering system.

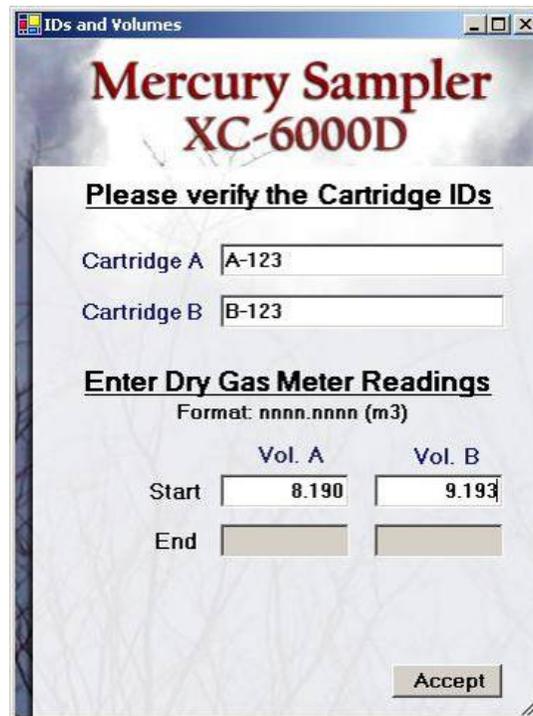


Figure 1-22. Mechanical DGM Index Screen

## Test Start

After clicking “Accept” the following screen appears. The system is ready to start the test.

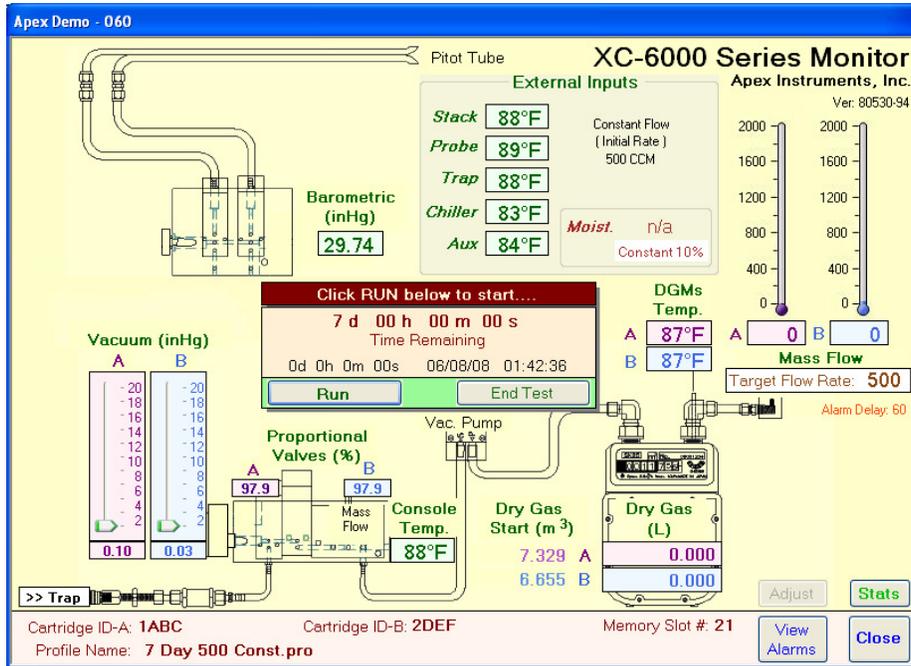


Figure 1-23. Test Ready to Run Screen

To start, click “Run” and the system should indicate flow with the digital rotameters in the top right of the screen. Also, check to ensure the electronic totalizer on the gas meter is incrementing.

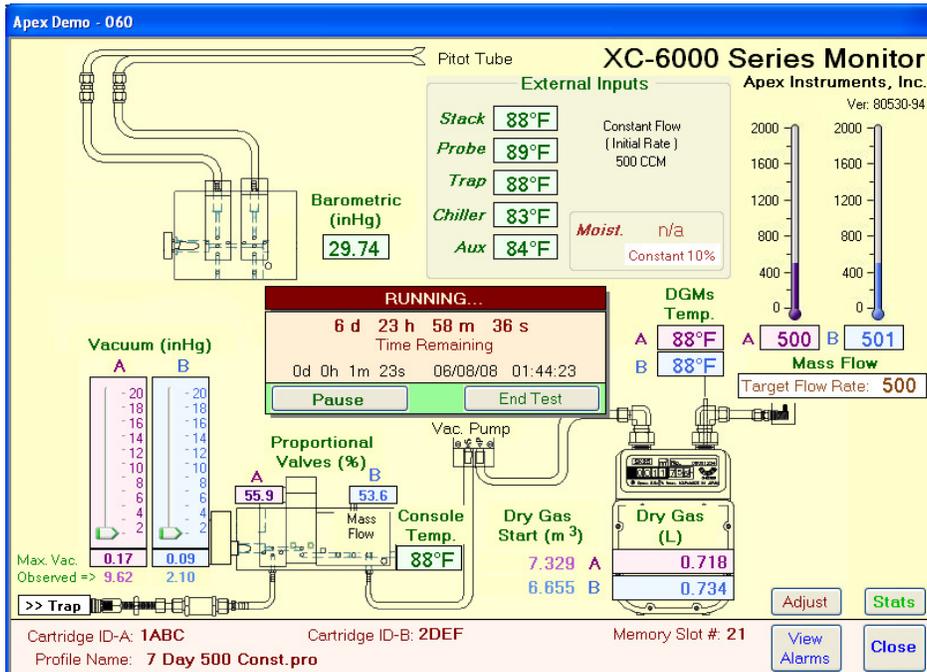


Figure 1-24. Test Running Screen

## Stat Screen

To see a non-graphical representation of the run data screen, single click the “Stat” button and the following screen will appear. This screen does override other screens and will need to be closed in order to open another screen. Close this screen by clicking the X box in the top right of the screen.



Figure 1-25. Stat / Sensors Screen

## Pause Test

To pause the test, single click the “Pause” button in the center of the screen. The button will then toggle to “Run” to continue the test.

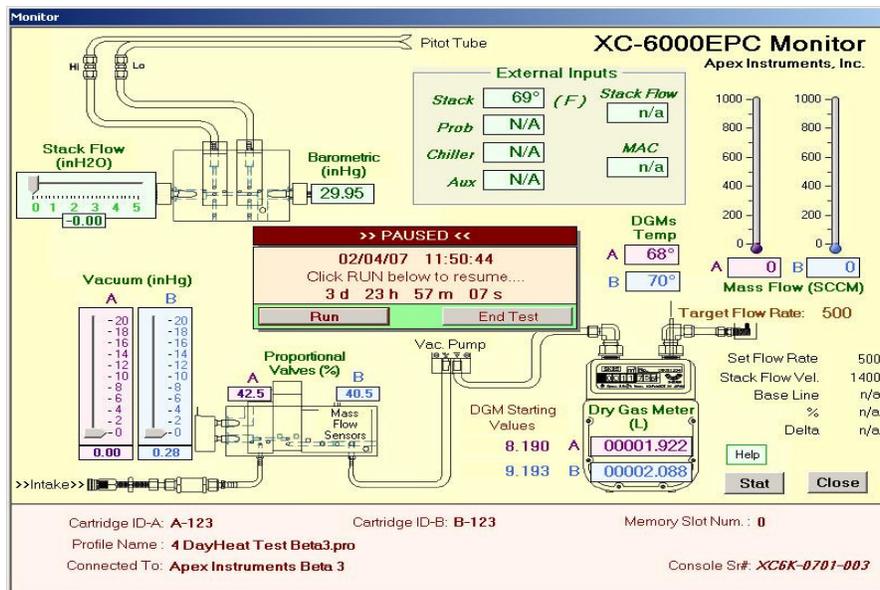


Figure 1-26. Test Paused Screen

In addition, a remote pause functionality has been integrated into the software. By interfacing with the remote pause connector on the rear panel of the unit, the user may pause the test without the need for a connected PC. The remote pause functionality is discussed in the Test Setup menu.

## Adjust Screen

The XC6000 is designed to offer flexibility during testing as well as when creating profiles. Press the **Adjust** button to change the trap / probe heater set point or the target flow rate during testing,



**Figure 1-27. Adjust Screen**

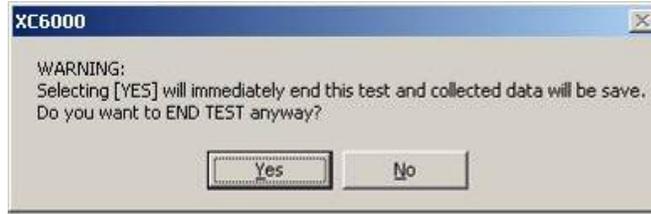
The **Trap Heater Setpoint Adjust** section allows either an arbitrary set point or a set point 0-99 degrees F above the stack temperature to be set. The original set point is stored and may be recalled using this screen as well.

The **Adjust Flow Rate** section allows the flow rate to be increased or decreased from the original target flow rate. Positive numbers between 0 and 999 add to the flow rate, while negative numbers between -1 and -998 reduce the flow target.

After changing any parameters on the **Adjust Screen**, press the **Apply New Temperature** and / or **Apply New Flow Rate** buttons, and then close the screen by pressing the **Close** button.

## End Test

To end the test there are two options. The user can wait until the system times out and automatically stops the test. Second, the user can end the test early by single clicking the “End Test” button in the center of the graphical run data screen. The system will prompt the user to confirm this action.



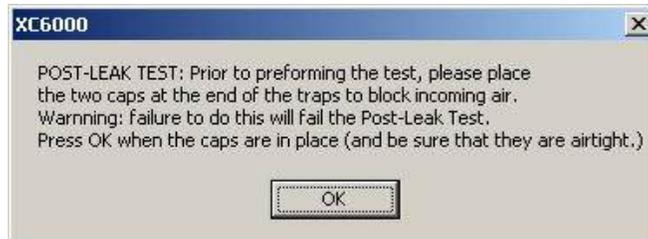
**Figure 1-28. End Test Early Prompt**

The following prompt informs the user the system will store the data.



**Figure 1-29. End Test Confirmation Prompt**

The following prompt informs the user the Post-Test Leak check is next and to remove the probe from the stack and plug the ends of the traps.



**Figure 1-30. Initial Post-Test Leak Check Prompt**

## Post-Test Leak Check

The following screen displays the status of the leak check and allows the user to start/pause the leak check. The system has logged the highest vacuum achieved for both flow channels A and B as displayed in the center box and will control the vacuum level to just over those levels. Just like with the Pre-Test Leak Check, the user can bypass this step but no leak check data will be stored. But if no Post-Leak is performed the sample run data will be invalid.

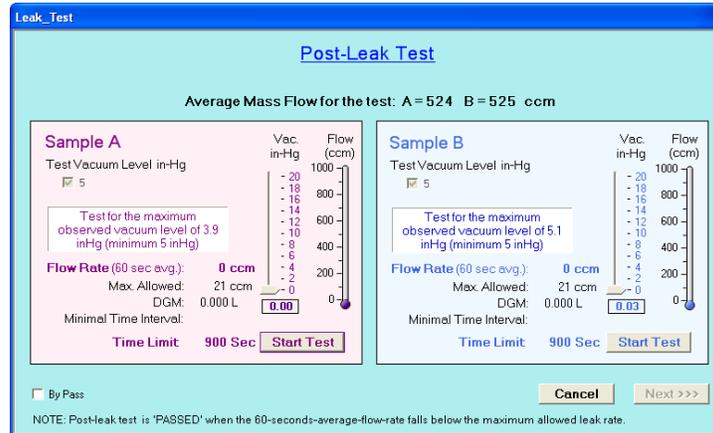


Figure 1-30. Initial Post-Test Leak Test Screen

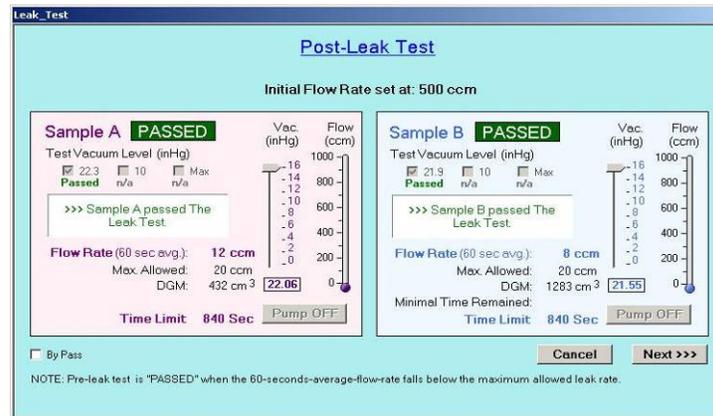


Figure 1-31. Running Post-Leak Test Screen

After both flow channels have passed. Click the “Next>>>” button and cycle off the pumps and the system will inform the user it is storing the leak check data.



Figure 1-32. Save Data to Memory Prompt

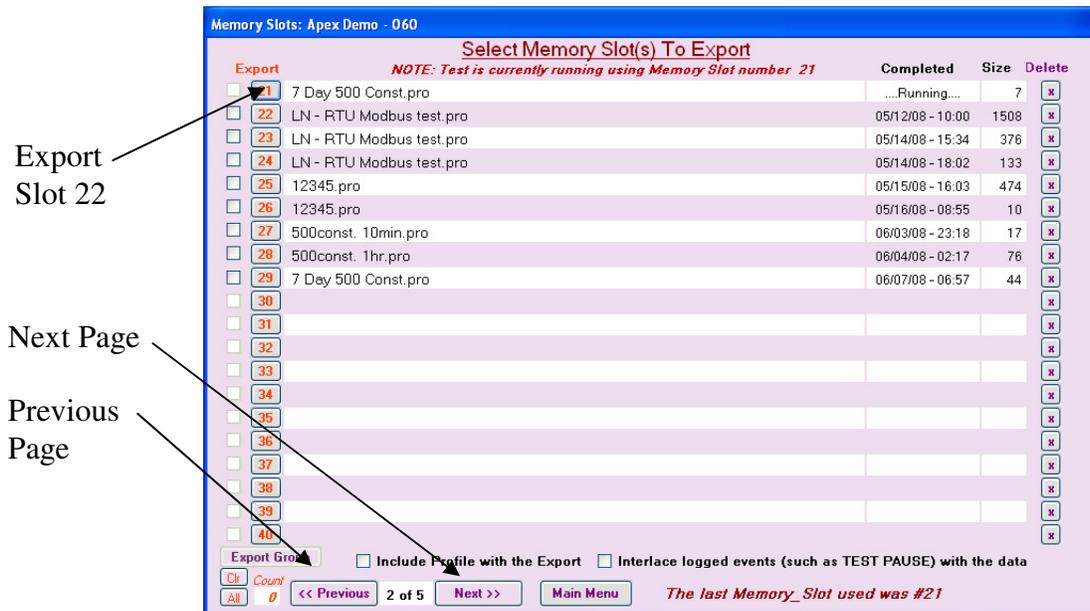
## Export Data

The system will now go back to the main screen. To export and view the data file(s), Click on the Export Data box.



**Figure 1-33. Export Data to File from main screen**

Now select test data to export, the bottom right of screen will indicate sample run just completed.



**Figure 1-34. Export Data from memory slot**

Click on the button corresponding to the slot number of the test to be exported. The XC6000 supports 99 memory slots, which may be accessed 20 at a time using the **Previous** and **Next** buttons.

## Export Data Cont.

Once the slot number button is pressed, the following dialog box will prompt the user to save the file to a local or network location. A text file (.txt) and a comma separated value (.csv) file will be generated at this user-specified location. The text file can be viewed in various applications such as Notepad, Word Pad, Word, Excel, etc. The CSV file is formatted to be opened in a spreadsheet application such as Excel.

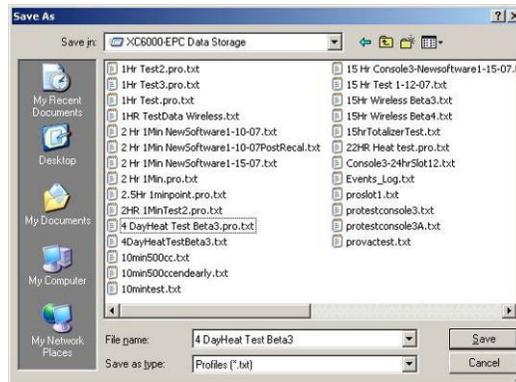


Figure 1-35. Export Data Path Screen

## Multi-File Export

The XC6000 also supports multi-file export, which will export a group of completed test profiles to a folder on the local hard drive. To use multi-file export, select the Multiple Slot Export check boxes next to the slots desired. To select all available slots, press the **ALL** button. To clear all selected slots, press the **CLR** button.

The screenshot shows the 'Select Memory Slot(s) To Export' screen with the following table and annotations:

Export	Slot	Profile Name	Completed	Size	Delete
<input type="checkbox"/>	21	7 Day 500 Const.pro	...Running...	7	X
<input type="checkbox"/>	22	LN - RTU Modbus test.pro	05/12/08 - 10:00	1508	X
<input type="checkbox"/>	23	LN - RTU Modbus test.pro	05/14/08 - 15:34	376	X
<input type="checkbox"/>	24	LN - RTU Modbus test.pro	05/14/08 - 18:02	133	X
<input type="checkbox"/>	25	12345.pro	05/15/08 - 16:03	474	X
<input type="checkbox"/>	26	12345.pro	05/16/08 - 08:55	10	X
<input type="checkbox"/>	27	500const. 10min.pro	06/03/08 - 23:18	17	X
<input type="checkbox"/>	28	500const. 1hr.pro	06/04/08 - 02:17	76	X
<input type="checkbox"/>	29	7 Day 500 Const.pro	06/07/08 - 06:57	44	X
<input type="checkbox"/>	30				X
<input type="checkbox"/>	31				X
<input type="checkbox"/>	32				X
<input type="checkbox"/>	33				X
<input type="checkbox"/>	34				X
<input type="checkbox"/>	35				X
<input type="checkbox"/>	36				X
<input type="checkbox"/>	37				X
<input type="checkbox"/>	38				X
<input type="checkbox"/>	39				X
<input type="checkbox"/>	40				X

Annotations on the left side of the screen:

- Multiple slot export check boxes (pointing to the checkboxes in the 'Export' column)
- Export Group (pointing to the 'Export Group' button)
- Clear All (pointing to the 'CLR' button)
- Select All (pointing to the 'ALL' button)

Additional screen details:

- NOTE: Test is currently running using Memory Slot number 21
- Buttons: Export Group, Include Profile with the Export, Interlace logged events (such as TEST PAUSE) with the data, CLR, ALL, << Previous, 2 of 5, Next >>, Main Menu
- Status: The last Memory\_Slot used was #21

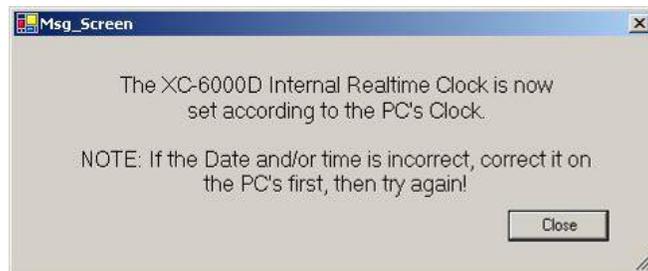
## Multiple File Export (cont.)

After the slots are selected, press the **Export Group** button. The XC6000 application will prompt the user for a directory as in single file export. With a multiple file export, all slots will be exported to the directory selected for the first slot. Exported files will be named based on their profile name, and all will be given unique filenames.



## Set Clock

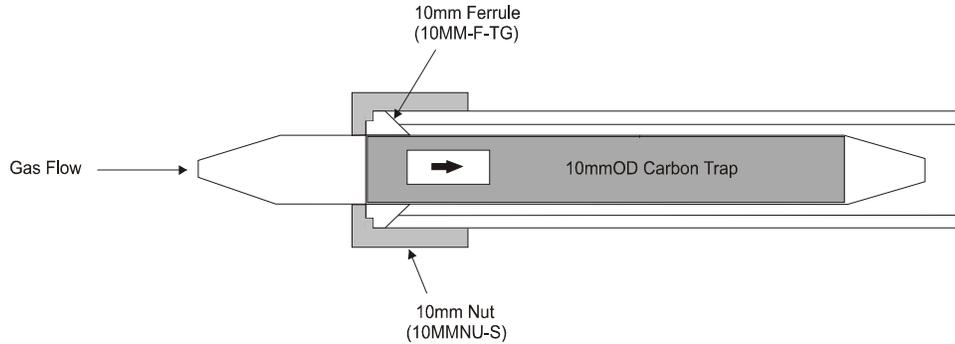
The Config/Utilities screen has various other functions built-in. The "Set Clock" button automatically synchronizes the MercSampler Console time with the clock time of the computer connected.



**Figure 1-36. Set Console Clock Confirmation Screen**

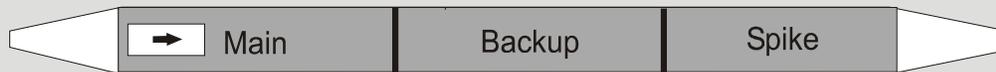
# Sorbent Traps

## Large Trap (Standard)

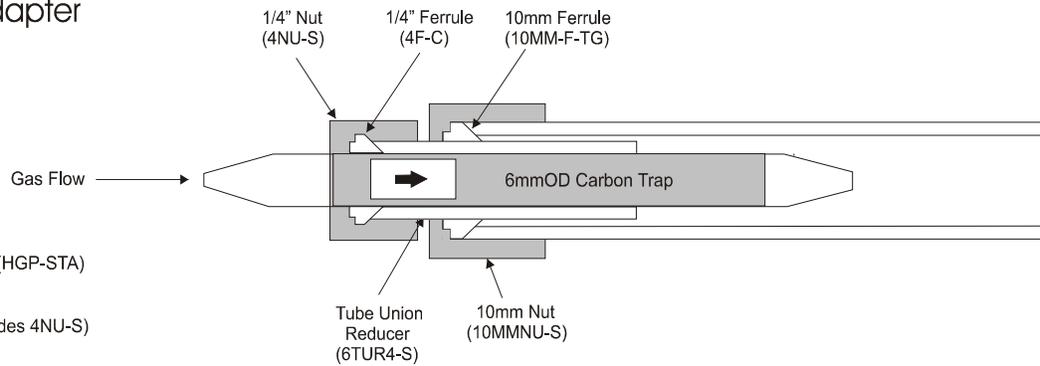


## Sorbent Trap Sections

Main: Standard Collection Section    Backup: Break-through Detection    Spike: Pre-Injected Mercury Vapor (+/- 50% Expected Mass Collected)

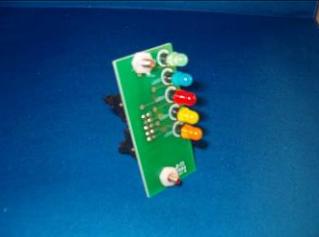


## Small Trap Adapter HGP-STA (Optional)



Small Trap Adapter (HGP-STA)  
Includes:  
Qty Part#  
1 6TUR4-S (Includes 4NU-S)  
3 4F-C

# Appendix 1

<b>REPLACEMENT PARTS</b>		
<b>CONSOLE</b>		
M-PCB-DAC-V3A	POPULATED Printed Circuit Board for Data Acquisition & Control (DAC) Board for XC-6000EPC Dual PC-Based Hg Console Series	
PCB-TC/MUX	POPULATED TC/Mux Board for use in XC-6000EPC Mercury Console Series. 8 Type K TC Channels with External Signal and Moisture Analyzer Inputs.	
PCB-LED-HG	BOARD, LED DISPLAY	
EL-PCB-MODBUS	BOARD, TCP/IP MODBUS INTERFACE	
EL-SDCARD	A-DATA Speedy 1GB Secure Digital (SD) Flash Card Model SDC-1G0	

**AUTOMATED MERCURY SOURCE SAMPLER**

<p>EL-EBR-2310</p>	<p>D-LINK ROUTER, IEEE 802.3/3u, IEEE 802.11b/g Wired-G Broadband Router</p>	
<p>EL-WBR-1310</p>	<p>D-LINK ROUTER, WBR-1310 Wireless G Router - 54Mbps, 802.11g, 4-Port, used in Meter Consoles in SKB, Environmental Enclosures</p>	
<p>GP-C131-11</p>	<p>PUMP, BTC DIAPHRAGM PUMP, BRUSHLESS MOTOR, 10,000 HR, MAX VACUUM 20"HG, 12VDC, 3900 RPM, MAX PSIG 24", 6 lpm max free flow, 900cc @15" Hg</p>	
<p>DGM-SK25-5701</p>	<p>DRY GAS METER, MODEL SK-25, METRIC, with optical encoder (no mechanical index)</p>	
<p>DGM-SK25EN</p>	<p>DRY GAS METER, MODEL SK-25, METRIC, with optical encoder (for XC-6000EPC)</p>	

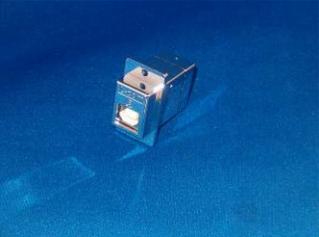
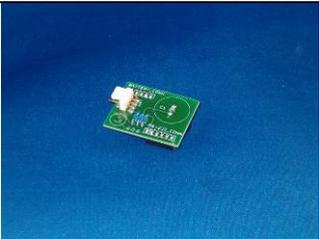
**AUTOMATED MERCURY SOURCE SAMPLER**

TOT4-36X72	QUADRATURE PULSE DIGITAL TOTALIZER	
AK-6000	Deluxe Mercury Audit Kit for Appendix K/Method 30B System includes:SK25 DGM with 15-pt calibration, quadrature totalizer,vaccum gauge, 4U black polyethylene molded case, Handheld type K Thermocouple Simulator with Certificate, Hand-held digital barometer, Digital Thermometer, Vacuum Bottle	
EL-670-OA938	FAN, AC Fans 92mm 115VAC 50CFM	
AWM-4360	Airflow Sensor, Signal Conditioning: Amplified; Flow/Pressure Range: + 6000 sccm (6.0 SLPM); Linear Range 1LPM; Port Style: Manifold	
XC-6K-PGMC	Programming Cable for XC-6000EPC Automated Mercury Sorbent Trap Metering Console.	
M-AM2312	VALVE, 3-WAY, .055/.048 ORIFICE, 12V	

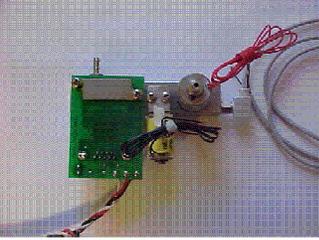
**AUTOMATED MERCURY SOURCE SAMPLER**

VSO-1SV	VALVE, SOLENOID, PROPORTIONAL Model VSONC-3S11-IC-FO MANIFOLD MOUNT WITH WIRE LEADS AND 11.5VDC	
SP-PSE541-M5	SENSOR, PRESSURE, 0-30" Hg, 1 NPN/PNP OPEN COLLECTOR TRANSISTOR OUTPUT, 30VDC, 125mA	
BARO-A-4V	Barometric Pressure sensor, 600 to 1100 mbar, temperature compensated, amplified output	
M-CBR10A-M	Magnetic Type Circuit Breaker Rocker Switch, 10 Amp. Horizontal Mount. Typically Used in 120V Consoles as Probe/Oven Breaker Switch.	
M-CB15A-M	Magnetic Type Circuit Breaker, 15 Amp., Typically Used in 120V Consoles as Main Breaker.	
D-60A	POWER SUPPLY, 5V@6A, 12V@ 4A, Meanwell	

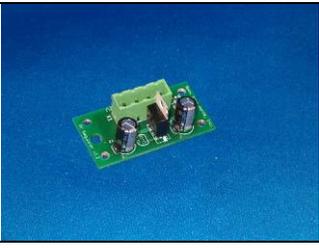
**AUTOMATED MERCURY SOURCE SAMPLER**

EL-P1082-031	CONNECTOR, A TO B USB, PANEL MOUNT	
EL-TL5242W	Memory Backup Lithium Batteries 3.6V 2.1Ah BATT PACK	
PCB-BATTERY	Battery interface board with short-term capacitor backup	
TC-PJK	THERMOCOUPLE JACK, TYPE K, PANEL, SNAP-IN	
AM-T3107000	AMP. CONN, 7P FEMALE, PNL, C16 C16-1 Series Amphenol Circular Connector. High Grade Plastic for Harsh Environmental Conditions. Panel-Mount Straight Female Slots, 7 Slot (6 + Ground (First Mate/Last Break)) – Hardigg Case external input connector	
AM-T3108	AMP. CONN, 4 PIN (MALE),CBL,C16 – Probe / Trap Heater power connection, console side	
AM-T3109	AMP. CONN, 4 SCKT (FEMALE),CBL – Probe / Trap Heater power connection, probe	

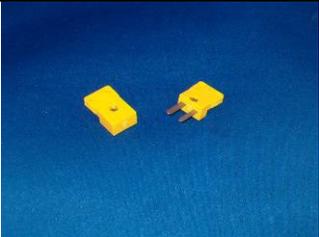
**AUTOMATED MERCURY SOURCE SAMPLER**

	side	
XC-6K-MANI	<p>MANIFOLD SUBASSY, XC-6000EPC</p> <p>Includes vac sensor, mass-flow sensor, manifold valve, proportional valve, ss hose barb fittings. Assembly calibration data to be provided with this unit.</p>	
<b>COOLER</b>		
SSR-330-25	RELAY, SSRT, 25A 110/240V	
SGC-TR4/7-SCR	<p>HEAT EXCHANGE ASSEMBLY FOR STIRLING GAS CONDITIONER</p> <p>Heat Exchange Assembly, 4 inch inner Tube, 7 inch overall with outer tube.</p>	
26840	<p>CARTRIDGE, Aluma-Sorb Gas Drying Unit with 1/8" SS FNPT Fittings. 2-5/8"x11-3/8". 50g H2O Capacity. &lt;.01psi@200lph press drop. 90psig working press. Polycarbonate</p>	
26809	MOUNTING CLIP FOR ALUMA-SORB CARTRIDGE	

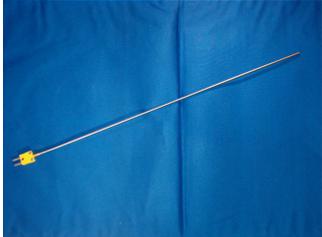
**AUTOMATED MERCURY SOURCE SAMPLER**

AM-SP100A	Fan, for Stirling Chiller, 115V, Sunon 95/115 Air Flow	
M-SD31	Temperature Controller, Red LED, Watlow	
M-PSRS7512	POWER SUPPLY, 75W, 12V, 6 AMP, INPUT: 100-240VAC	
D-60A	POWER SUPPLY, 5V@6A, 12V@ 4A, Meanwell	
M-PCB-REG-A	REGULATOR PCB ASSEMBLY, 5V, for use with M-PSRS7512	
M-CBR10A-M	Magnetic Type Circuit Breaker Rocker Switch, 10 Amp. Horizontal Mount. Typically Used in Cooler as AUX breaker	

**AUTOMATED MERCURY SOURCE SAMPLER**

M-CB15A-M	Magnetic Type Circuit Breaker, 15 Amp., Typically Used in Cooler as Main breaker	
<b>PROBE</b>		
TC-SP-K	Thermocouple Plug, Mini, Type K, Male	
TC-LJ-KA	TC, CONNECTOR ASSY, TYP.K, F, CORD 7.200 7.20 Includes: Female Type K Thermocouple Plug Assembly, Cord-mount, with cover, screws and bushing.	
TC-LPS-KA	TC, CONNECTOR ASSY, TYP.K, M, CORD 5.500 5.50 Includes: Male Type K Thermocouple Plug Assembly, Cord-mount, with cover, screws and bushing.	
TC-MJ-KA	TC CONN. ASSY. MINI, TYP K, CORD, F 5.500 5.50 Mini-Thermocouple Assembly, Type K, Female, Cord Mount, includes Plug, Cover, Screws and Bushing	
TC-SP-KA	TC CONN. ASSY. MINI, TYP K, CORD, M 5.500 5.50 Mini-Thermocouple Assembly, Type K, Male, Cord Mount, includes Plug, Cover, Screws and Bushing	

**AUTOMATED MERCURY SOURCE SAMPLER**

WK-125CI	Replacement Thermocouple with Magnesium Oxide Insulation, Type K, 1/8" Dia, per ft	
MPT-6-133H	Modular Pitot Tip, 'S' type	
HGH-4T463W	Replacement Probe Heater, 4-ft, 463 watt	
HGH-5T1650W	Replacement Probe Heater, 5-ft, 1650 watt	
HGH-STRI72	Replacement Probe Heater, 6-ft, 2000 watt	
HGH-2T144W	Replacement Probe Heater, 2-ft, 575 watt. (used on all probes, exit end of probe)	
HGH-9T838W	Replacement Probe Heater, 9-ft, 838W	

HGH-12T1000W	Replacement Probe Heater, 12-ft, 1000W	
HGP-STA	Small Trap (6mm) Adapter for Mercury Probes. Includes 10MTUR6M-S (with 10mm Nut and ferrule) and Three 1/4" Ceramic Ferrules	

**CONSUMABLES**

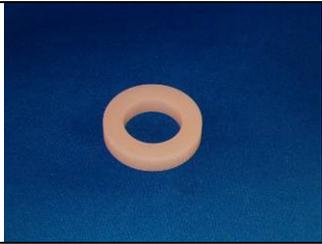
**CONSOLE**

DIF-N70	FILTER , INLINE, DISPOSABLE, NYLON Disposable In-Line Filter, Nylon Housing with 1/4" tube stubs, 95%+ efficiency for 0.1 micron.	
---------	--	--

**COOLER**

GSB-1000SC	SAMPLE BOTTLE, CLEAR GLASS, GL-45 THREADED, 1000mL Safety Coated, for Condensate Collection	
GSB-400SC	SAMPLE BOTTLE, CLEAR GLASS, GL-45 THREADED, 500mL Safety Coated, for Condensate Collection, used in 16U shock mount rack chiller	

**AUTOMATED MERCURY SOURCE SAMPLER**

GSB-250SC	BOTTLE, SAMPLE, CLEAR GLASS, GL-45 THREAD, 250mL with Safety Coat Sample Bottle, 250mL, used in SC-40 condensate collection ice bath	
GA-GL-45S	Seal for 1000 ml bottle	
GA-GL-45B	Cap for sample bottles – fits 1000mL, 500mL, 250mL bottles	
ALUMA-SORB	ACTIVATED ALUMINA DESSICANT, highly efficient adsorbent with high porosity and contact surface. 1/8" diameter beads, 2.5Kg (5.5 LB) container with 80% active alumina (>= 92%) and 20% silica gel.	
AG-1080	DESSICANT AIR DRYER WITH INDICATOR, disposable drying canister	
QC-PMC2	QC, STIRLING GAS CONDITIONER, MALE, STRAIGHT CONNECTOR, 1/4" OD PTF, 1/8"ODX.170"ID (used on Drierite Cartridge outlet/top) – Threaded Male	
QC-SGC-F4	QC, STIRLING GAS CONDITIONER, FEMALE, FERRULELESS POLYTUBE FITTING, PTF (used on jumper from Stirling Cooler to sampling console) – Tube-Mount Female	

**AUTOMATED MERCURY SOURCE SAMPLER**

QC-SGC-F3	QC, STIRLING GAS CONDITIONER, COUPLING BODY, 1/4"OD, FEMALE, 1.73" (on Stirling, sample-in connection) – Threaded Female	
QC-SGC-M2	QC, STIRLING GAS CONDITIONER, STRAIGHT CONNECTOR, FERRULESS POLYTUBE FITTING, PTF, 1/4"ODX.170"ID (Heated U-Cord Sample Line to Stirling, high-SO2 connector) – Tube-Mount Male	
HGU-10DJ	TUBING, PFA, 5/32ID X 1/4OD X .047 WALL (jumper from Stirling Cooler to sampling console), replace 10DJ with desired length (standard is 10ft.)	
<b>PROBE</b>		
9531K22	CAP, VINYL PROTECTIVE, used for capping sorbent traps during pre- and post-leak testing	
10MMNU-S-EXT	PARTICULATE SHIELD FOR 10MM SORBENT TRAP Stainless Steel Tube, 3/4" o.d. x 1.25" L with 10mm nut, welded	
10MMNU-C-EXT	PARTICULATE SHIELD FOR 10MM SORBENT TRAP,C276 Hastelloy C276 Tube, 3/4" o.d. x 1.25" L with 10mm nut, welded	

**AUTOMATED MERCURY SOURCE SAMPLER**

10MMNU-S	NUT, 10MM TUBE, Stainless Steel	
10MMBLP-S	PLUG, 10mm TU, SS – thread-on plug for end of probe, protects probe when not sampling	
SR-2.625	Neoprene square ring, 2" ID x 2 5/8" OD x 3/16" tk, for cam-lock connectors	
10M-F-TG	FERRULE, 10MM, Single, Glass filled Teflon	
4NU-S	NUT, 1/4 TUBE, Stainless Steel	