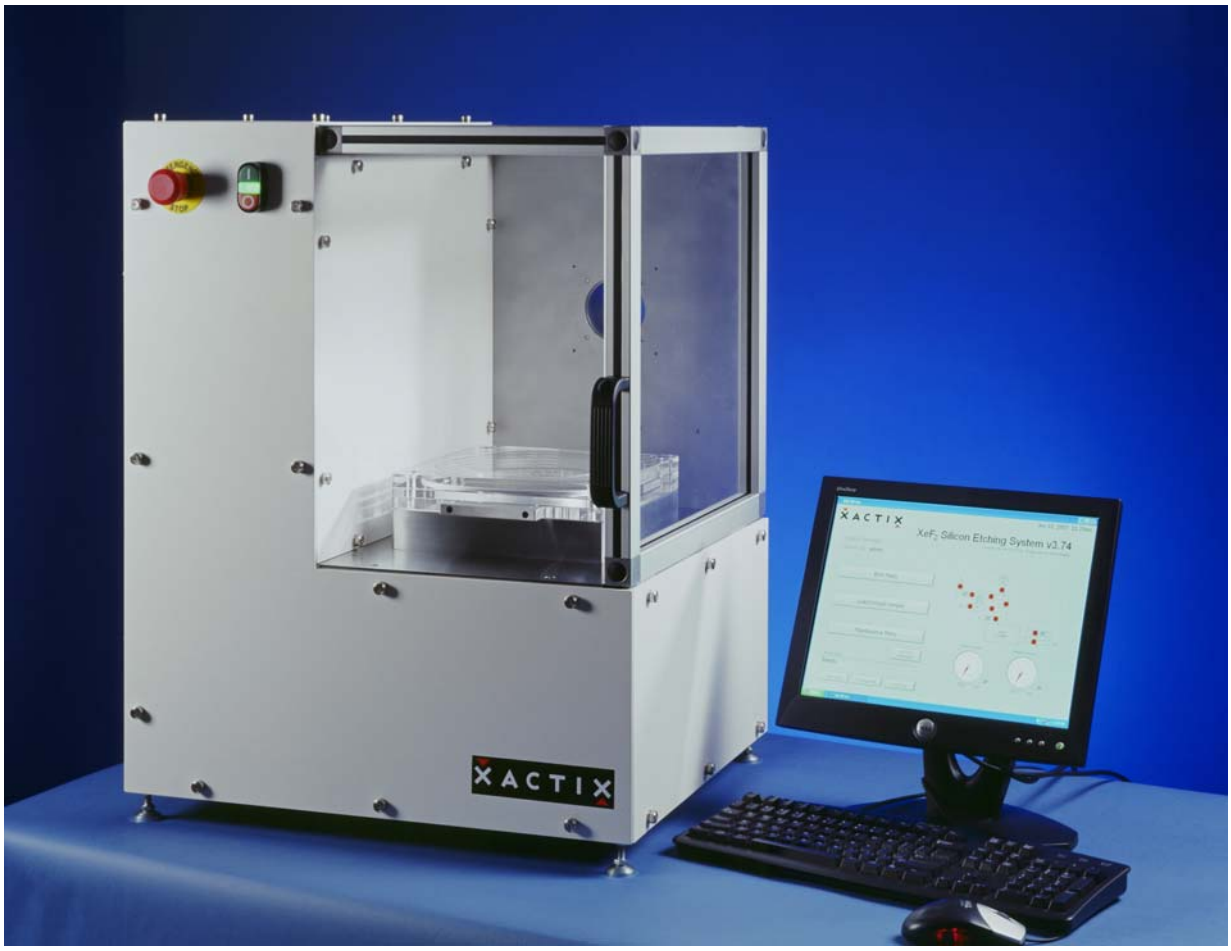
The MEMS Equipment Company™

Xetch® e1 Series™ System Manual



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1 Table of Contents

2 Introduction

Thank you for purchasing the Xetch® e1 Series™ xenon difluoride etching system.

XeF_2 (xenon difluoride) isotropic silicon etching is particularly well suited to MEMS applications. XeF_2 vapor phase etching exhibits nearly infinite selectivity of silicon to photo-resist, silicon dioxide, silicon nitride and aluminum. Being a vapor phase etchant, XeF_2 avoids many of the problems typically associated with wet processes. K. Pister discusses the use of xenon difluoride, as an etchant for MEMS applications, in part in US patent number 5,726,480.

The Xetch e1 Series is the ideal solution for those seeking a cost effective R&D xenon difluoride etch system. Built for high etch uniformity, simplicity, low cost of ownership, and a small footprint, the e1 Series is well suited for both research laboratories and universities.

This manual covers un-crating, installation, initial start-up, operation, and maintenance of the unit.

To use the e1 Series, simply place your wafer, die, or other structure into the etch chamber, close the lid, set the etching conditions, and press start on the software. The details of the process sequence are captured in the control software, and the user just has to set target etch conditions. Etch progress is easily monitored using the stereomicroscope located above the transparent chamber lid.

Installation is very easy since only 120V AC input; dry compressed air, nitrogen, system and chamber area fume exhaust, and a pump exhaust line are required. The XeF_2 canister is contained within the etch system. The combination of a robust design, tested etchant control software, top quality components, and experienced workmanship results in a dependable and flexible etching tool for your research needs.

The e1 Series is a system designed to expose samples to xenon difluoride gas in either a cyclic (pulsed) mode in which the etch chamber is repeatedly filled with XeF_2 gas and pumped out again.

Depending on the options purchased with the system, the e1 Series can be fitted with the following components:

- Microscope
- Multiple process software modules
- Electronic image capture of the process chamber

The major components of the Xetch are:

- XeF_2 source bottle (supplied by customer) contains solid XeF_2, a white crystalline substance much resembling rock salt. At room temperature, the vapor pressure of XeF_2 is 3.9 Torr.
- N_2 source: supplies N_2 gas (supplied by customer) for venting and purging the process chamber, and combining with XeF_2 for etching.
- Expansion chamber: sublimated XeF_2 and nitrogen gas collect in the expansion chamber before entering the process chamber. The pressure of XeF_2 and the pressure of N_2 are selected by the user, and gases are allowed into the process chamber only when these pressures have been achieved.
- Process chamber: this is where the etching occurs for the amount of time specified by the user. When the etch cycle time is up, gas is pumped out and another etch cycle begins.
- Vacuum pump: this pumps gases out of both the process chamber and the expansion chamber.
- N_2 regulator in the gas box which controls the pressure of the N_2 for the venting of the main chamber and N_2 filling of the expansion chamber. Higher pressures lead to faster fill rates but may lead to reduced fill accuracy or in the case of venting, disturbances to the sample.
- Needle valve for accurately adjusting the flow rate of N_2 for the Expansion chamber is located on the left side of the Xetch, on the gas panel. It should not have to be adjusted for normal use, and should remain partially open. Regulation of XeF_2 and nitrogen (N_2) is automatically accomplished through a series of computer controlled valves. The needle valve provides fine control of the flow rate of N_2 whereas the regulator provides gross control.
- Displays of pressure in the expansion chamber and process chamber are located on the computer screen.

This manual gives physical details of the services and ambient conditions required to accommodate the Xetch e1 Series xenon difluoride etching system and to allow it to produce the high performance for which it is designed.

It must be emphasized that the time and expense devoted to proper site preparation will be rewarded by the consequent trouble-free, consistent operation and the resulting reduction in downtime.

WARNING

READ THIS MANUAL BEFORE INSTALLING AND USING THE XETCH E1 SERIES. FAILURE TO DO SO COULD RESULT IN HARM OR INJURY. ALSO, READ THE MSDS FOR XENON DIFLUORIDE.

2.1 USEFUL CONVERSIONS

1 US gallon = 3.79 liter	1 liter = 0.26 US gallon
1 lb. = 0.455 kg	1 kg = 2.2 lb.
1 Imp. Gallon = 4.55 liter	1 liter = 0.22 Imp. Gallon
1 inch = 2.54 cm	1 cm = 0.4 inch
°F = (9/5 x °C) + 32	°C = 5/9 x (°F -32)

3 Installation

3.1 Preparation

3.1.1 General Requirements of the Site

A solid laboratory table capable of accommodating the weight of the e1 Series must be provided. The table should be flat and rigid, and allow adequate airflow and access around the system.

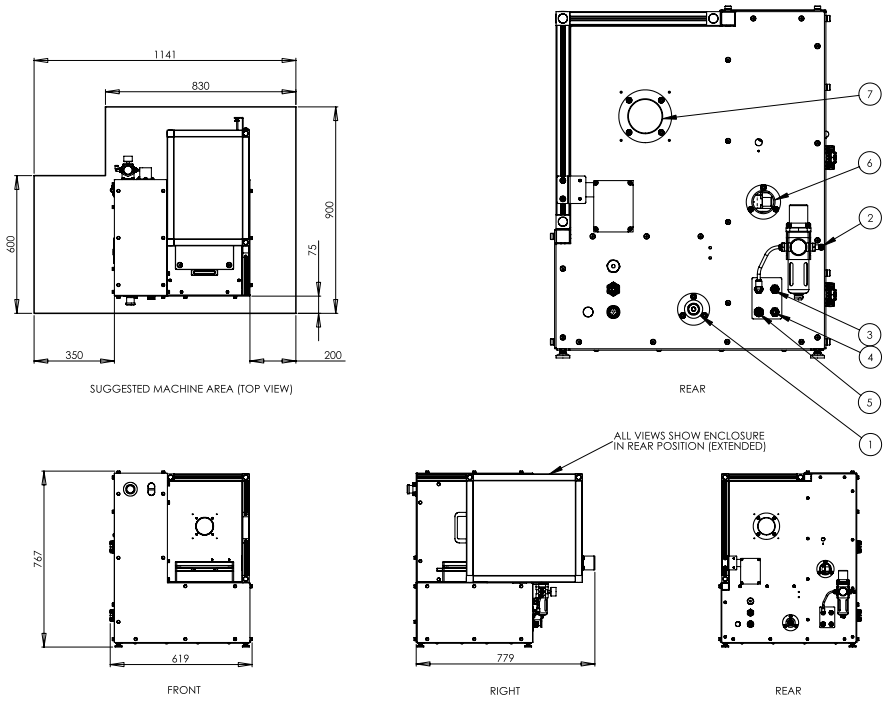
Normal clean room and/or laboratory environmental conditions are adequate for the Xetch.

WARNING

BECAUSE OF THE WEIGHT OF THE XETCH E1 SERIES, THREE OR MORE PEOPLE ARE REQUIRED DURING THE INSTALLATION TO REMOVE THE UNIT FROM THE SHIPPING CONTAINER AND TO POSITION IT INTO ITS FINAL POSITION FOR OPERATION.

3.1.2 Dimensions and Weights

Crated dimensions (W x D x H):	54.5” x 34” x 58.5” (1385mm x 864mm x 1486mm)
Crated weight:	~600 lb (272 kg)
Xetch e1 Series dimensions:	See Figure 1.
Xetch e1 Series weight:	~200 lb (90 kg)



CONNECTION NUMBER	STYLE ON MACHINE	SPECIFICATIONS	PURPOSE
1	NW25	CONNECT TO SUPPLIED VACUUM PUMP	MAIN VACUUM CONNECTION
2	¼" TUBING SMC ONE TOUCH FITTING	80 PSI CDA	PNEUMATICS AIR SUPPLY
3	⅛" TUBING SMC ONE TOUCH FITTING		PNEUMATICS EXHAUST
4	¼" TUBING SMC ONE TOUCH FITTING	5 PSI N_2	PURGES GAS PANEL BOX
5	½" MALE VCR FITTING	20 PSI MAX. HIGH PURITY N_2	NITROGEN USED IN PROCESS
6	2" OD TUBING	-2.5 mm H_2O STATIC PRESSURE	GAS PANEL VENTILATION
7	3" OD TUBING	-25 mm H_2O STATIC PRESSURE EXHAUST	CHAMBER LID AREA VENTILATION

Additional Connections:
- NW 25 exhaust connection from vacuum pump
- Remote pump box requires 11A 120VAC (powers both eXplorer and pump)
- Computer and display require 6A 120VAC

Other notes:
- Provide space for compact tower PC, keyboard, mouse, and 15" LCD
- Add additional clear space to right of system if using optional microscope

Dimensions and connections of Xetch ®e1 Series™

All dimensions are in mm
XACTIX, Inc. reserves the right to change dimensions

Figure 1. Machine dimensions and locations of utility connections. Note, some systems do not require connection 4. Please contact XACTIX for more info.

3.1.3 Space Requirements

The suggested free table space for the e1 Series in the clean room or laboratory environment is shown in Figure 1. In addition, sufficient space must be provided behind the unit, or in the service chase, for the system's electrical box (see Figure 2) and vacuum pump (see Figure 3).

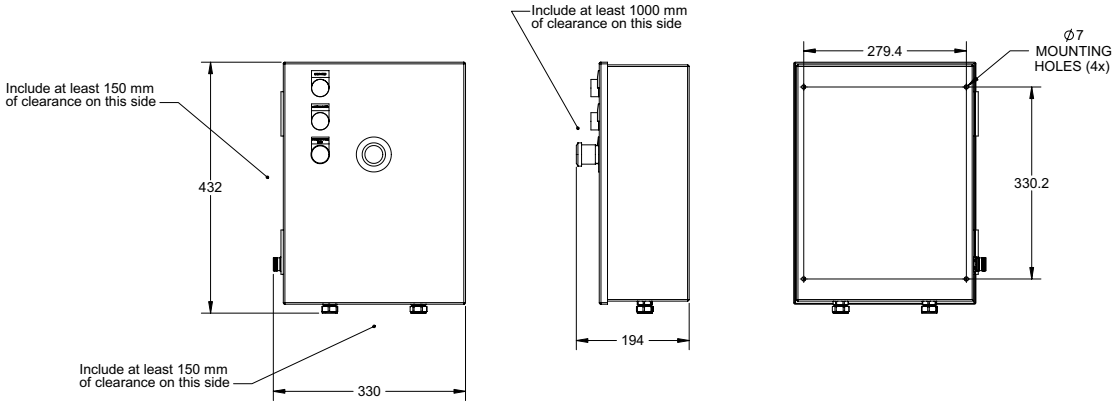


Figure 2. e1 System electrical power box to be mounted near e1. This unit is connected to the e1 system via a 5m cable connecting to the left of the electrical box. The mass of this box is 10 kg and all dimensions are in mm.

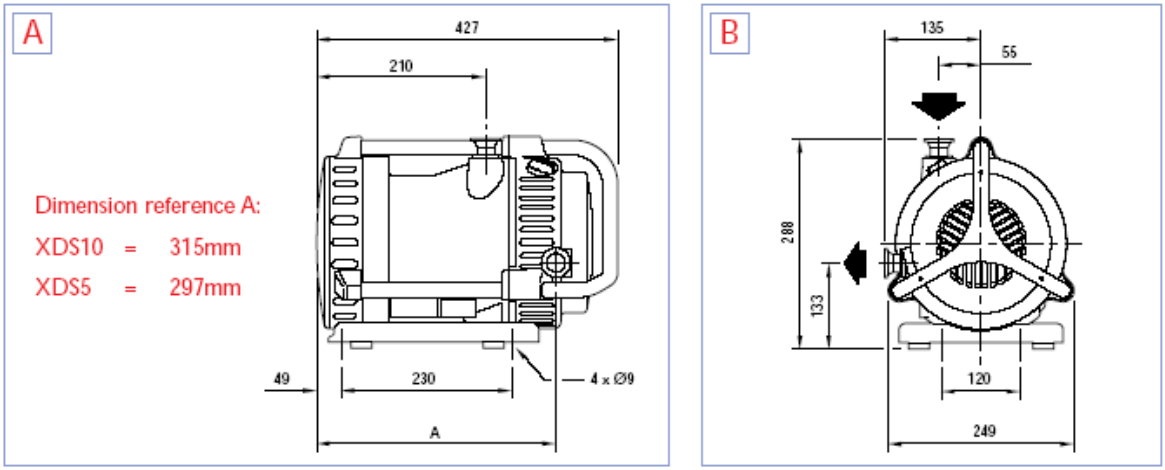


Figure 3. XDS5 pump dimensions in mm. Graphic taken from XDS5 datasheet. See www.bocedwards.com for more details. The pump is to be connected near the system using the supplied 1.2 m long bellows connection. If necessary, longer connections are possible with customer supplied connections. The mass of this pump is 23 kg and all dimensions are in mm.

3.1.4 Electrical Services Required

For North American operations only, the e1 Series is supplied with an appropriate 115-volt single-phase power cable and plug. For all other countries the unit is delivered with a mains power cable terminating with bare wires as standard. It is the responsibility of the customer to provide a suitable mains connector that complies with the local regulations governing electrical connections. The vacuum pump is controlled via the system's electrical box.

	e1 Series and pump	**Control PC**
Mains supply required:	100-120 VAC 50/60Hz Single phase	100-120 VAC 50/60 Hz Single Phase
Mains voltage fluctuations:	±10%	±10%
Power consumption:	1.4kW	0.7kW
External fusing:	15 A at 100-120 V	15 A at 100-120 V

General Ambient Conditions:

The area accommodating the e1 Series should have:

- Adequate space all around the unit for servicing,
- Adequate space behind the unit for proper ventilation, and
- No unnecessary items near the unit.

Maximum ambient temperature to ensure Operation within specifications 85°F (29°C)

Relative humidity at 68°F (20°C) 40-70%

WARNING

ANY INTERRUPTION OF THE EARTH CONNECTION INSIDE OR OUTSIDE THE E1 SERIES IS LIKELY TO MAKE THE UNIT DANGEROUS. THE SAFETY EARTH CONNECTION SHOULD FULFILL ALL LOCAL SAFETY REQUIREMENTS. ENSURE THAT THIS IS CHECKED DURING THE PRE-INSTALLATION SITE CHECK.

3.1.5 Gas Requirements

- At a minimum, one cylinder of nitrogen gas containing a minimum of 40 cubic feet of gas must be available during installation. Utilizing a wall- or bench-mounted support bracket, this cylinder should be firmly secured to prevent possible damage or explosion of the cylinder and/or cylinder valve. The customer must also provide a suitable pressure regulator (Matheson MA-18 or equivalent) with a shut-off valve for the process gas supply.
- A source of clean dry air, compressed to 70-100 psi is required for operation of the pneumatic valves.
- One standard cylinder filled with xenon difluoride, (not included with the e1 Series), should also be available for installation within the system. Information on xenon difluoride suppliers can be found on the XACTIX website http://www.xactix.com. A schematic of a typical cylinder can be found on page 13.

3.1.6 Exhaust Requirements

There are three exhaust/ventilation connections to the e1 Series:

1. Exhaust connection from the vacuum pump, which is NW25
2. Ventilation connection from the chamber ventilation shroud, which is to be connected to a 3" inside diameter hose
3. Ventilation connection from the gas box, which is to be connected to a 2" inside diameter hose

WARNING

THE EXHAUST GAS FROM THE OUTPUT PORT OF THE E1 SERIES'S VACUUM PUMP MUST BE VENTED INTO A SUITABLE FUME EXHAUST SYSTEM. ANY FITTINGS AND/OR TUBING REQUIRED SHOULD BE OBTAINED LOCALLY. THE CUSTOMER, TO COMPLETELY VENT THE SYSTEM GAS BOX, SHOULD ALSO SUPPLY EXHAUST VENTILATION USING A 2" INSIDE DIAMETER HOSE TO THE BACK OF THE FRAME.

WARNING

THE CUSTOMER SHOULD SUPPLY EXHAUST VENTILATION TO THE GAS BOX. THIS IS ACCOMPLISHED BY THE CUSTOMER CONNECTING A 2" INSIDE DIAMETER VENTILATED HOSE TO THE GAS BOX VENTILATION CONNECTION ON THE BACK OF THE FRAME.

WARNING

THE CUSTOMER SHOULD SUPPLY EXHAUST VENTILATION TO THE CHAMBER FUME SHROUD. THIS IS ACCOMPLISHED BY THE CUSTOMER CONNECTING A 3" INSIDE DIAMETER VENTILATED HOSE TO THE CHAMBER FUME SHROUD VENTILATION CONNECTION ON THE BACK OF THE CHAMBER FUME SHROUD.

WARNING

ALL VENTILATION CONNECTIONS SHOULD BE SUFFICIENTLY INDEPENDENT SUCH THAT A VENTILATION SYSTEM FAILURE DOES NOT ALLOW ANY EFFLUENTS DISCHARGING INTO THE SYSTEM OR TOWARDS THE OPERATOR. ALSO, ALL EXHAUST CONNECTION MUST CONFORM WITH ALL LOCAL REQUIREMENTS.

3.1.7 Installation Material

- Electrical connectors as required for local electrical outlets
- Overpressure relief valves in the Nitrogen process gas lines to prevent the process Nitrogen gasses from exceeding 100 psi at the rear system connections
- Gas regulator for Nitrogen gas box purge gas (some systems do not require this purge, please contact XACTIX for more information)
- Gas cylinder mounting bracket bench mount, or wall mount (if using gas cylinder)
- Gas box exhaust hose
- Chamber shroud exhaust hose
- Vacuum pump exhaust tubing - stainless steel recommended
- One XeF_2 cylinder for e1 Series with XeF_2

WARNING

ANY DEVIATION FROM THESE INSTALLATION AND SAFETY REQUIREMENTS MAY CAUSE DETERIORATION IN THE E1 SERIES PERFORMANCE AND/OR DANGEROUS OPERATION.

3.2 Pre-Installation Checklist

Subject	Requirement	Yes	No	Comments
Space requirements	See above			
Room temperature	65-75°F (19-24°C)			Minimize temperature fluctuations
Relative humidity	40-70%			
e1 Series and pump mains supply	100-120 V ±10%, includes transient fluctuation, 15 A			
	Single phase			
	50/60 Hz			
Earthing				Consult local requirements
Process gas	40 cu. ft. min, Nitrogen, 20 psi outlet			
	Provide safety overpressure device for Nitrogen process line			Max. 100 psi
	One cylinder of xenon difluoride for e1 Series			See below for bottle and valve
CDA	Compressed, dry air, 70-100 psi			
Gas box purge gas	Nitrogen, 5 psi : (some systems do not require this purge, please contact XACTIX for more information)			Used to supply diluent gas to gas box to flush possible fumes
System exhausting	Gas box exhaust connection			
	Fume exhaust to vacuum pump outlet			
	100 cfm exhaust to chamber area			

3.3 Cylinder and valve for XeF2

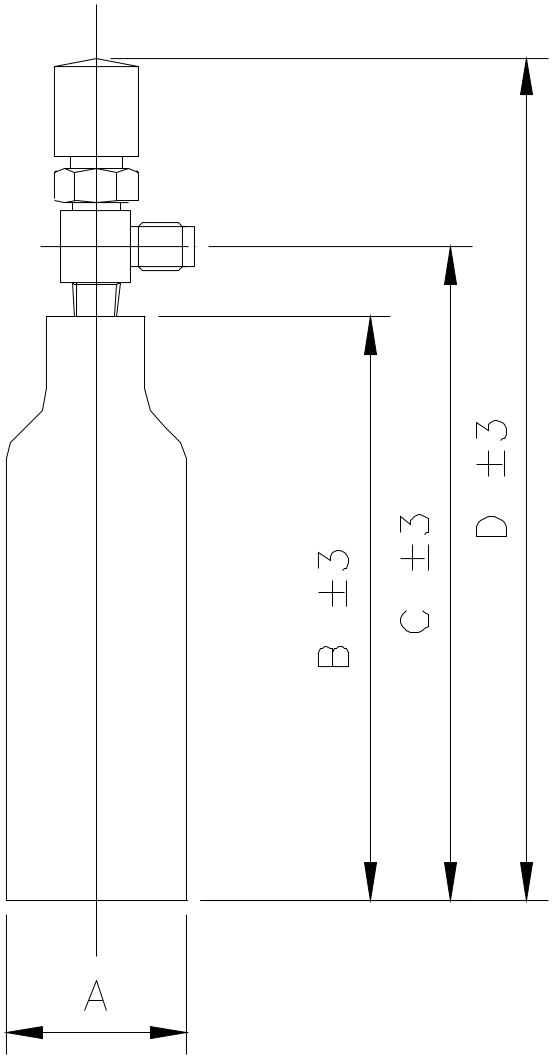


Figure 4: Xenon Difluoride Lecture Bottle (drawing not to scale).

Cylinder size	Maximum XeF_2	A	B	C	D
0.3 L	0.6 kg	51 mm	253 mm	273 mm	325 mm

- Cylinder: Seamless Aluminum
- Valve: Stainless steel, Whitey angle pattern valve and ¼" VCR male outlet

3.4 Uncrating

Inspect the shipping crate for signs of obvious damage encountered during shipment (dents, scrapes, holes, etc.). Also inspect the "Tip n' tell" gauges and ensure that they have not been tripped (blue powder will be in the arrowhead if it was handled roughly). If a gauge has been tripped, this indicates that the crate was handled roughly and/or tilted at high angles during shipment. Please make a note to the shipper and contact XACTIX immediately.

Figure 5. Crated system.

Note that the crate should be lifted from the end as indicated below:

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⚠	**WARNING** **BECAUSE OF THE WEIGHT OF THE E1 SERIES, THREE OR MORE PEOPLE ARE REQUIRED DURING THE INSTALLATION TO REMOVE THE UNIT FROM THE SHIPPING CONTAINER AND TO POSITION IT INTO ITS FINAL POSITION FOR OPERATION.**

Using a power screwdriver, start opening the crate by removing the side panel labeled “Open This Side First,” as shown in Figure 5.

Figure 6. Shock sensor

Notice in Figure 6 that there is a shock sensor that should be inspected to determine if the shipment may have been subjected to mishandling. In addition, you should look for any included tip sensors inside of the crate (see Figure 7) for any other indications of mishandling (mishandling is indicated by blue powder in the upper portion of the arrow).

Figure 7. Tip sensor.

	**CAUTION** **Some of the boxes in the crate are heavy and may require two people to safely remove.**

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WARNING

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The system should be picked up (with 3 or more people or other appropriate technique) from the bottom, being careful not to damage any external system components, and placed onto a suitable work surface.

Lastly, place the all accessories to its operation location in your processing facility.

4 Setup

The installation process is described below. To begin the setup of the e1 Series, unpack all items from the boxes, then:

Step Number	Step Details	Completed
1	Level the system using the leveling feet (Figure 8)	
2	Setup the computer and plug into ***customer supplied electrical outlet***	
3	Set up the display and plug its power supply into ***customer supplied electrical outlet***	
4	Make display connection to computer, video connection (also serial port if there is an optional touchscreen)	
5	Install keyboard and make connections	
6	Install vacuum connection on e1 Series to vacuum pump (see Figure 9and Figure 10)	
7	Set vacuum pump ballast to position one (see Figure 11)	
8	Connect vacuum pump to ***customer supplied exhaust***	
9	Connect e1 Series to power controller box (see Figure 12 and Figure 14)	
10	Connect e1 Series to computer through the DeviceNet cable (see Figure 12 and Figure 15)	
11	Connect power to pump from power controller box (see Figure 16), set pump power switch to ON position.	
12	Connect ***customer supplied pressure relieved nitrogen line (max. 100 psi)*** to process nitrogen connection (see Figure 17)	
13	Connect ***customer supplied compressed dry air line*** to CDA connection (see Figure 19)	
14	Set internal nitrogen regulator to 10 psi (see Figure 18)	
15	Set CDA regulator to 80 psi (see Figure 19)	
16	Connect gas box exhaust to ***customer supplied exhaust*** (see Figure 20)	
17	Connect shroud exhaust to ***customer supplied exhaust*** (see Figure 21)	
18	Connect ***customer supplied nitrogen*** to gas box purge (see Figure 17)	
19	Insert showerhead stop (see Figure 22 and Figure 23)	
20	Plug in power controller box into ***customer supplied electrical outlet***	

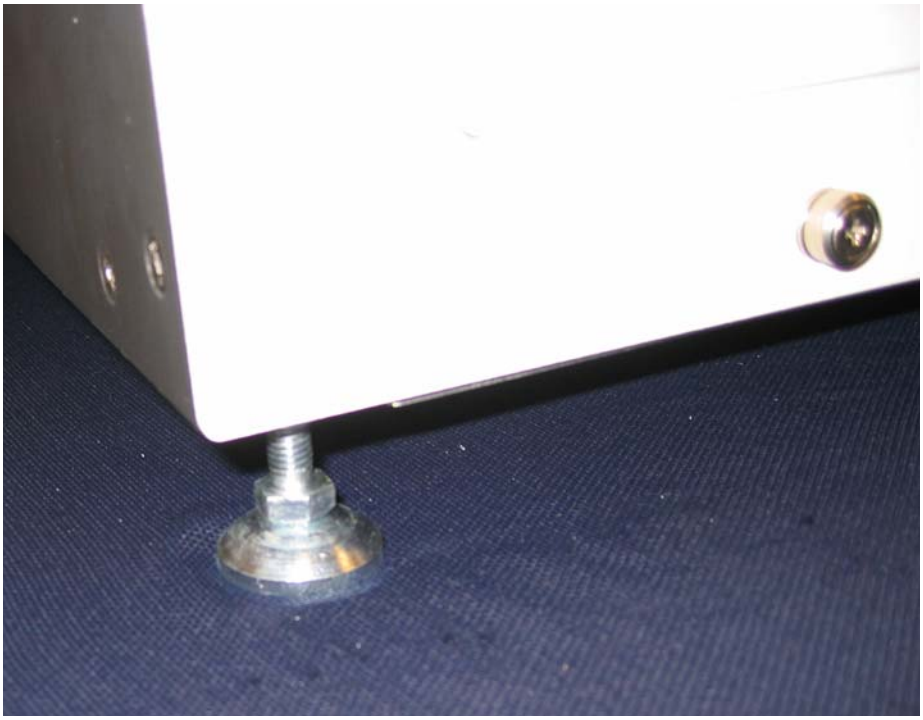

Figure 8. One of four levelling feet.

Figure 9. Close-up of vacuum connection with bellows attached.

Figure 10. Edwards XDS 5 pump

Figure 11. Pump ballast control should be set to position 1.

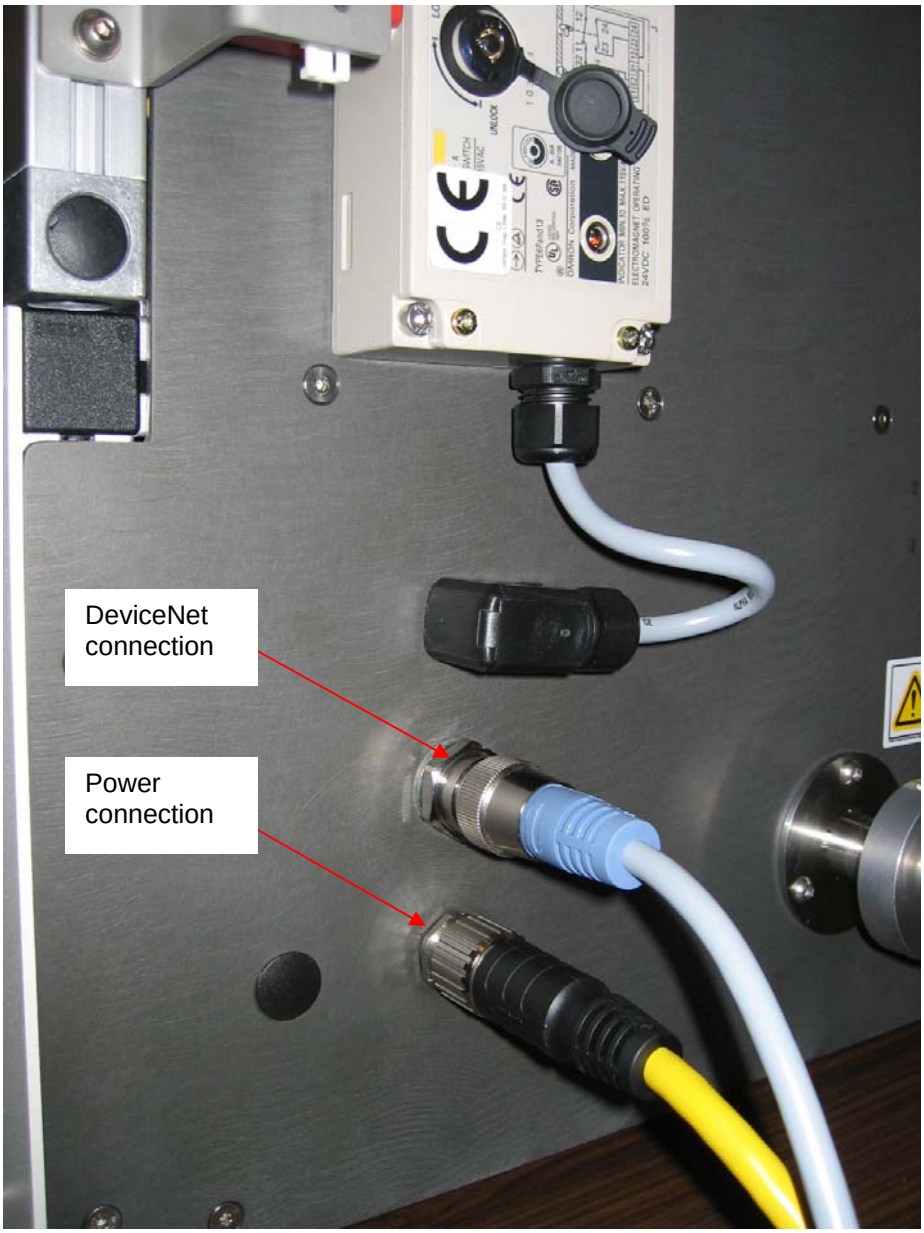

Figure 12. DeviceNet and power connections to rear of e1 Series.

Figure 13. Power controller box.

Figure 14. e1 to power controller cable connection.

Figure 15. DeviceNet connection on rear of PC.

Figure 16. Pump power connection.

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Figure 17. Rear Gas Connections of Xetch.

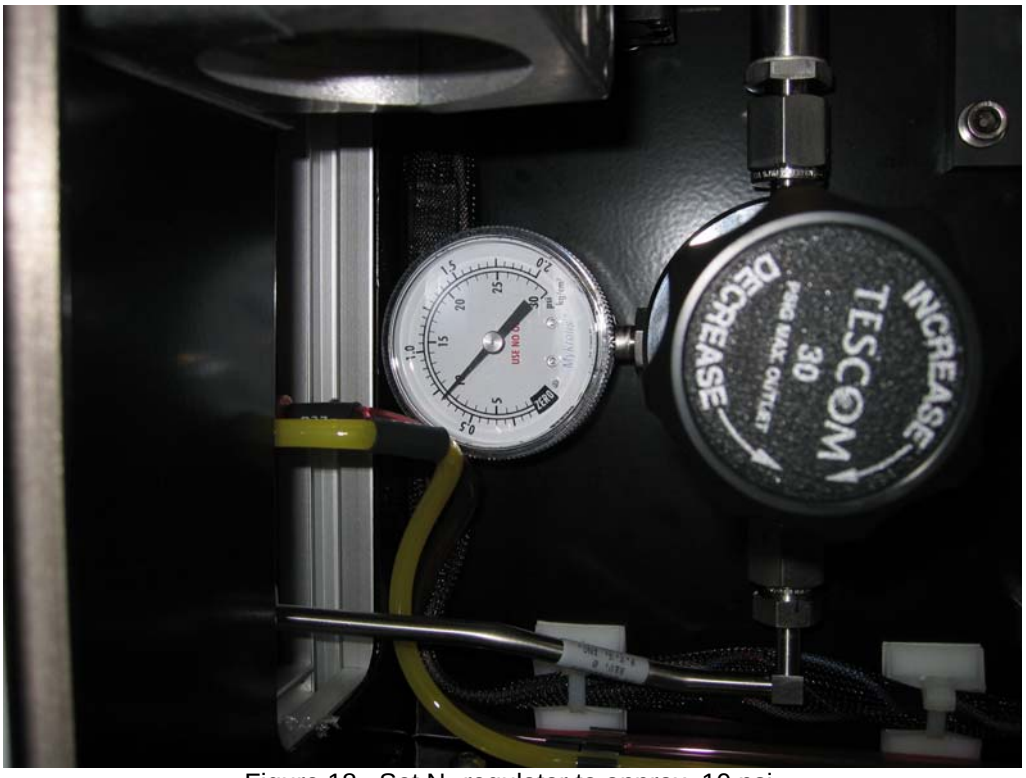


Figure 18. Set N_2 regulator to approx. 10 psi.

Figure 19. CDA pressure regulator and connection.

Figure 20. Gas box exhaust connection.

Figure 21. Shroud ventillation connection.

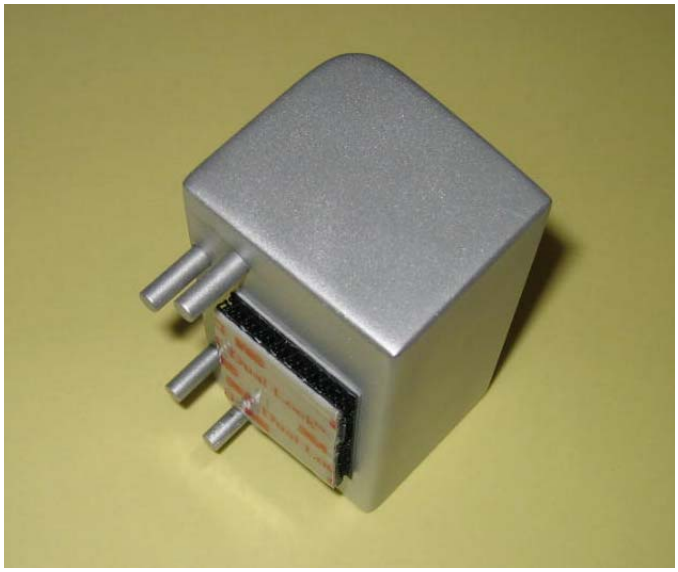


Figure 22. Showerhead stop.

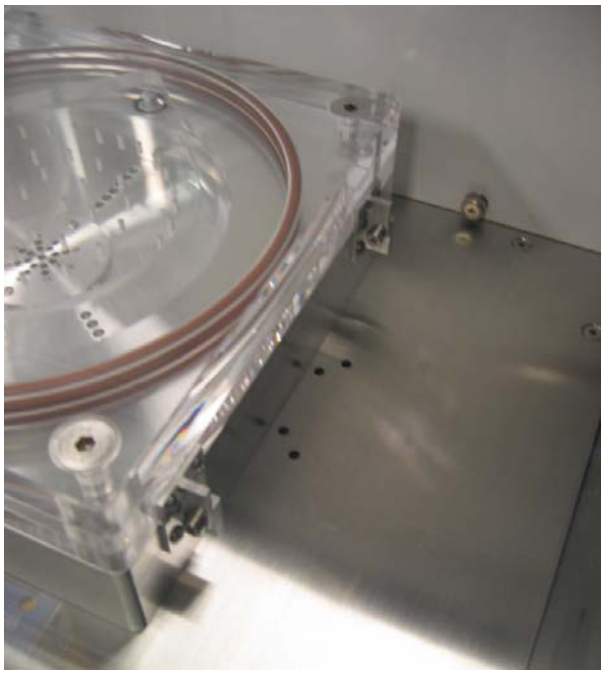


Figure 23. Insert showerhead stop into holes behind chamber.
Note, it is not necessary to expose adhesive.

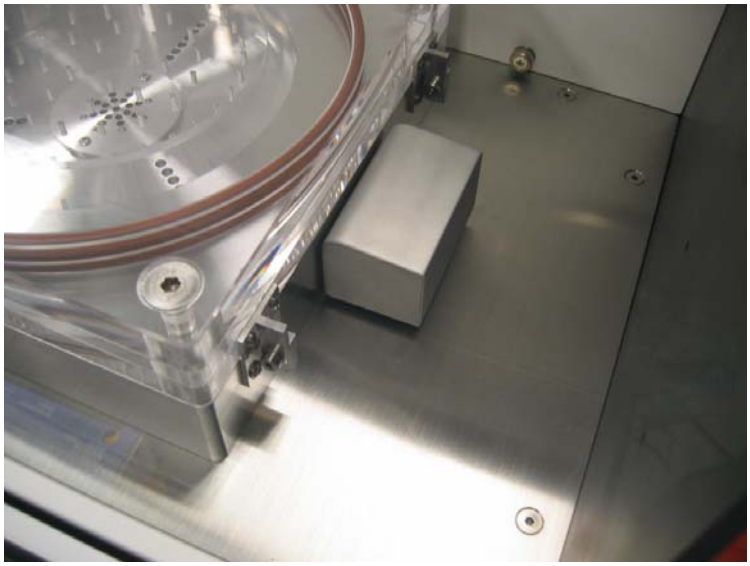


Figure 24. Showerhead stop installed.

5 Initial Start-up

5.1 Safety verification

At this point, verify the following points:

a) Exhaust ventilation is on and all system exhaust including that for the vacuum pump is properly installed.

b) Dry compressed air pressure is between 70 and 100 psi

c) Nitrogen pressure is between 10 and 20 psi at the process connection

d) Nitrogen is flowing in through the gas box purge connection

e) Power is available to the system.

f) Emergency Stop button (EMO) is pulled out on both the system and the power control box.

5.2 Power Up and EMO reset

Figure 25. Power control box with indicators and control power reset.

First, examine the box shown in Figure 25 which is inside of the front system panel. The top light, LINE POWER, should be lit which indicates there is 100-120 VAC to the system. The lower light, CONTROL POWER, should initially not be on. This light indicates that the power that controls the system components is on. To turn on the CONTROL POWER, press the CONTROL POWER RESET button. CONTROL POWER should remain on except if any of the following situations occur:

- If the Emergency Stop button is pressed (either on the system or on the pump controller box)
- If there is a loss of power to the system

In these situations, resetting the CONTROL POWER as described above will be necessary.

As long as there is CONTROL POWER, the system power can be controlled using the Green (on) and Red (off) buttons on the front of the system as shown in Figure 26.

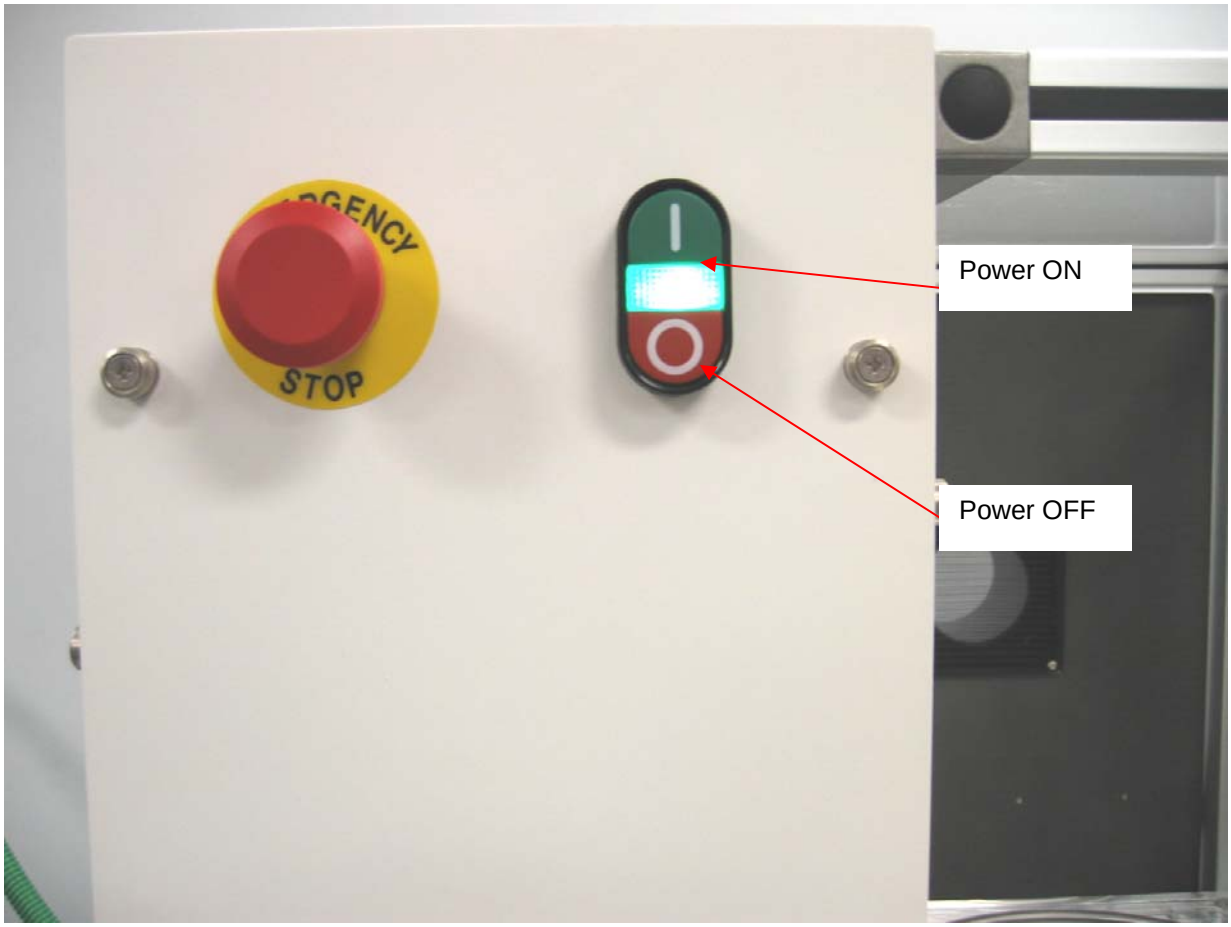


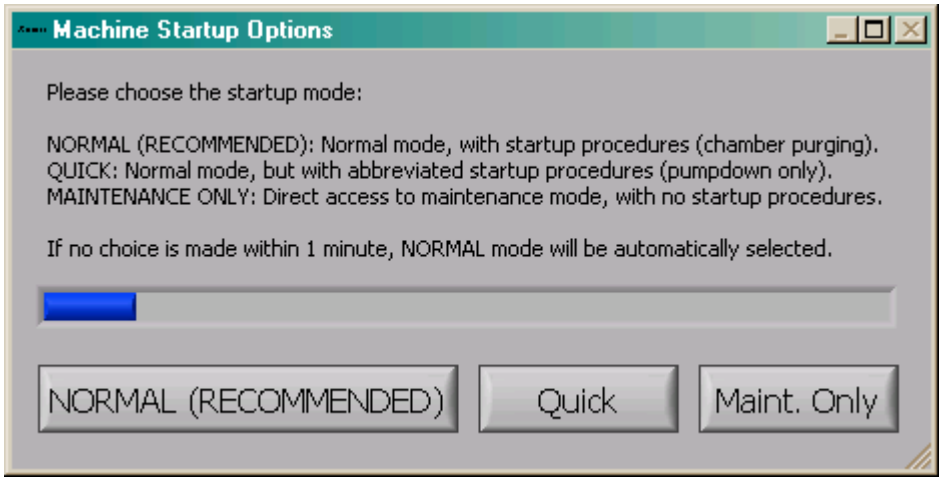
Figure 26. Main power controls.

Press the ON button to start up the e1 Series and the vacuum pump.

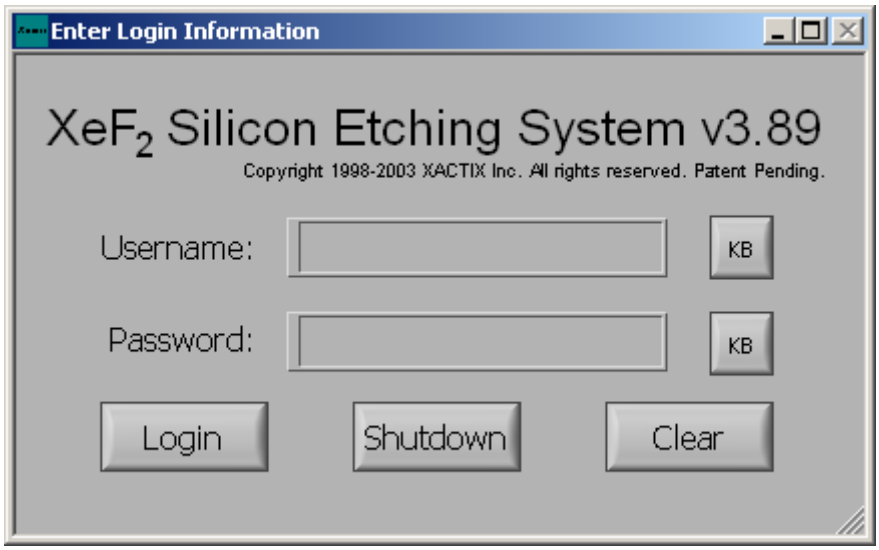
Since the system has not been running, let the system warm up for 4 hours so that the gas box temperature can stabilize. Also, be certain that the room temperature is between 65ºF and 75ºF (18ºC to 24ºC) and does not fluctuate.

After the warmup period, start the computer system. Then, the e1 Series control program, which is located under; Start Button; Programs; Xactix; Xetch, will autostart (if it is not set to autostart, it can be started manually).

After the initialization procedure, a dialog box will appear as below:



Allow the NORMAL startup routine to complete. The control program will run an automatic system purge routine that sequences the various valves making sure that all of the chambers have been purged. This routine will last approximately ten minutes. At the end of this process, the control screen will display a log in menu as shown below:



The e1 Series is now ready for use.

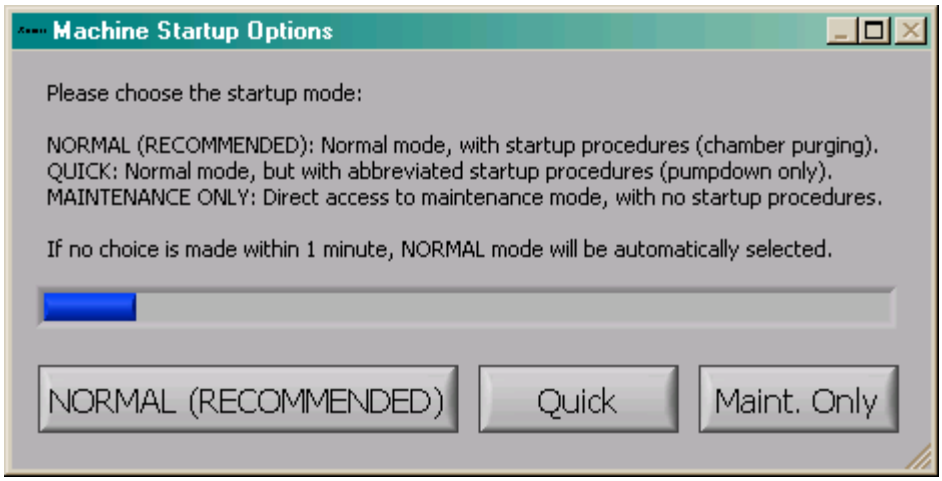
If the system does not reach this menu within 1 hour of startup, see Section 9.9.

6 Software Control

The e1 Series performs several activities when the system is turned on, including initializing hardware, purging the chambers, and preparing the software to run. There are three options displayed after the machine initializes the hardware, and this dialog box is shown below.

- Normal mode is the recommended method of startup for the e1 Series. In this mode, the machine pumps and purges all of the machine chambers, assuring the user that the chambers are purged.
- In Quick mode, the chambers are simply pumped down, with no purging performed. This mode is useful when the state of the system is known upon startup, and no purging is necessary.
- In Maintenance only mode, the etch menu and load sample menu are disabled, and only the maintenance menu can be reached. This mode is useful when there is a machine fault that needs to be resolved by a technician.

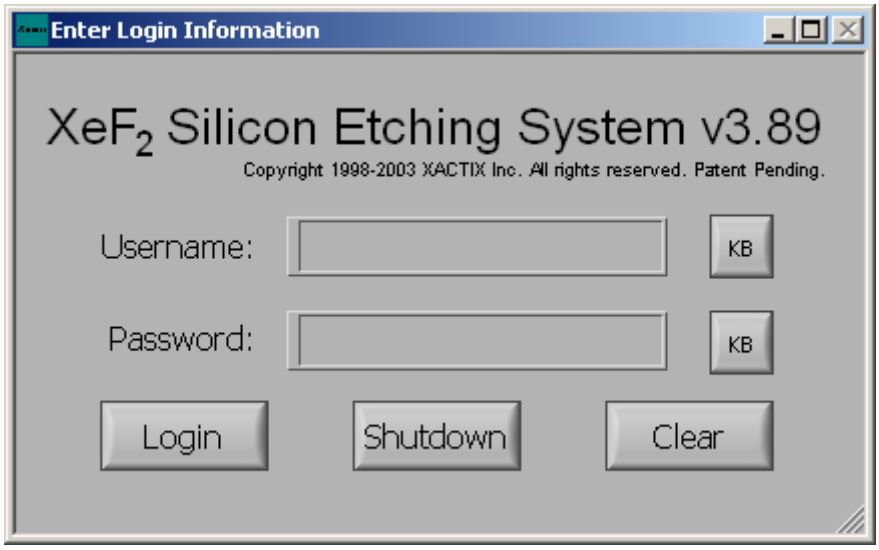
If no choice is made for one minute, Normal mode is selected by default. This allows the system to start up unattended.



6.1 e1 Series Log in

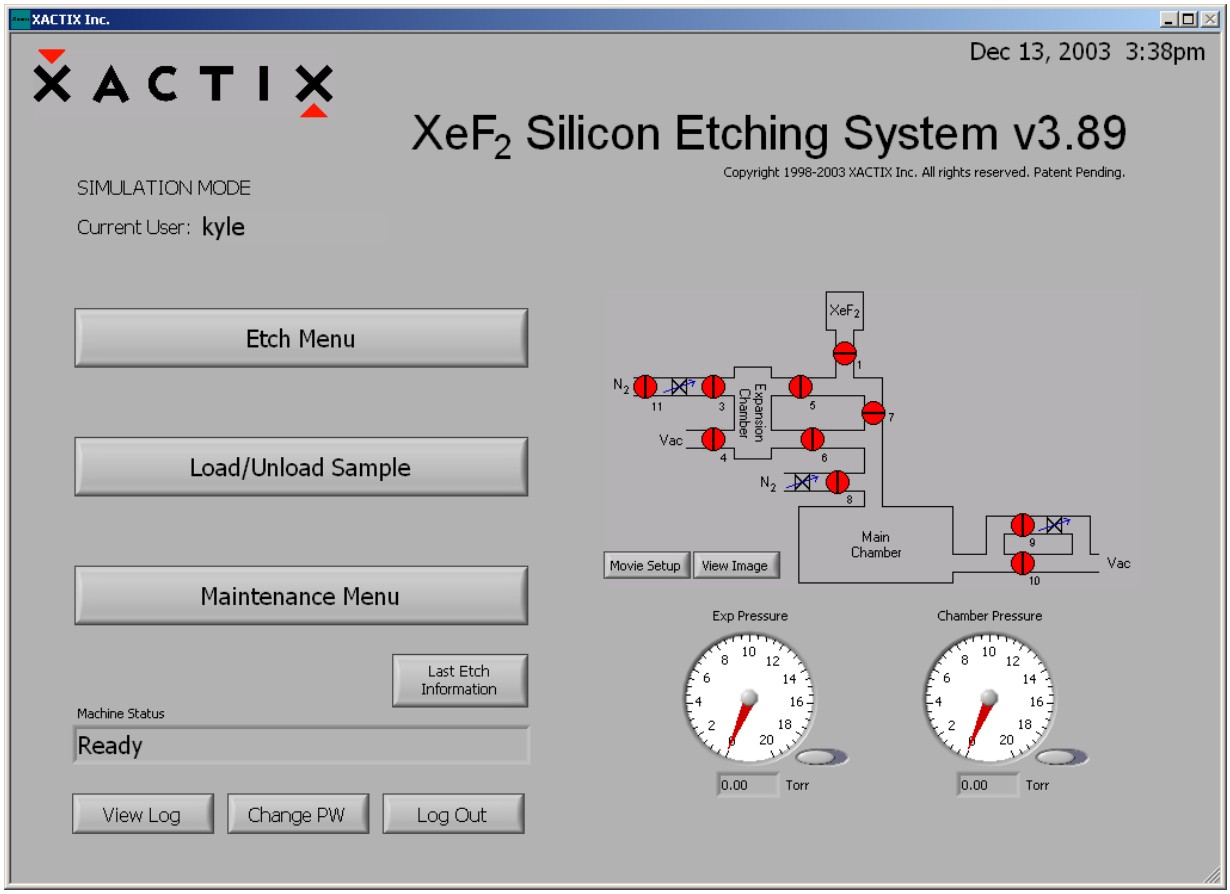
The e1 Series is set up so that individual users are required to log in to the system. When starting the e1 Series the prompt below will be displayed. Each operator is required to input their username and password which will be assigned to them by the system administrator. The KB button beside the Username and Password field can be used to access the on-screen keyboard.

The system administrator can log in to the system by inputting “admin” as the username. A password can be created after the initial log in as the administrator (for the first login, the password field should be left blank).



6.2 Main menu

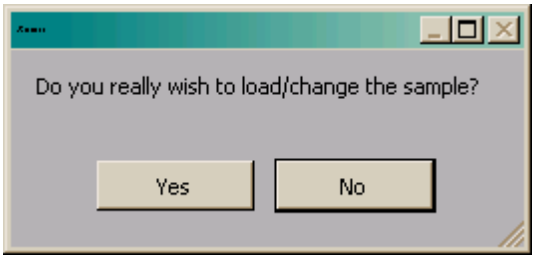
Upon a successful login, the main menu will be displayed as shown below which also indicates the software version number. The software version number may be newer than that shown in this manual. The machine status is shown in the bottom left corner. When the main menu is displayed, the chamber is under vacuum and ready for use. A schematic for the machine is shown on the right. Red dots denote closed valves, while green dots represent open valves. Pressure gauges for the main chamber and the expansion chamber are at the bottom right. The three options available on the main menu consist of performing an etch, loading/unloading a sample, and accessing the maintenance menu.

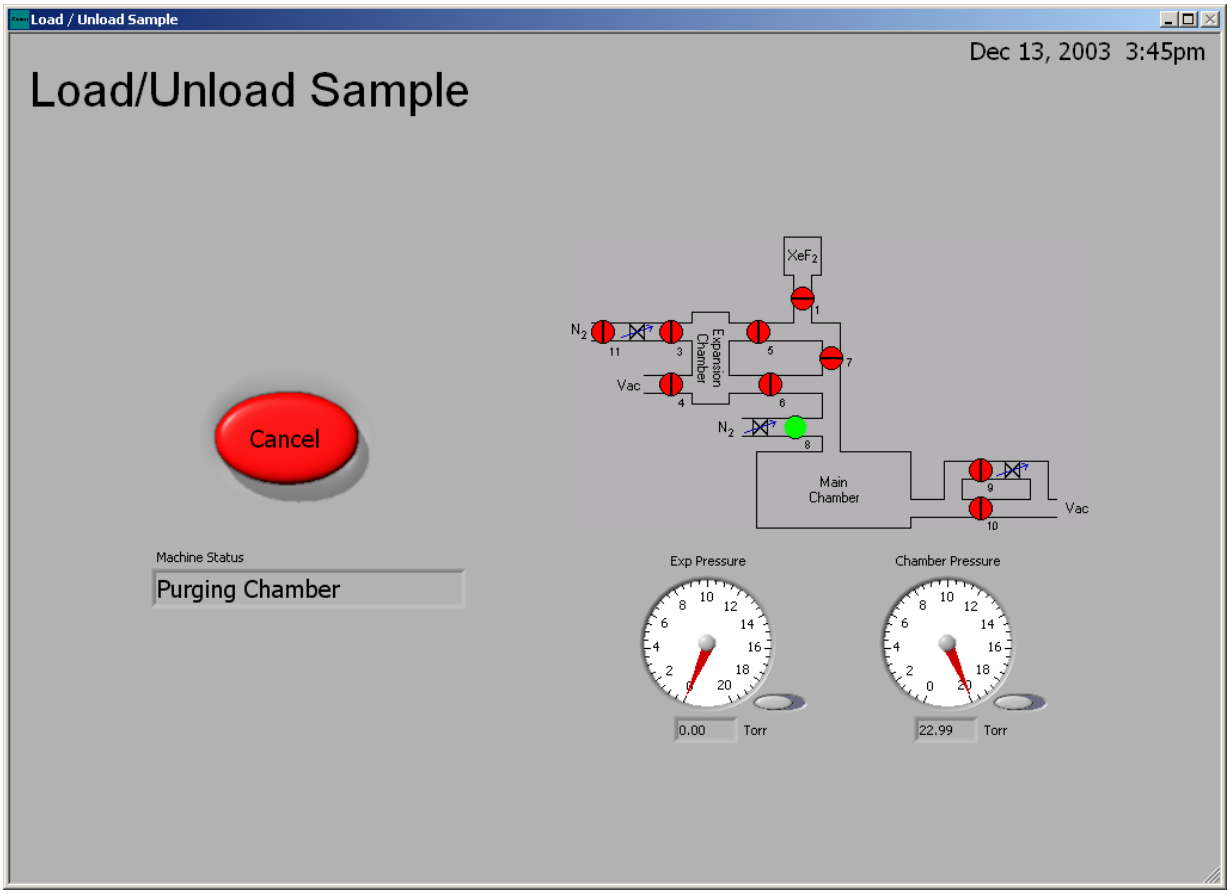


6.2.1 Sample Loading

To load/unload a sample:

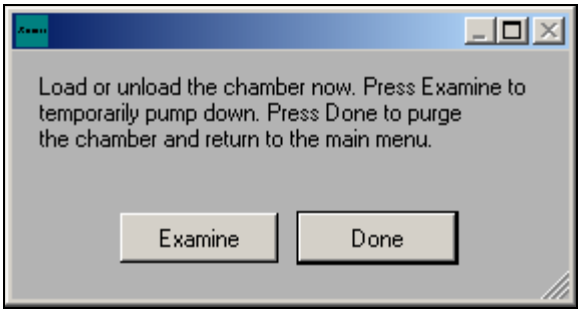
1. Press “Load/Unload sample” on LCD screen. The system will go through prompts to ensure a correct decision: Are you sure? Press YES if you’re sure, NO if you’re not. This prompt is provided since the load/unload process can be time consuming and is inconvenient if accidentally started. The system begins chamber purges and flushing cycles to evacuate the chamber, shown below.





2. Swing the optional microscope out of the way of the chamber. If the chamber ventilation shroud covering the chamber is not pulled fully forward (see Figure 27), a request to close the shroud will be displayed before venting the chamber. Move the shroud forward (see Figure 28) and acknowledge the prompt.

3. When the chamber is vented, the dialog box below will appear and you can open the chamber lid. The lid will rest open on the stop behind chamber.



4. If desired, load a sample. If the sample holder and pins have not been placed inside of the chamber, and you wish to do so, please do so now. See Figure 29 and Figure 30.
5. Close the lid.
6. Press "Done" on LCD screen as shown below, the system will go through a purging cycle prior to chamber pump-down. As a side note, the Examine button only pumps the chamber down, without purges, so that the system can be quickly vented to load the sample. This is very useful when examining a sample away from the system to prevent moisture from accumulating in the chamber. However, it is always necessary to press Done before etching the sample.
7. During the pumping cycle, a "click" sound will be heard that indicates that the ventilation shroud can be moved.

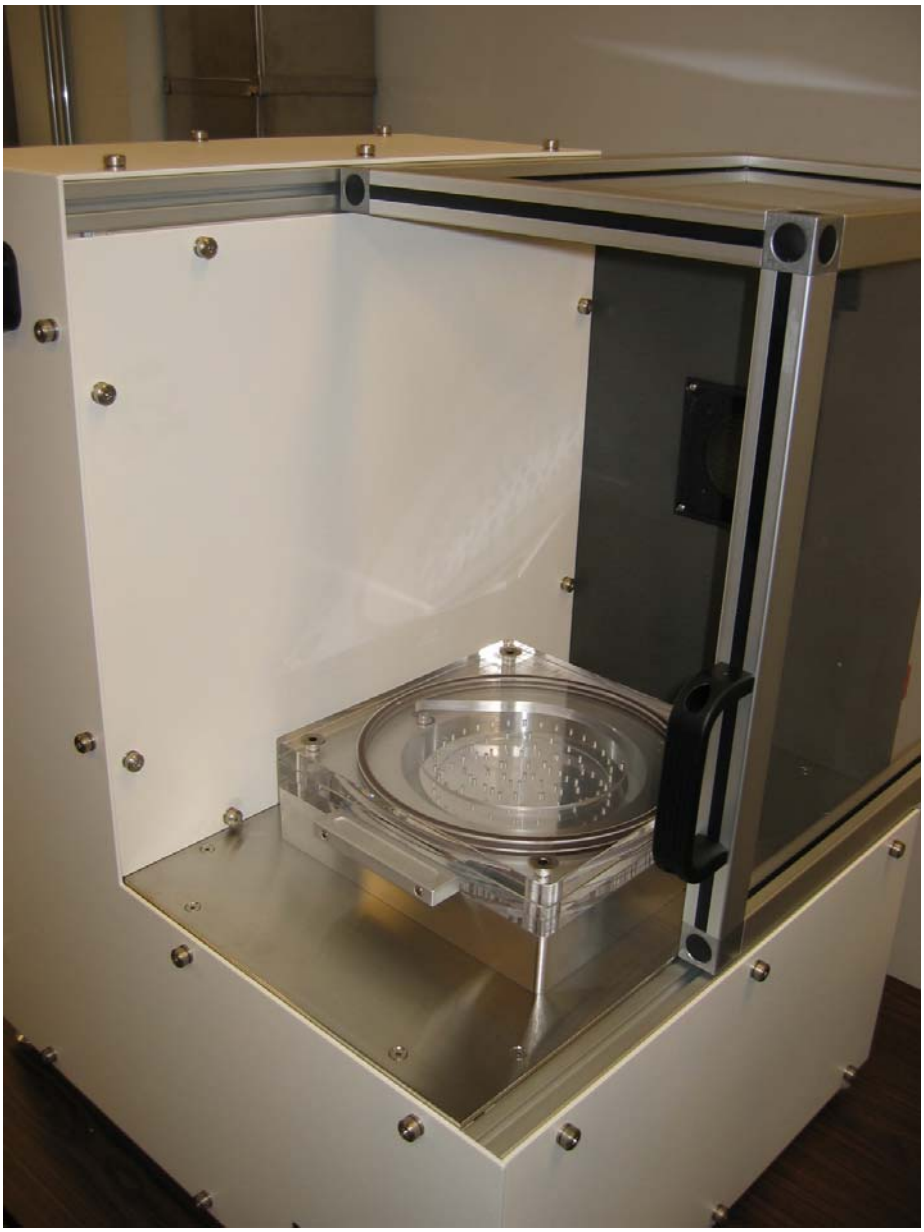


Figure 27. Chamber ventilation shroud moved to back.

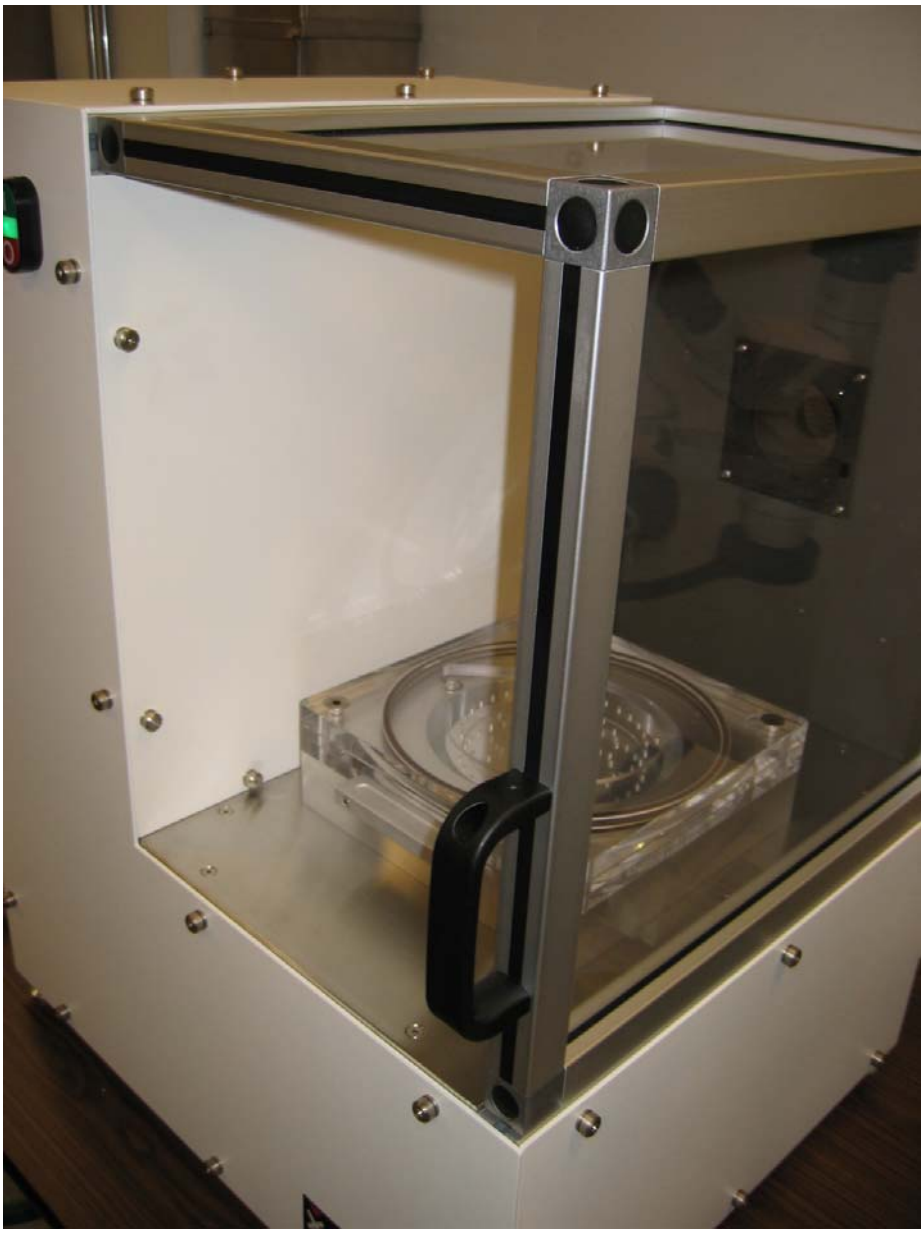


Figure 28. Chamber ventilation shroud pulled forward.

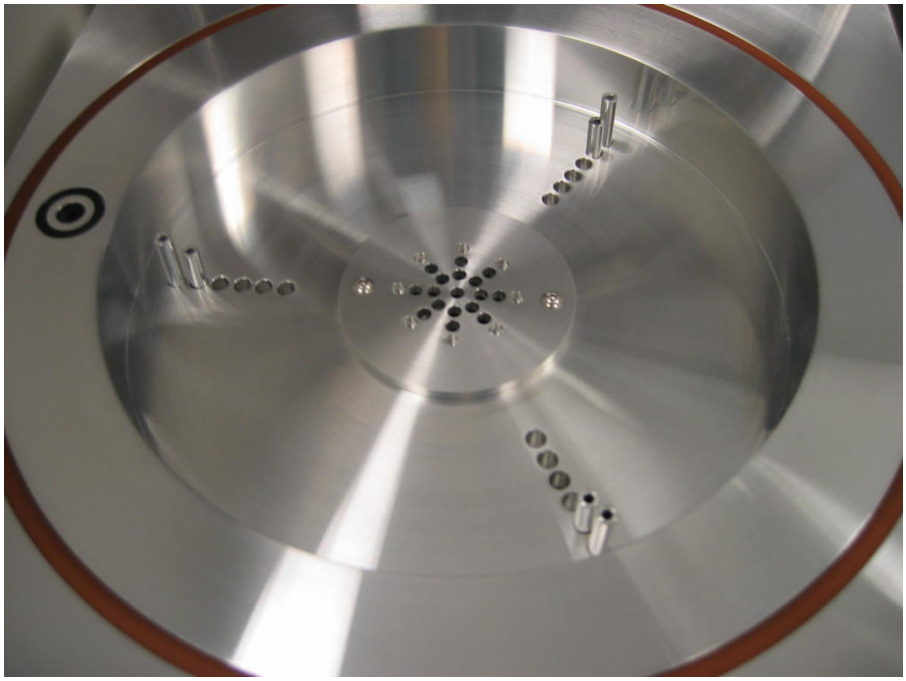


Figure 29. Wafer holding pins in place.

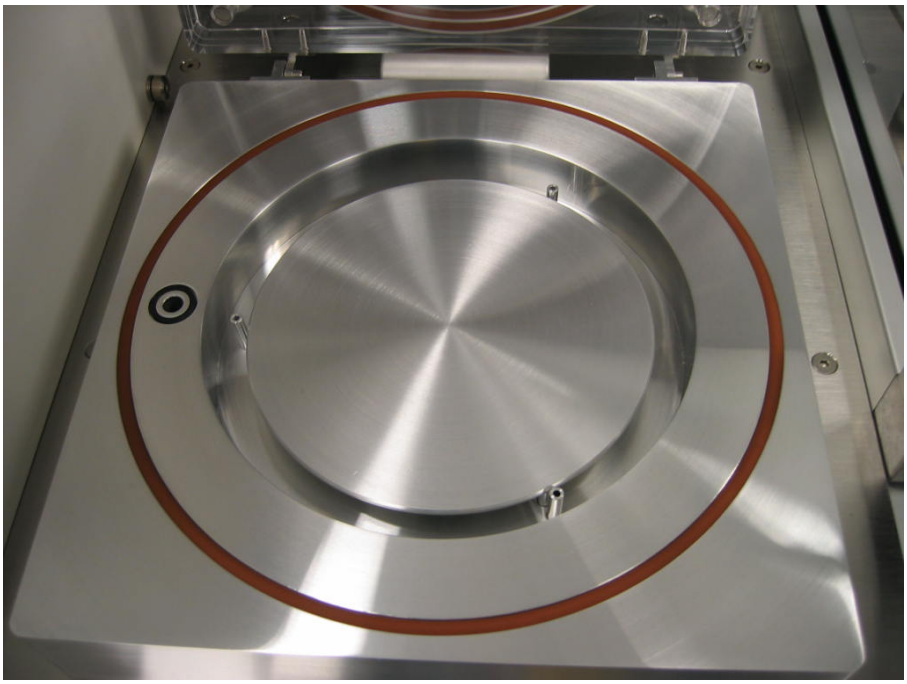
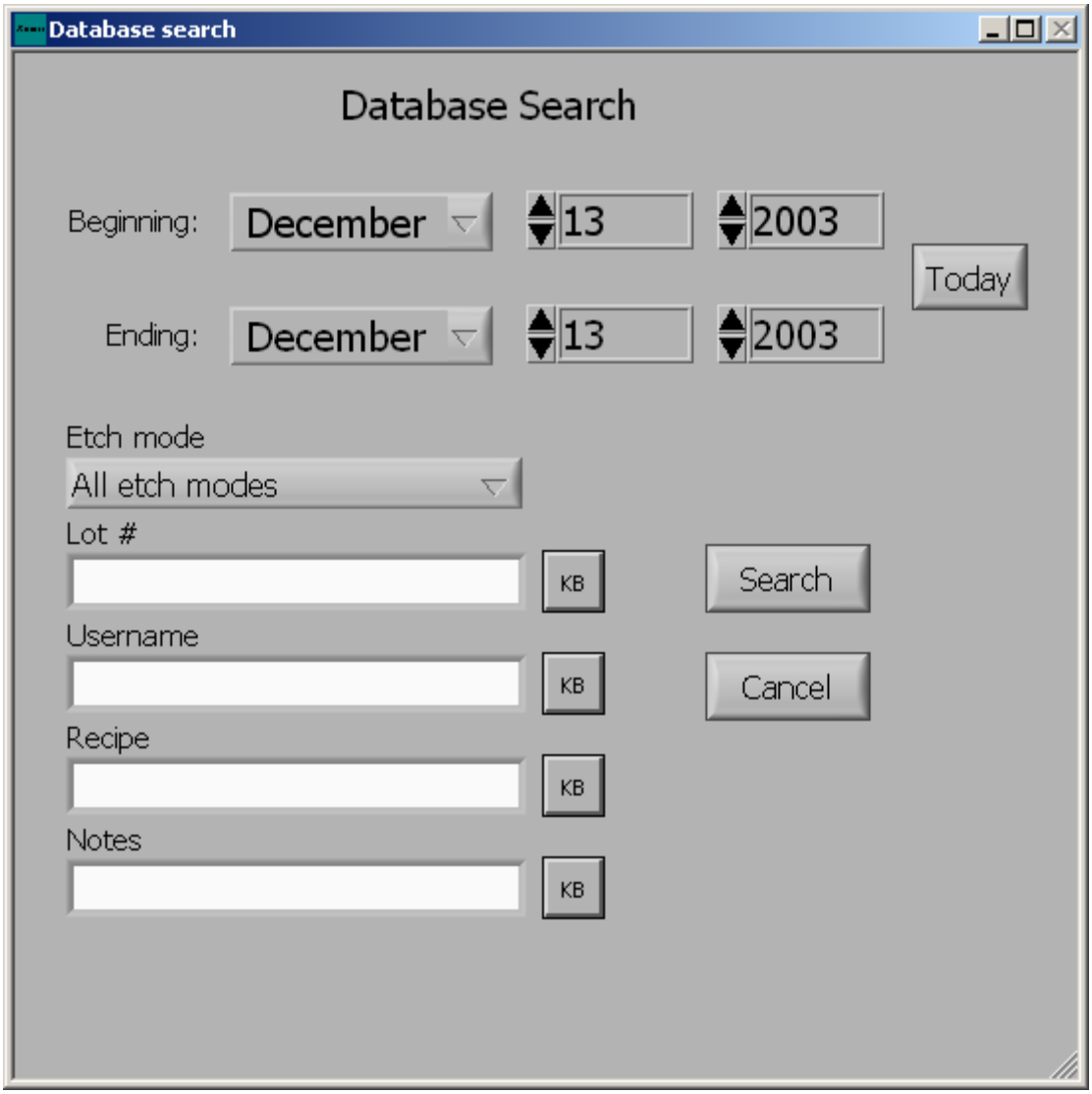


Figure 30. Wafer holder placed on pins.

6.2.2 Viewing the Log

The log may be viewed by clicking on the “View Log” button on the Main Menu. The log file is a database that is queried by beginning date and ending date. The “Today”: button will automatically set the dates to the current month, day, and year. The lot number, username, recipe, note’s keyword(s),

and/or etching mode used can further specify your search. Wildcard characters (*,?) may be used to fully specify the search criteria.



If the boxes are left blank, clicking the search button will reveal all history info, displayed in a tabular form.

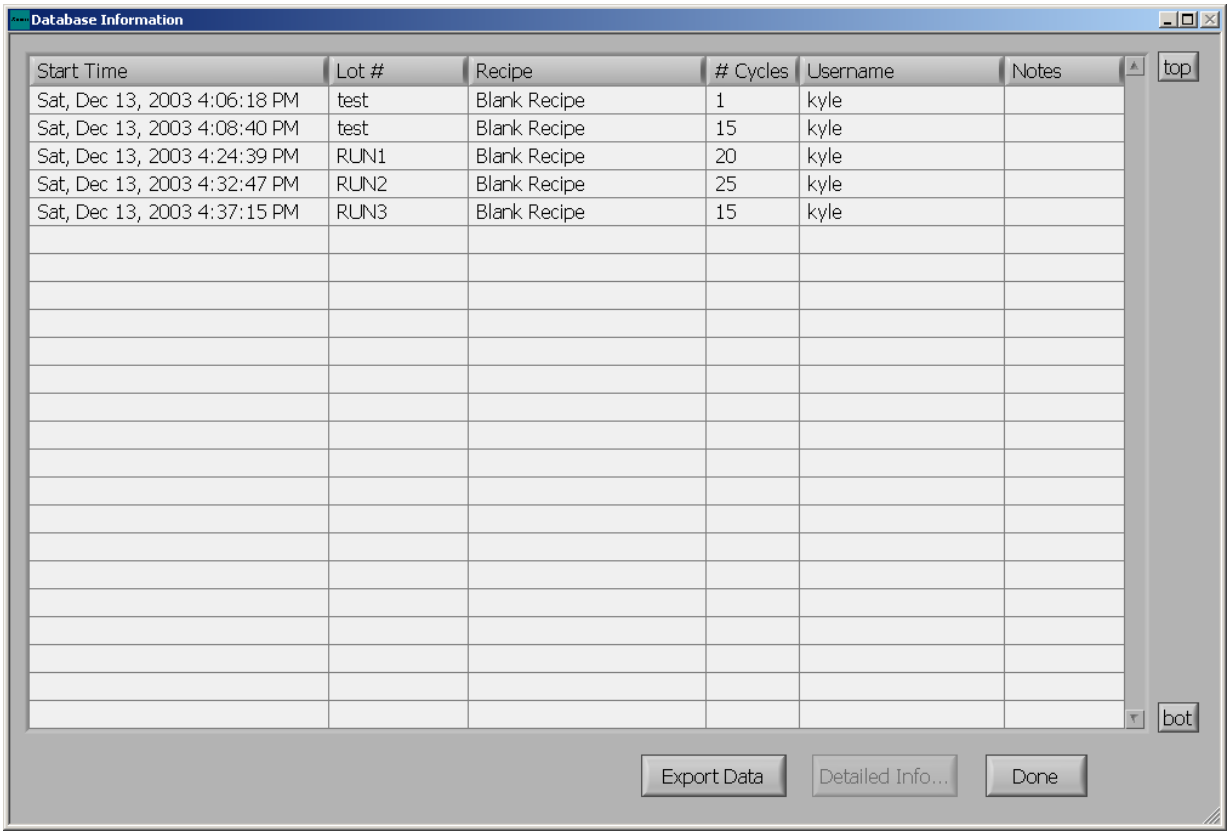
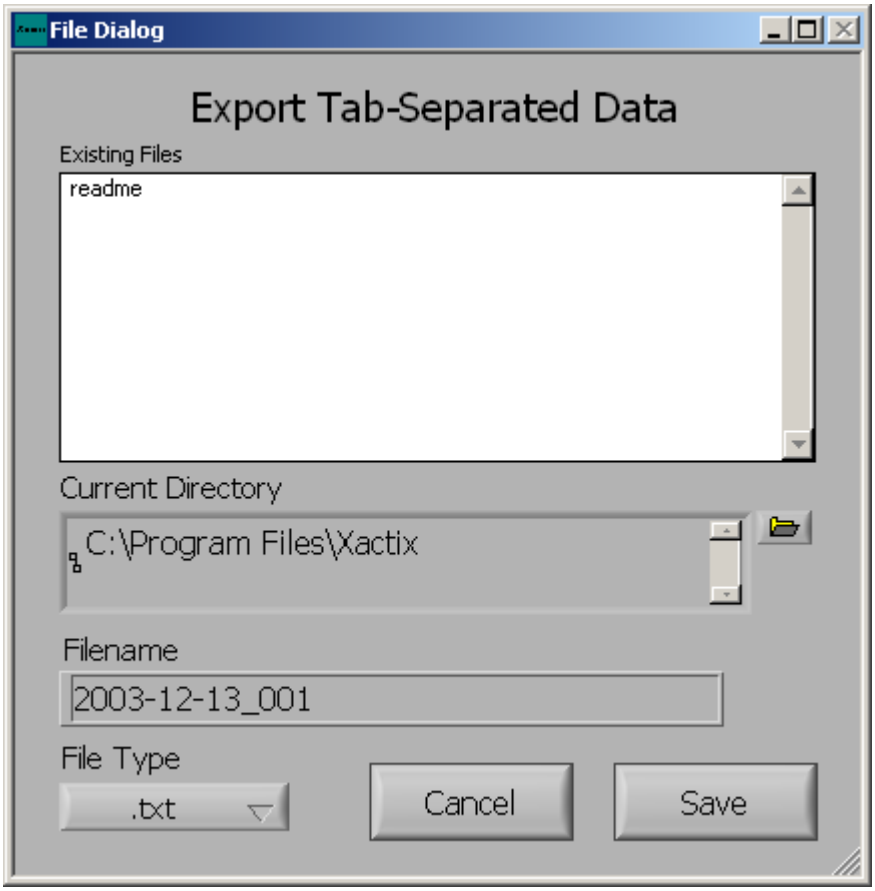
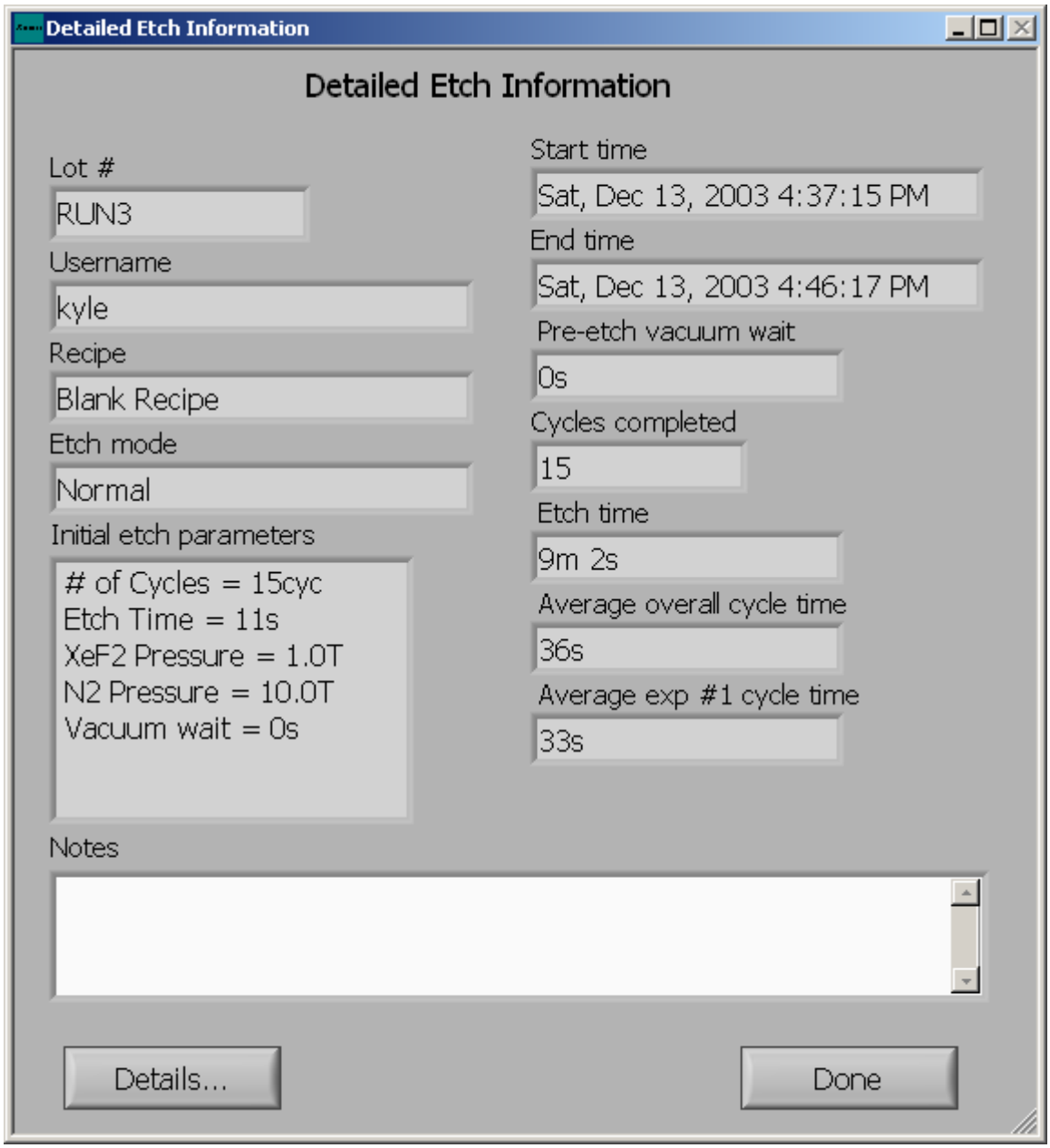


Figure 31. Database Information screen.

The export data button allows you to export all of the information shown in the table to a tab-separated text file that can be opened in the program of your choice, such as Microsoft Excel, Microsoft Access, and Microsoft Word, as shown below. Choosing a destination folder can be done by clicking on the folders icon at right side of the “File Dialog” screen. A default folder for saving log files and photos may be selected in the “System Configuration Menu”. File names are automatically entered in this form, (2003-12-13_001.txt). This represents the year, month, day, and the number of the export for that day.



Besides being able to export the information, a selection from the displayed in the "database information" screen (see Figure 34), the information for a particular date and time can be accessed by highlighting the row of information desired and clicking the "detailed info" button. Note that the file is automatically scrolled to the bottom of the file, the "Top" or "Bottom" buttons are used to scroll instantly to the top or to the bottom of the log file. The result of the detailed information display is below. One unique feature of this menu is that comments can be typed into the Notes area (however, the number of characters is limited to 250). One other item to note is that the Average Overall Cycle time is not the average of the expansion chamber cycle times, but is computed by dividing the total run time divided by the number of cycles.



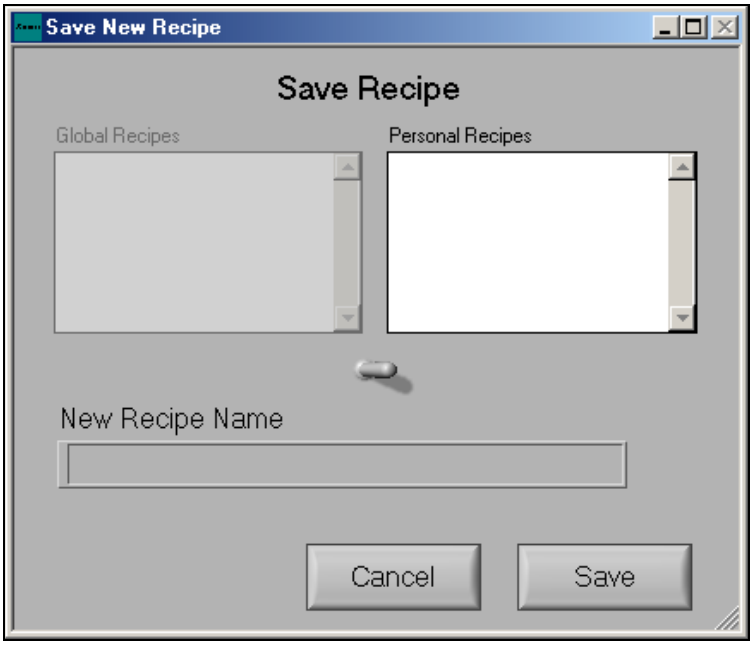
6.2.3 Other Main Menu items

At the bottom left side of the main menu are buttons for changing the user's password and logging out. The log shows all of the operations that have been recently performed. The log can also be useful for accessing the exact start and end times of a run. The "change password" button allows a user to change their password by entering their username and previous password. The log-out button is used to exit the system. A prompt will appear once the button has been pressed inquiring if the user wishes to log out. Once the log out has been completed the system returns to the login screen.

7 Software operation details

7.1 Recipe Storage

To save a recipe, click on the save button located near the top of the “perform etch screen”. The save new recipe screen is pictured below. By using the toggle switch in the middle of the screen users can save the new recipe to their Personal Directory or the accessible to all users Global Recipes directory (the ability to save recipes to the global directory may be turned off for some users as described below).



7.2 Recipe Manager

The recipe manager may be used to copy other users’ recipes, located in their personal directory to the current user’s personal directory. This option is limited to users with configurable etch access. The current user’s personal recipes are displayed in the left box (in this case admin). The personal directory for other users is found in the right box. The pull down bar at the top right can be used to select from the personal recipes of various users. To copy a recipe into the current user’s directory, select the desired recipe and click on the left arrow icon between the two directory windows.

A recipe may also be copied from the user’s personal directory to the global directory (if the user has global write access). This is done by highlighting a recipe in the user’s directory, selecting Global Recipes in the right window and then using the right arrow to copy it to the Global Directory.

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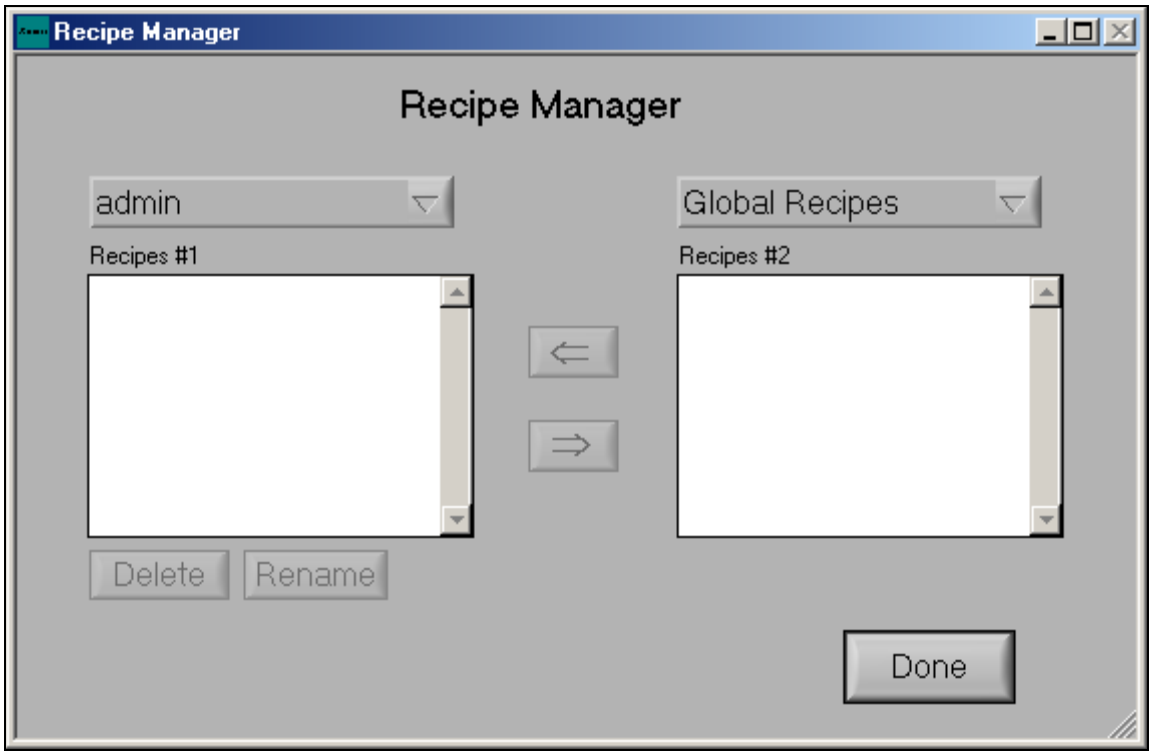


7.3 Performing an Etch

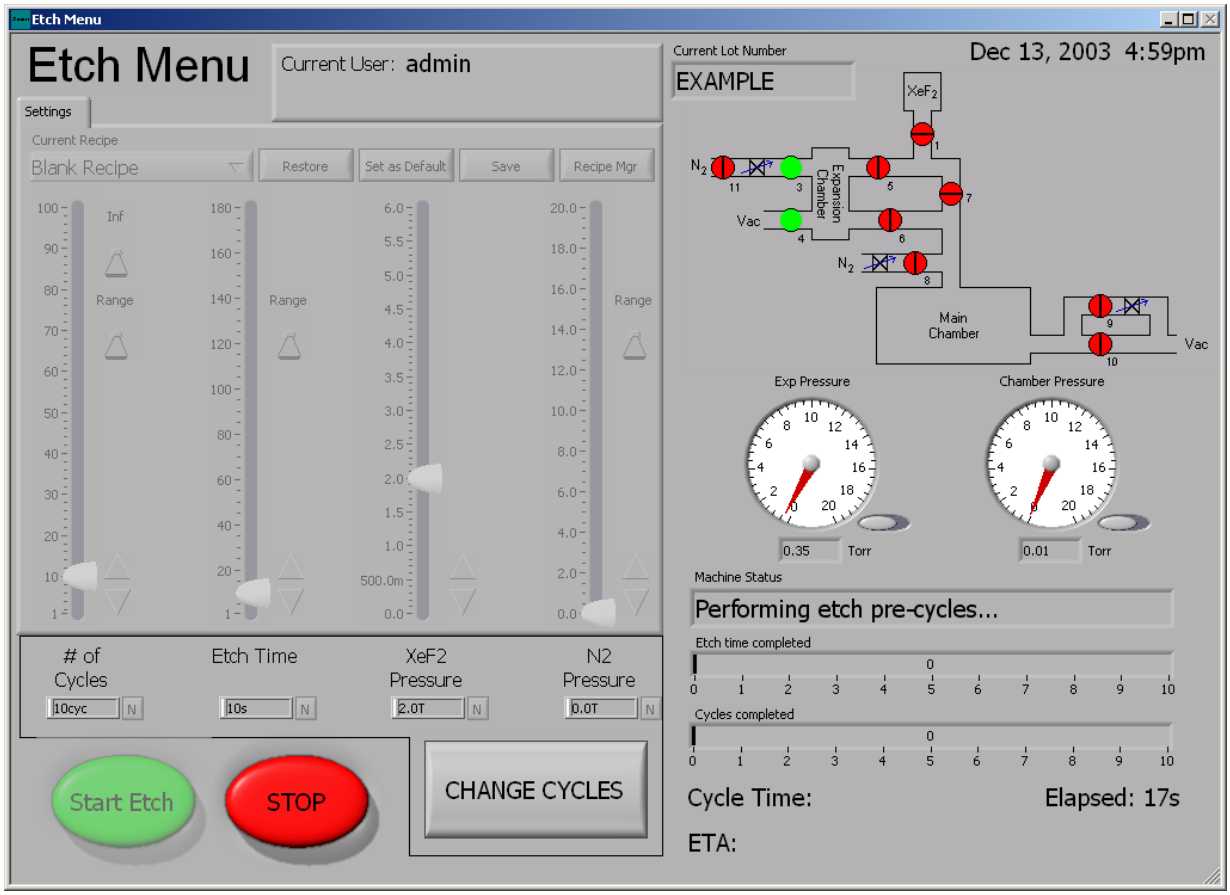
In order to perform an etch, the “perform etch” button in the main menu must be selected. The Xetch will prompt you to enter the lot number of the sample being etched. Press done once number is entered. The “perform etch” screen is shown below with lot number, “EXAMPLE” in this case; the screen pictured is for the normal etch mode.

It is important to note that in the “perform etch” screen, some options may not be available to certain users depending on the privileges which were given during the creation of their account.

The e1 Series software may be run in one of three operating modes that can be used during an etch. Two operating modes (Normal and Normal with Delays) are included with the system. The others are optional upgrades. The etch mode at the bottom middle of the “perform etch” screen can be used to select the etch mode.

- The normal mode, (included at delivery) utilizes a pulsed etch with a set xenon difluoride and nitrogen (if desired) pressure and etch time.
- Normal with delays mode, (included at delivery) utilizes a pulsed etch with a set xenon difluoride and nitrogen (if desired) pressure and etch time but also allows for a chill time for the sample to cool between each cycle.
- An advanced normal etch mode (optional upgrade) allows for the user to set the expansion chamber pump-out pressure between cycles.
- High conductivity etch mode (optional upgrade) is like Normal with delays mode but also adds in a flush of nitrogen between each cycle to quickly cool the sample and also remove effluents.

All modes offer unique advantages; therefore the user must determine which etch mode will be best suited for his/her process. Each of these modes is described in detail in the following pages.



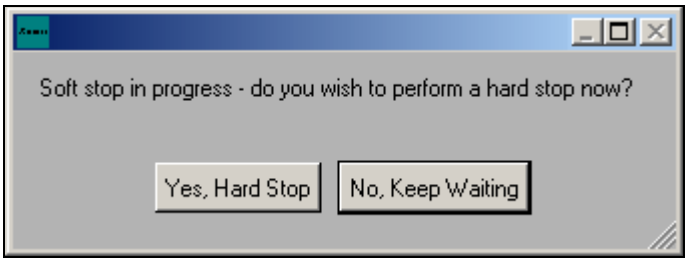
7.4 Etch Menu Features

On the right side of the “perform etch” screen a valve schematic of the e1 Series is shown so that the user can monitor the machine operation.

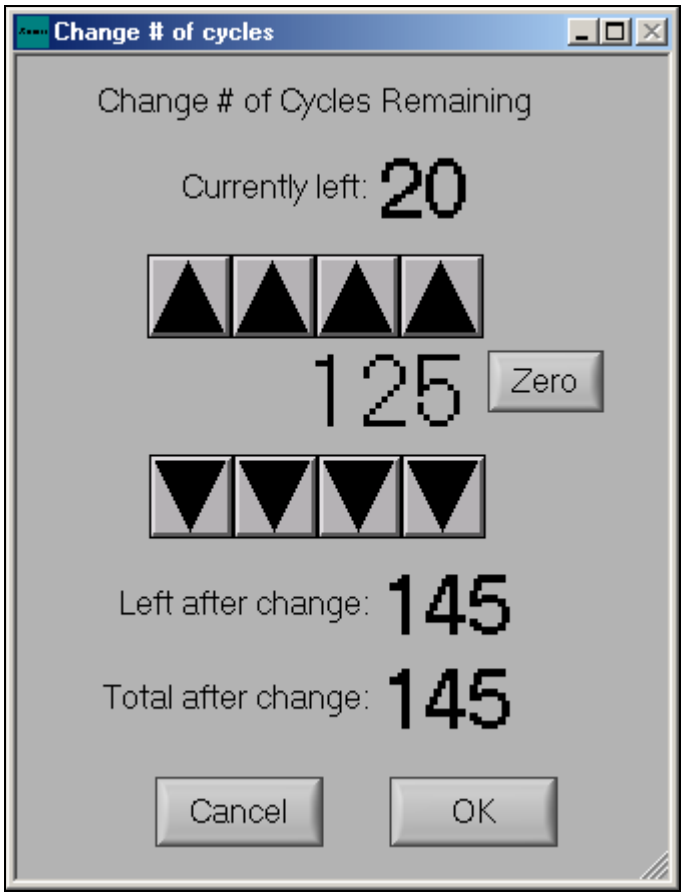
In addition to this, at the bottom of the right side of the screen are two counters. The first counter displays how much time has transpired during the etch portion of the cycle. The second counter shows the number of cycles completed.

At the very bottom of the screen; “START ETCH”, this is used to begin the etching process; “STOP”, this is used to end the etch prematurely; “CHANGE CYCLES” button which at any time during an etch can be used to add cycles to the etch in-progress. Once selected, the “Change # of Cycles” menu on next page, is prompted. The top row of arrows will add cycles in this order, (right to left); ones, tens, hundreds, and thousands; the lower row of arrows, having the same values, will remove cycles. All the user has to do is click on the designated arrow for the desired number of cycles needed to be added to the etch in-progress. For an example, an extra 125 cycles have been added to the etch by clicking the right most arrow (ones) five times, the next right most arrow (tens) twice, and the 2nd from left most arrow (hundreds) once.

NOTE*: *The “CHANGE CYCLES” button will only appear on the etch screen, if the etch parameter “Soft Stop” is set to “TRUE”, and only once etching has been started.



If “Soft Stop” is made “TRUE” in the “Etch Parameters” menu, the Xetch will allow the current cycle to finish before ending the entire etch. If the “STOP” button is pressed twice, the Xetch will prompt the above menu (See also “Soft Stop” on page 80). Choosing “Yes, Hard Stop” will end the etch cycle immediately and return the user to the main menu. If “No, Keep Waiting” is chosen only the current cycle will be completed before returning the user to the main menu.



At the bottom of the screen there is a figure labeled ETA. This feature displays the expected completion time. The ETA is continuously updated during the process run.

Once the desired recipe settings have been chosen then etching can be initiated. By pressing the “Start Etch” button at the bottom left, the set values are stored and used to complete the desired etching sequence. At this point all of the controls will be disabled except for the stop button.

At the bottom left side of the main menu are buttons for viewing the e1 Series Log, changing the user's password, and logging out.

The log shows all of the operations that have been recently performed. The log can also be useful for accessing etch information, such as the exact start and end times of a run.

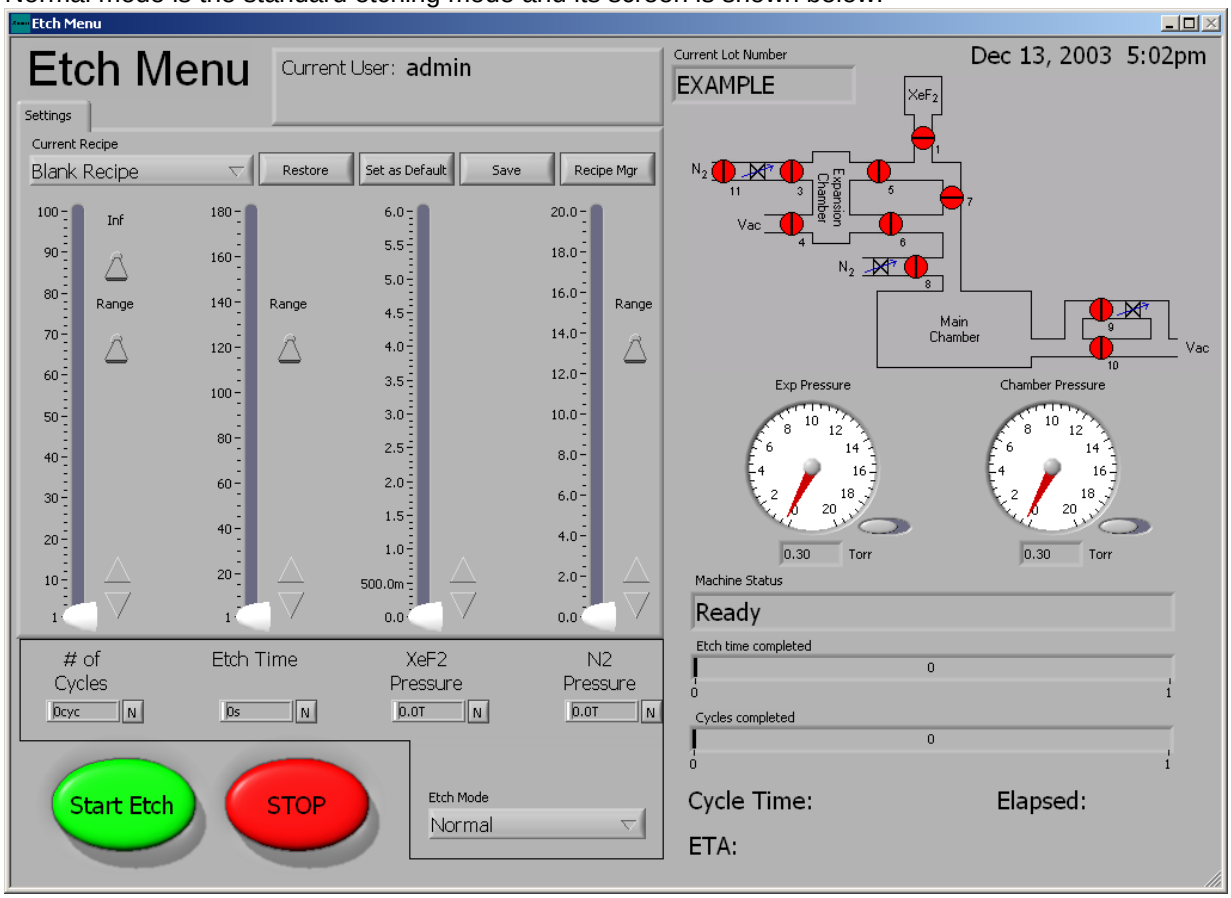
The change password button allows a user to change their password by entering their username and previous password.

The log out button is used to exit the system. A prompt will appear once the button has been pressed inquiring if the user wishes to log out. Once the log out has been completed the system returns to the login screen.

Parameters for the etching modes can be set by adjusting the sliders, tapping the up and down arrows, or direct entry by pressing the N button. Also, many parameters have a range button that allows the sliders to span a wider range of values if needed.

7.5 Performing an Etch in the Normal Mode

Normal mode is the standard etching mode and its screen is shown below:



7.5.1 Normal Mode Etching Variables

Number of cycles

Since the e1 Series is primarily a pulsed xenon difluoride etching system, the duration of etching is controlled by the number of cycles. A cycle consists of the xenon difluoride sublimating to the set pressure in the expansion chamber, etching for a set amount of time and evacuation of the main chamber and expansion chamber.

Etch Time

When the valve between the main chamber and expansion chamber is opened the pressure equilibrates and the etching process begins. The etch time is the time between the opening of the valve between the expansion chamber and the process chamber and the opening of the valve between the process chamber and the pump.

XeF_2 Pressure

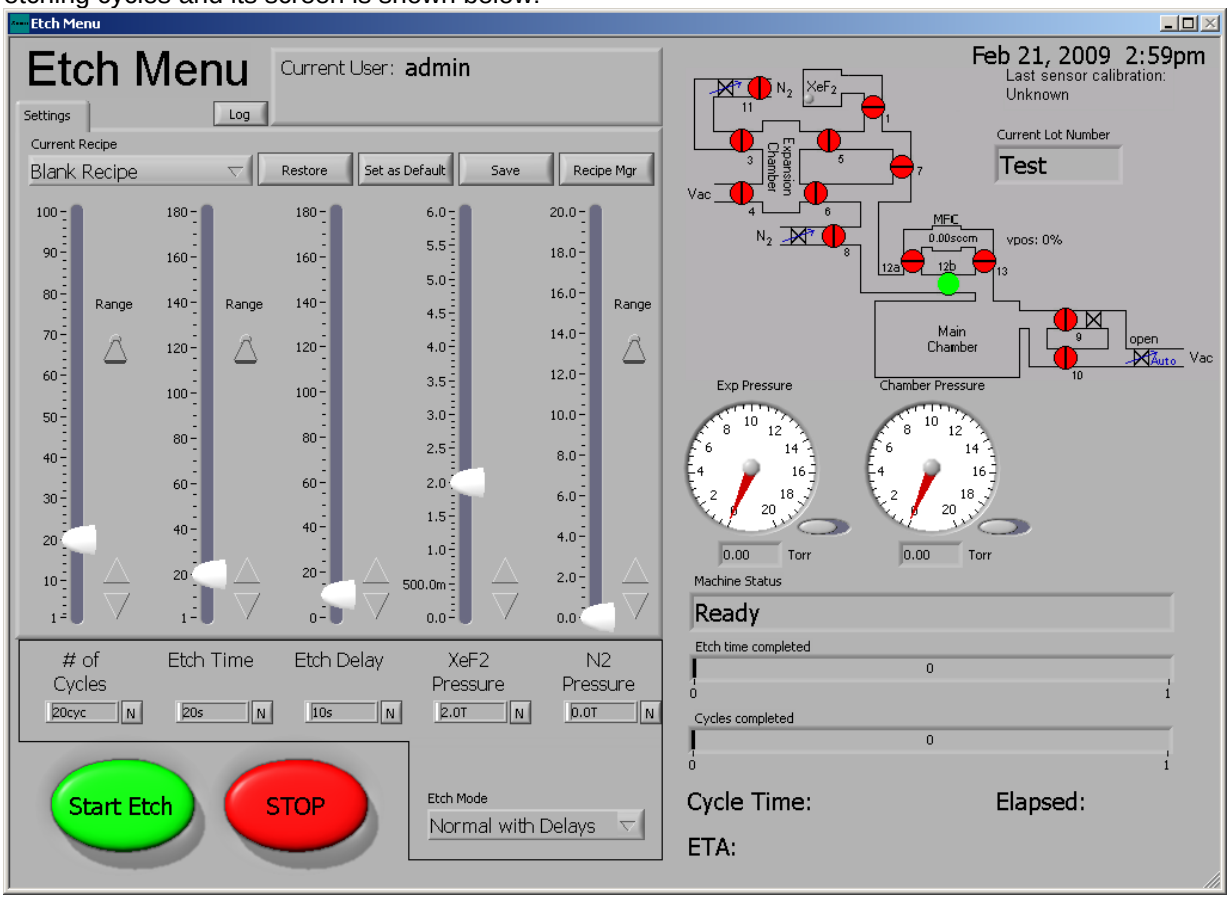
In order to introduce the proper amount of xenon difluoride into the main chamber a set pressure charge of xenon difluoride must be delivered to the expansion chamber. Because xenon difluoride has a vapor pressure of ~4T at room temperature the upper limit for the XeF_2 pressure is approximately 4T. Due to the slightly elevated temperature inside of the etcher cabinet, you may be able to get considerably higher XeF_2 pressures, however.

N_2 Pressure

Nitrogen can be added into a recipe to improve selectivity. The pressure obtained in the expansion chamber likewise controls the amount of nitrogen introduced into the process chamber.

7.6 Performing an Etch in the Normal with Delays Mode

An additional etch mode included with the system is Normal with Delays which allows for a pause between etching cycles. This pause is intended to allow the sample being etched to cool between etching cycles and its screen is shown below:



7.6.1 Normal with Delays Mode Etching Variables

Number of cycles

Since the e1 Series is primarily a pulsed xenon difluoride etching system, the duration of etching is controlled by the number of cycles. A cycle consists of the xenon difluoride sublimating to the set pressure in the expansion chamber, etching for a set amount of time and evacuation of the main chamber and expansion chamber.

Etch Time

When the valve between the main chamber and expansion chamber is opened the pressure equilibrates and the etching process begins. The etch time is the time between the opening of the valve between the expansion chamber and the process chamber and the opening of the valve between the process chamber and the pump.

Etch Delay

The etch delay is the time in seconds that the system waits before beginning the next etching cycle.

XeF_2 Pressure

In order to introduce the proper amount of xenon difluoride into the main chamber a set pressure charge of xenon difluoride must be delivered to the expansion chamber. Because xenon difluoride has

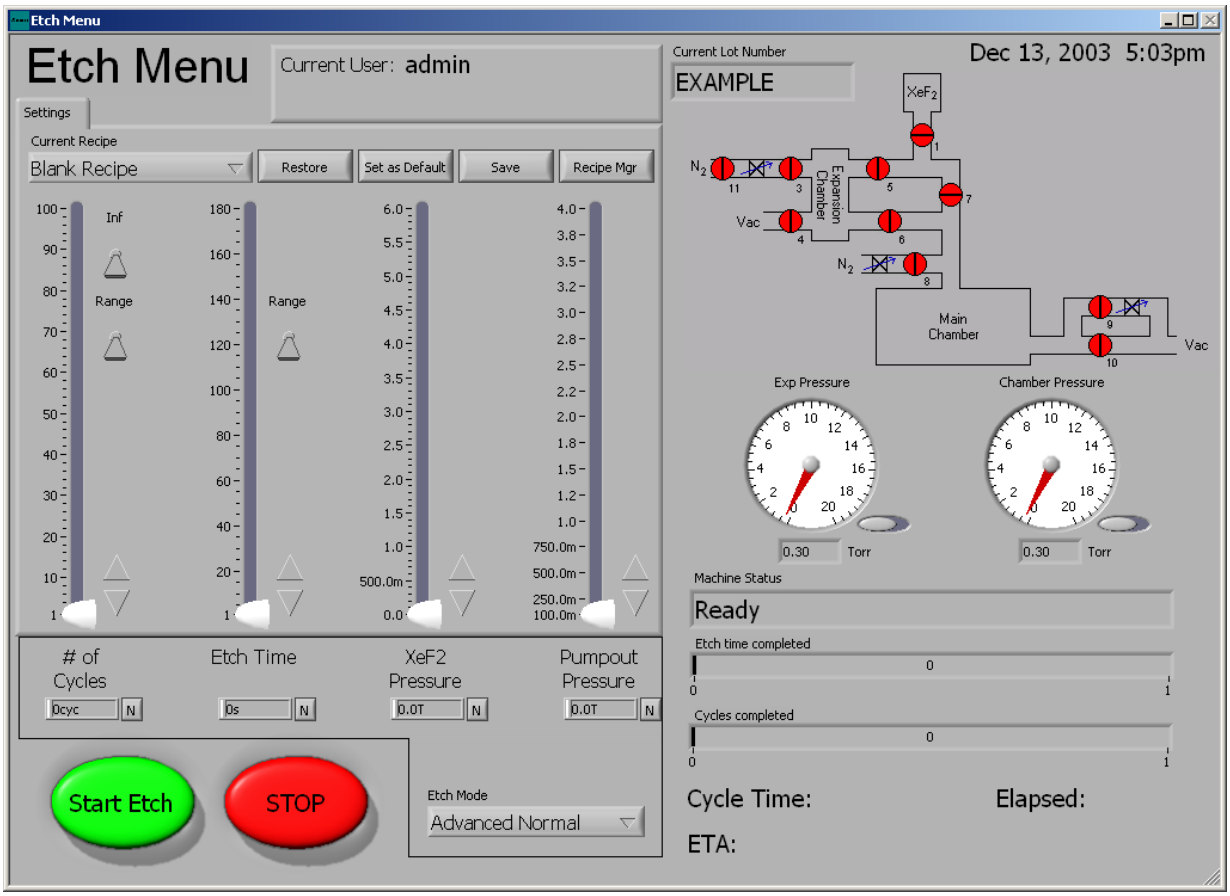
a vapor pressure of ~4T at room temperature the upper limit for the XeF_2 pressure is approximately 4T. Due to the slightly elevated temperature inside of the etcher cabinet, you may be able to get considerably higher XeF_2 pressures, however.

N_2 Pressure

Nitrogen can be added into a recipe to improve selectivity. The pressure obtained in the expansion chamber likewise controls the amount of nitrogen introduced into the process chamber. The above variables can be set either by moving the white slider on the scroll bar or by tapping or depressing on the arrows at the top and bottom of the scroll bar to increment each value or by direct entry through the keyboard.

7.7 Performing an Etch in the Advanced Normal Mode

The operation of the e1 Series in the advanced normal mode (optional upgrade) is similar to the normal mode; however in the advanced mode, which is a XeF2 only process, the user can set the pump-down pressure in the expansion chamber. The advanced normal mode allows for full optimization around the etch rate and cycle time leading to a higher throughput and its screen is shown below:



7.7.1 Advanced Normal Mode Etching Variables

Number of cycles

Since the e1 Series is primarily a pulsed xenon difluoride etching system, the duration of the etch is controlled by the number of cycles. A cycle consists of the xenon difluoride sublimating to the set pressure in the expansion chamber, etching for a set amount of time and evacuation of the main chamber and expansion chamber. Note that there is a range button which changes the slider range for selecting larger numbers.

Etch Time

When the valve between the main chamber and expansion chamber is opened the pressure equilibrates and the etching process begins. The etch time is the time between the opening of the valve between the expansion chamber and the process chamber and the opening of the valve between the process chamber and the pump. Note that there is a range button which changes the slider range for selecting larger numbers.

XeF_2 Pressure

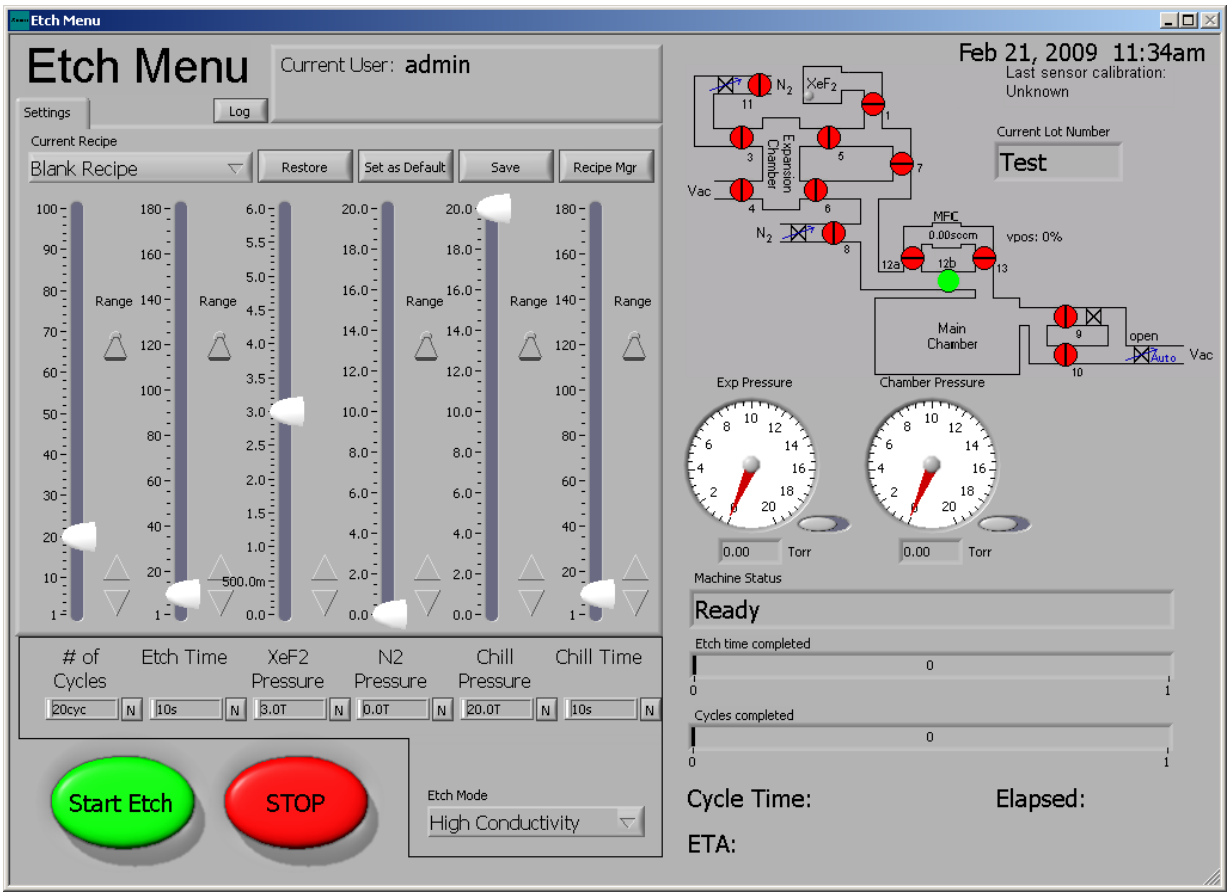
In order to introduce the proper amount of xenon difluoride into the main chamber a set pressure change of xenon difluoride must be delivered to the expansion chamber. Because xenon difluoride has a vapor pressure of ~4T at room temperature the upper limit for the XeF_2 pressure is approximately 4T. Due to the slightly elevated temperature inside of the etcher cabinet, you may be able to get considerably higher XeF2 pressures.

Pump-out Pressure

The pump-out pressure allows the user to set the pressure to which the process and expansion chambers are pumped down to during the evacuation portion of the cycle. The above variables can be set either by moving the white slider on the scroll bar or by tapping or depressing on the arrows at the top and bottom of the scroll bar to increment each value.

7.8 Performing an Etch in the High Conductivity Mode

The operation of the e1 Series in the high conductivity mode (optional upgrade) is similar to the normal mode; however in the high conductivity mode, there is the ability to flush the chamber between each cycle with nitrogen. This flush cools the sample and also helps to flush effluents through the chamber which often help improve etching selectivity and its screen is shown below:



7.8.1 High Conductivity Mode Etching Variables

Number of cycles

Since the e1 Series is primarily a pulsed xenon difluoride etching system, the duration of the etch is controlled by the number of cycles. A cycle consists of the xenon difluoride sublimating to the set pressure in the expansion chamber, etching for a set amount of time and evacuation of the main chamber and expansion chamber. Note that there is a range button which changes the slider range for selecting larger numbers.

Etch Time

When the valve between the main chamber and expansion chamber is opened the pressure equilibrates and the etching process begins. The etch time is the time between the opening of the valve between the expansion chamber and the process chamber and the opening of the valve between the process chamber and the pump. Note that there is a range button which changes the slider range for selecting larger numbers.

XeF_2 Pressure

In order to introduce the proper amount of xenon difluoride into the main chamber a set pressure change of xenon difluoride must be delivered to the expansion chamber. Because xenon difluoride has

a vapor pressure of ~4T at room temperature the upper limit for the XeF_2 pressure is approximately 4T. Due to the slightly elevated temperature inside of the etcher cabinet, you may be able to get considerably higher XeF2 pressures.

N_2 Pressure

Nitrogen can be added into a recipe to improve selectivity. The pressure obtained in the expansion chamber likewise controls the amount of nitrogen introduced into the process chamber.

Chill Pressure

Between each cycle, the Main Chamber can be pressurized with nitrogen which corresponds to the Chill Pressure setting.

Chill Time

The time that the main chamber remains at the Chill Pressure between each cycle is specified by the Chill Time.

7.9 Camera Option

A camera option is available that displays and captures images through the optional system microscope. To enable the use of the microscope, the image from the right eyepiece of the microscope must be diverted to the camera via the switch shown below and must be set in the IN position.

Figure 32. Video selector switch.

The focus of the camera can be adjusted relative to the eyepiece using the knob shown below.

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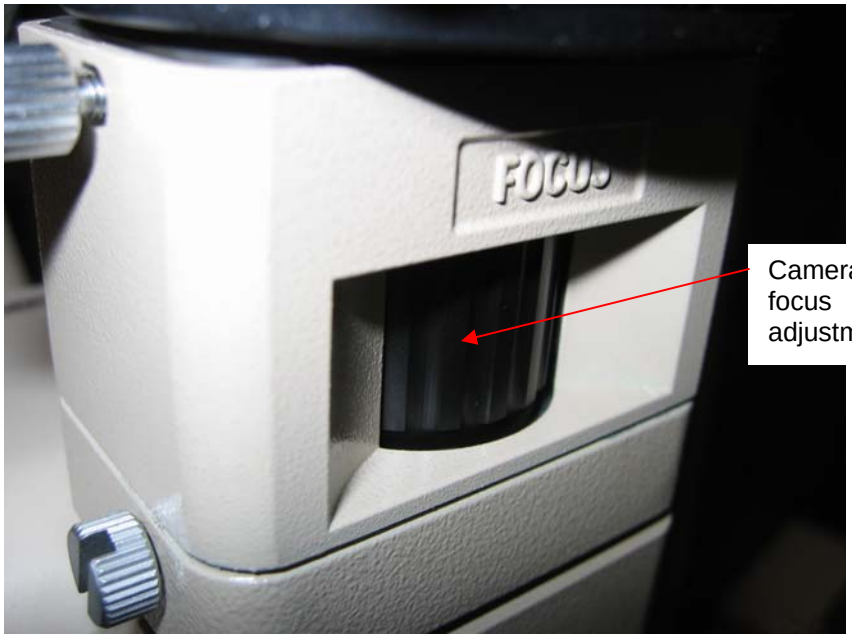
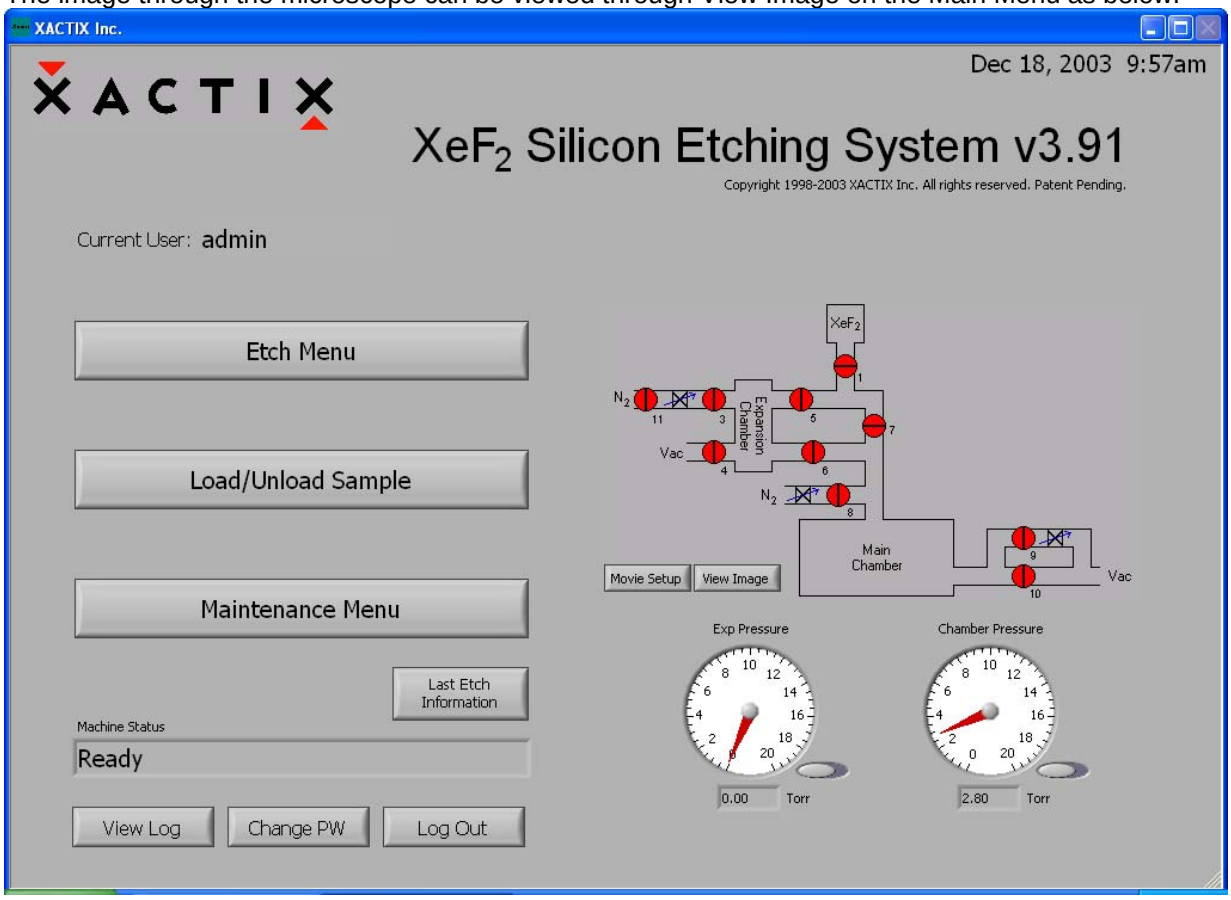
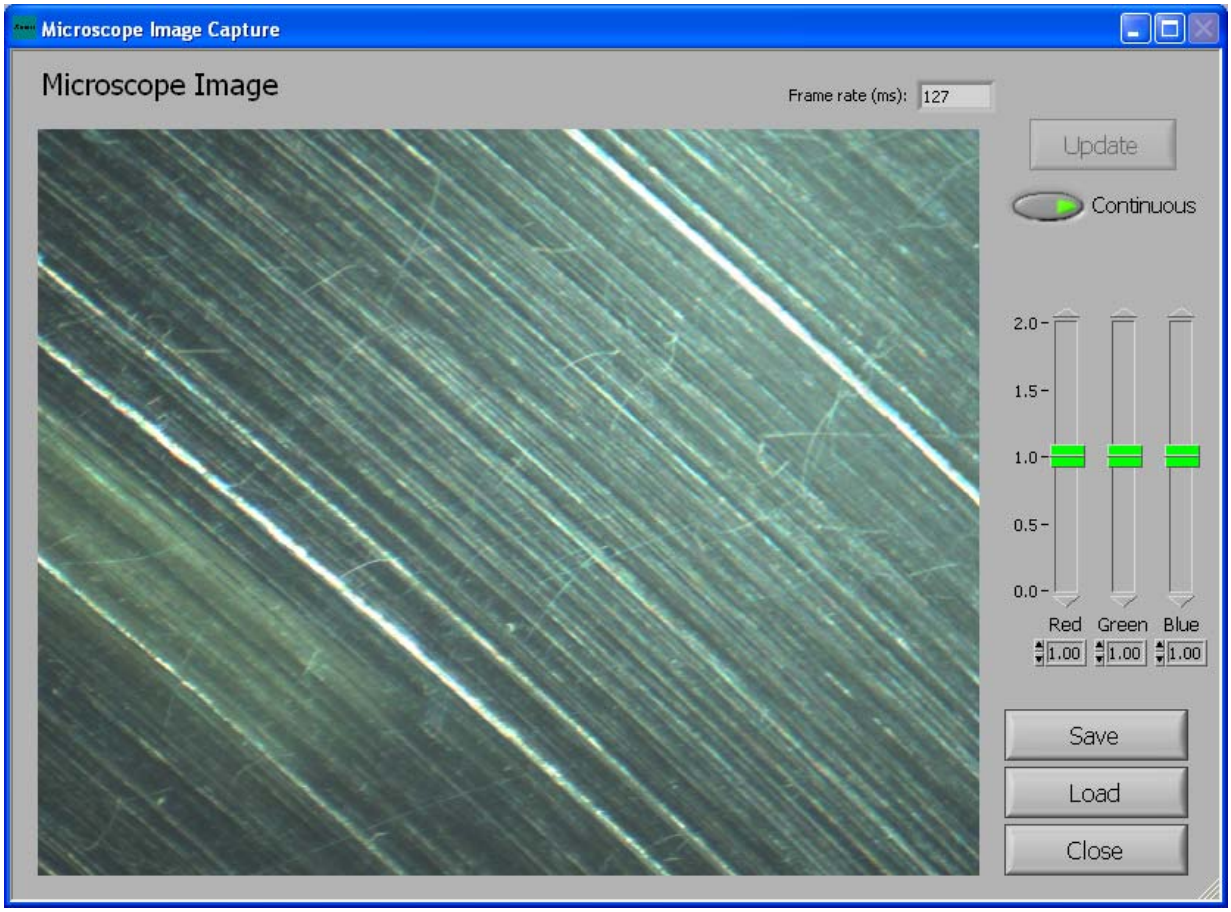


Figure 33. Camera focus knob.

7.9.1 Images

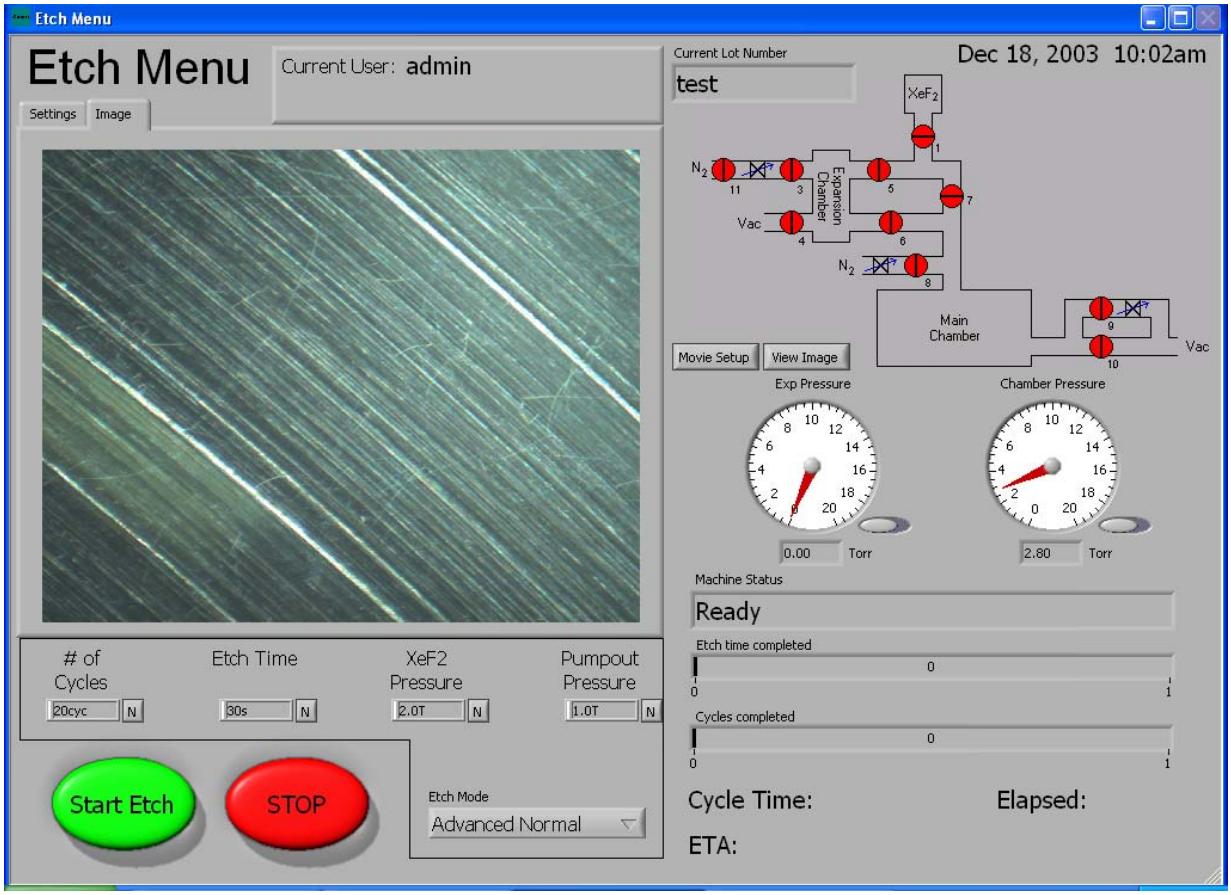
The image through the microscope can be viewed through View Image on the Main Menu as below.





Color adjustments to the image can be made in addition to changing the mode from still to continuous. Images can be saved and loaded through this menu.

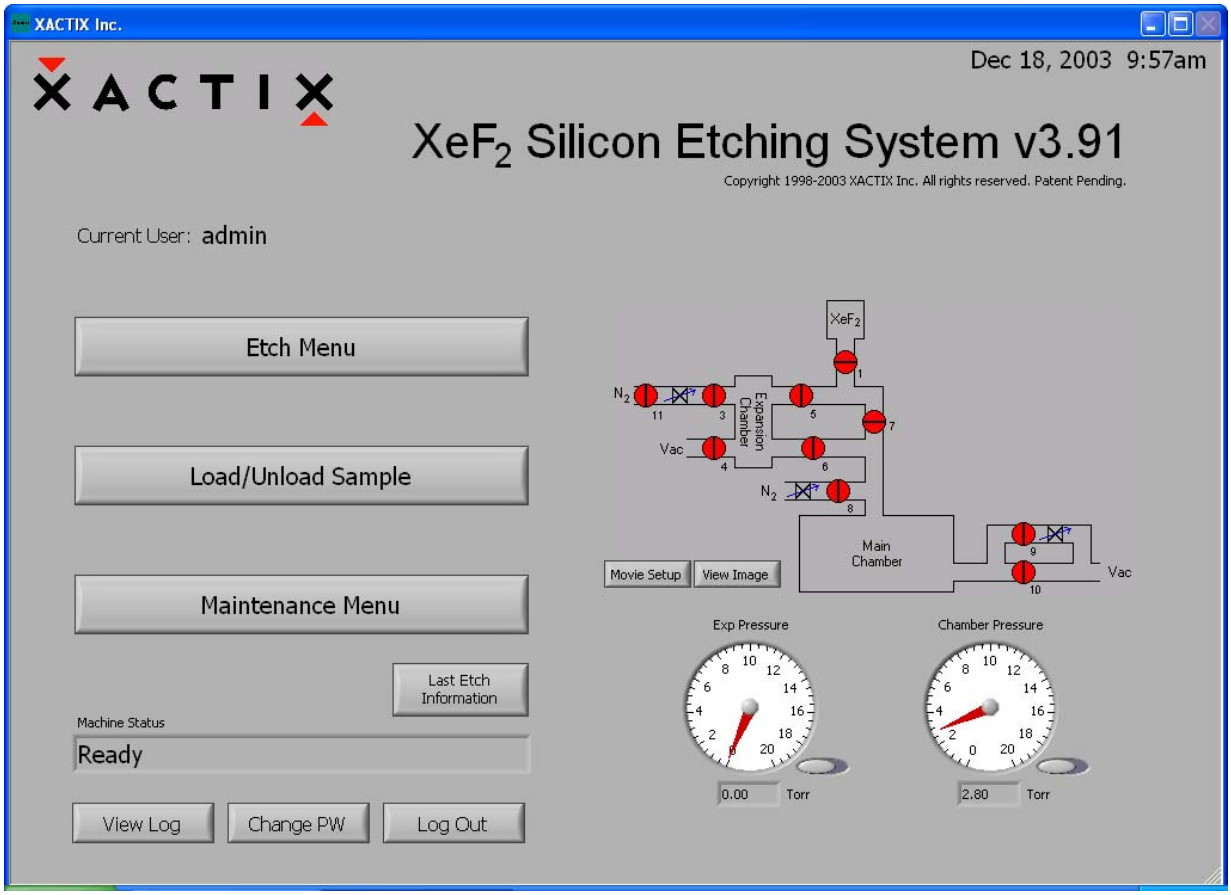
Images can also be seen by toggling the Etch Setting/Image screen to image as below.



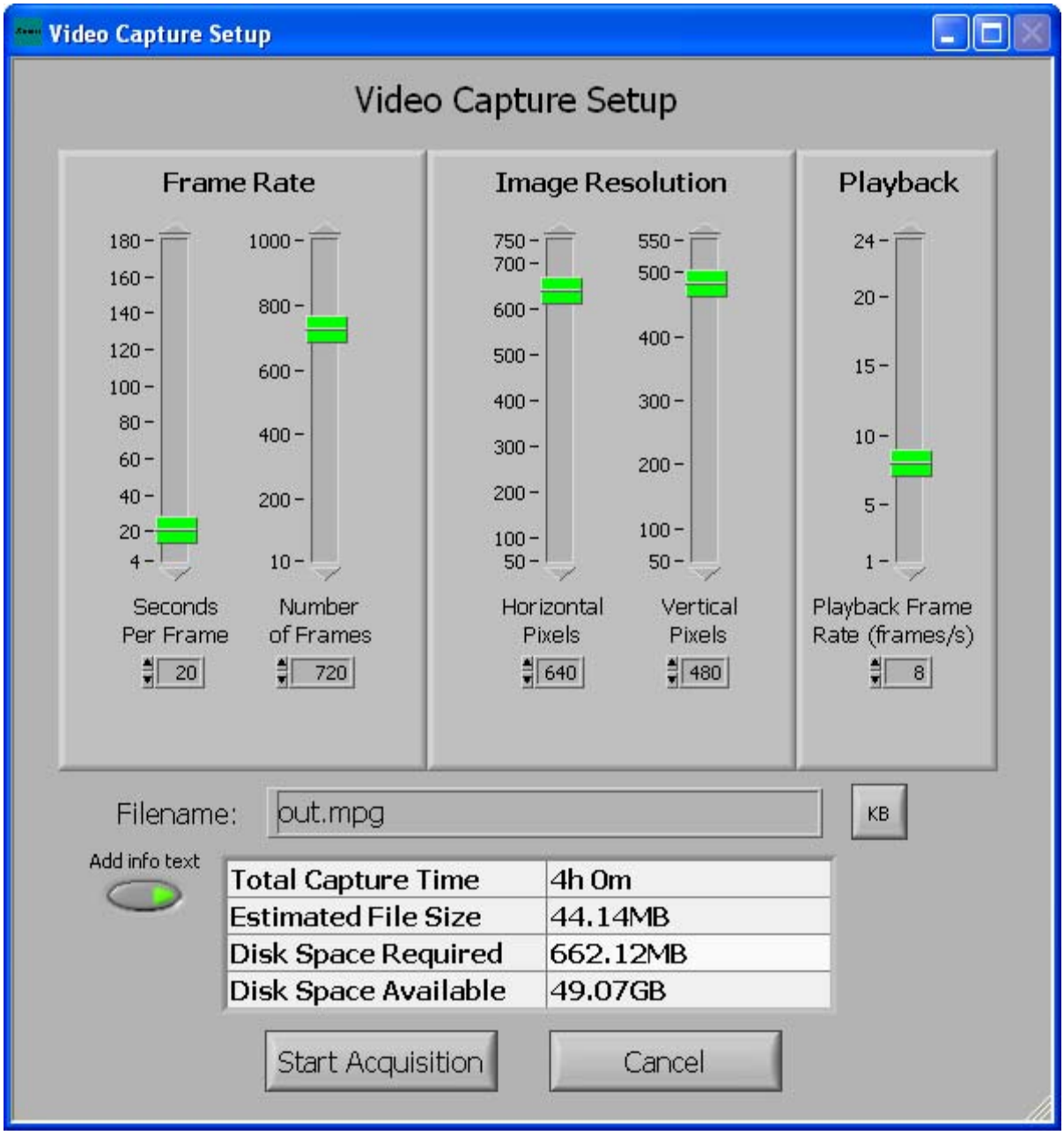
Images can also be seen by pressing View Image on the Etch Menu.

7.9.2 Movies

Movies can be taken with the camera and are set up using the Movie Setup button shown below.

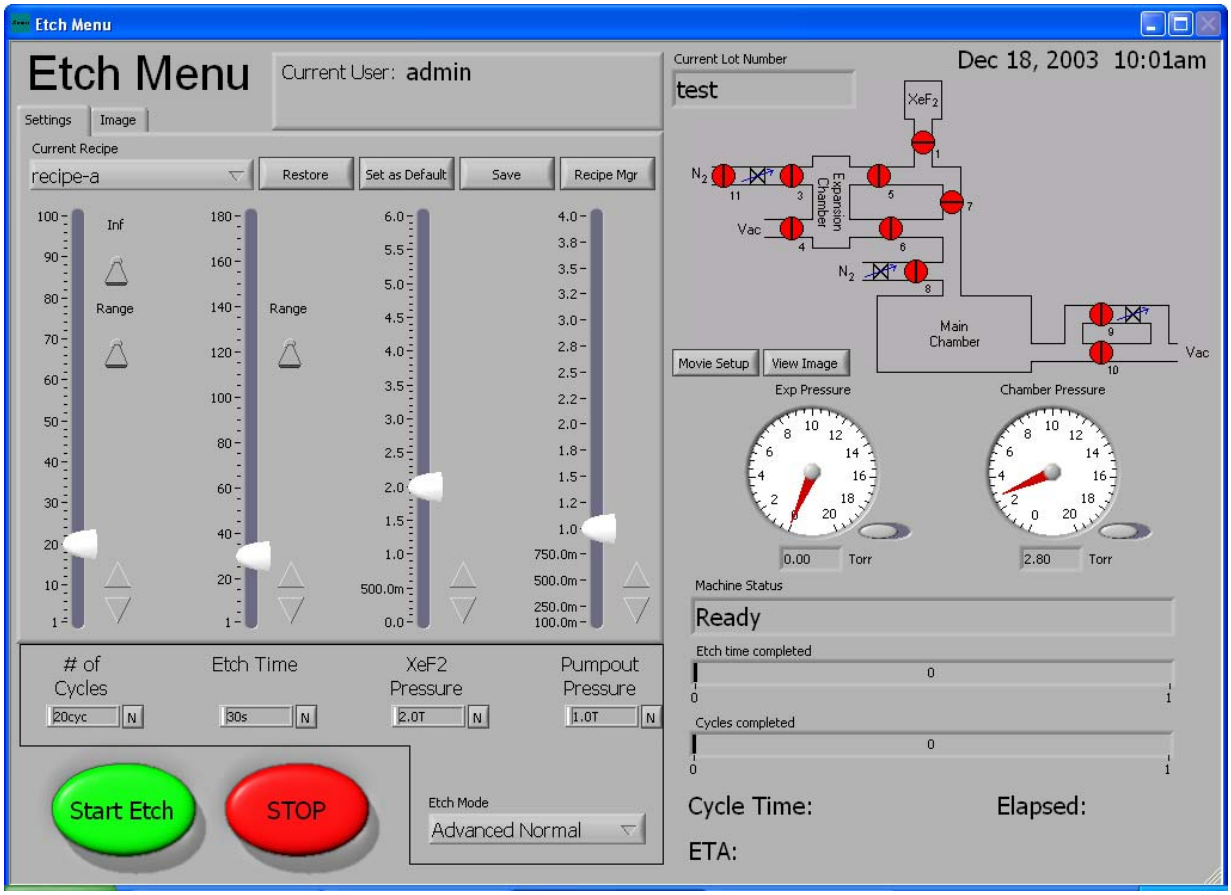


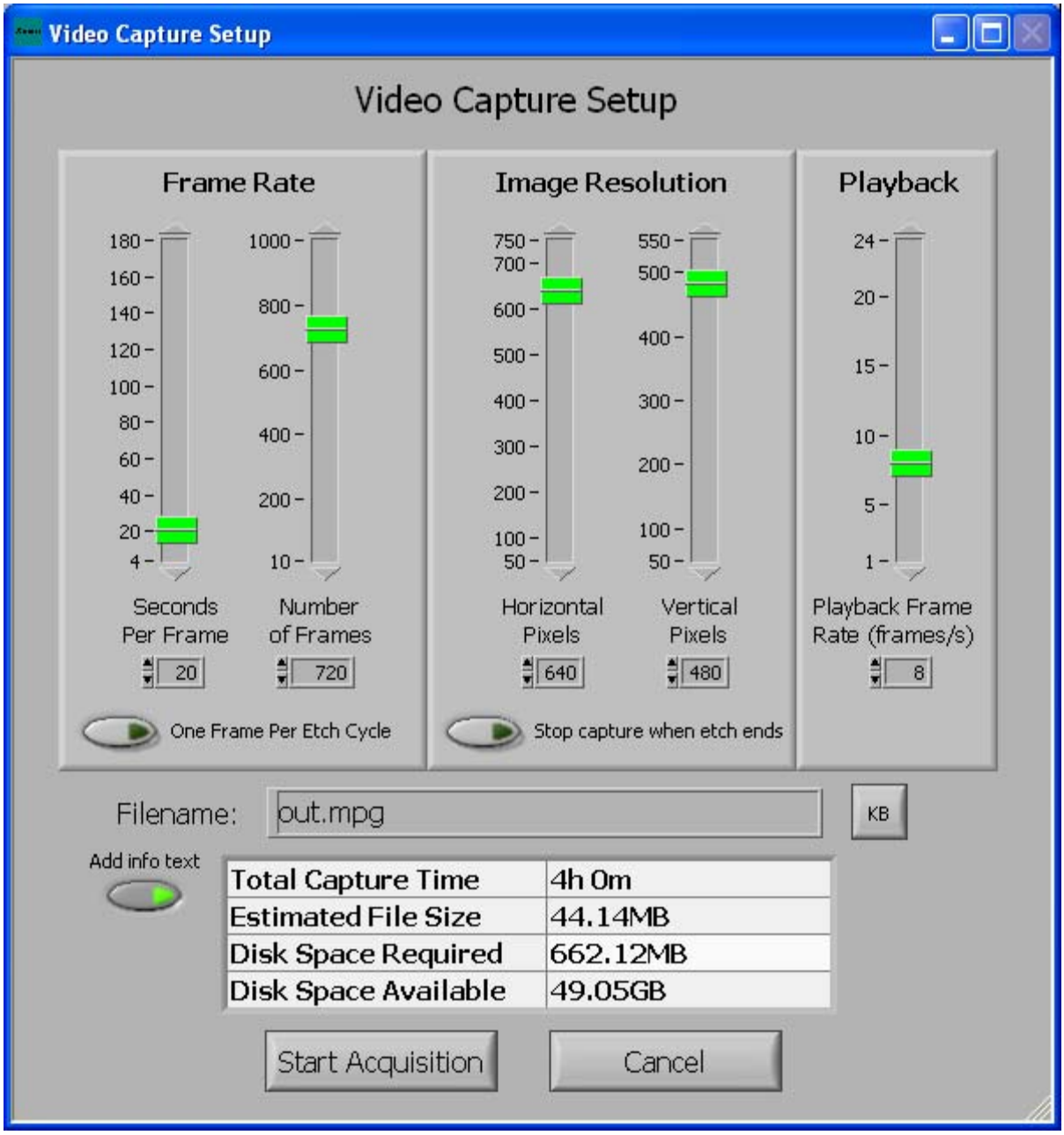
The menu connected with the Movie Setup button is as follows.



This menu allows for setting the result movie parameters including the time a frame is displayed, the total number of frames, the movie resolution, and the playback rate. The resulting movie filename can be set and info text can be added to the movie. Info text indicates the cycle number and etching parameters and is overlayed on top of the movie image. The details of the movie size are also displayed. Pressing start Acquisition begins the movie capture immediately.

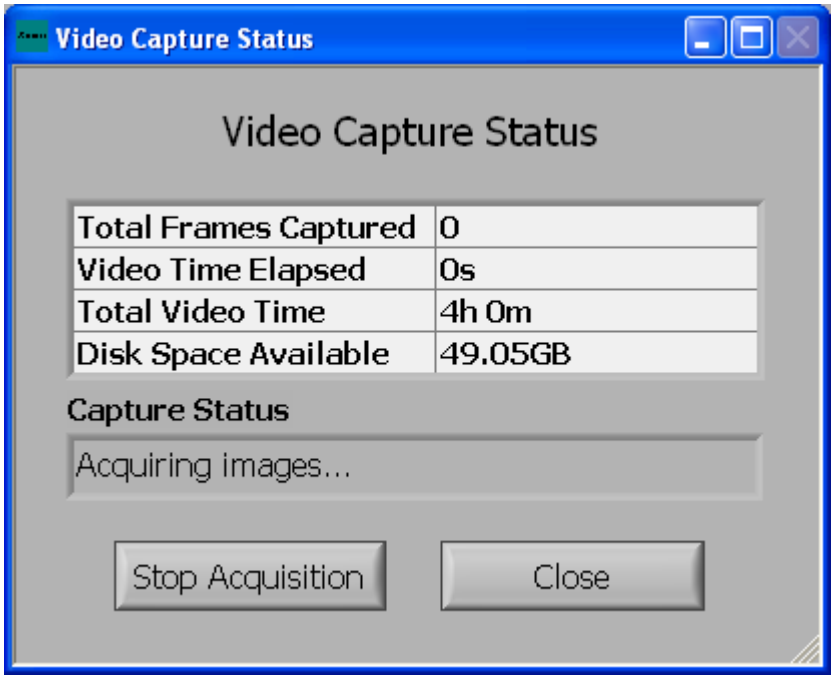
An alternative method of capturing images is found on the etch menu. Pressing Movie Setup brings up a slightly difference menu for setting the capture method.



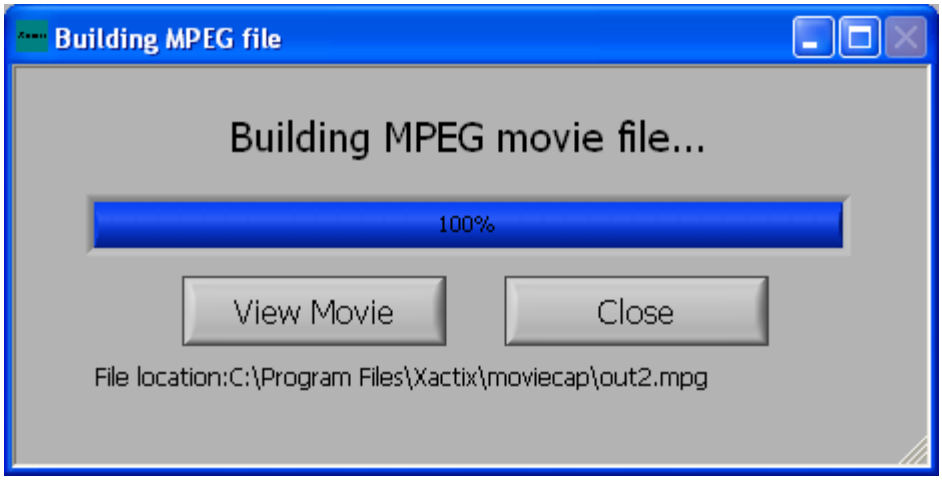


This menu allows the setting of the system to snap images at each etch cycle. Pressing Start Acquisition enables the video creation to start at the beginning of the etch.

The status of the movie is displayed by pressing Movie Status.



At the completion of the movie capture, a box indicating that the movie is being generated is displayed.



Press View Movie to watch the movie and the movie will be displayed.

7.10 Maintenance Menu

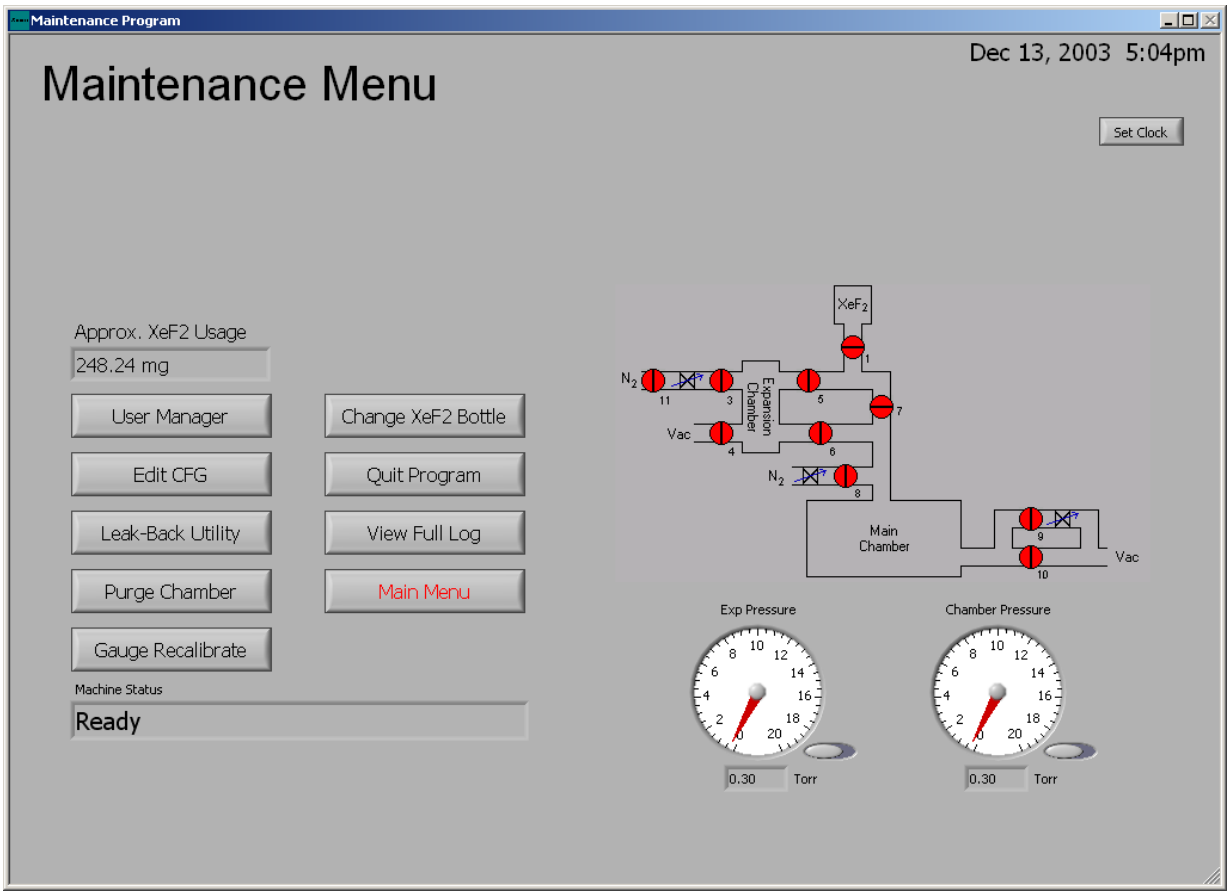
WARNING

MAINTENANCE MODE SHOULD ONLY BE USED BY THOSE INDIVIDUALS WHO UNDERSTAND THE RISKS OF EXPOSURE TO XEF2 AND ARE FULLY TRAINED IN THE USE OF THE MAINTENANCE ACTIVITIES FOR THE SYSTEM.

The Maintenance Menu may be accessed via the “Maintenance Menu” button found on the main menu screen. For users without maintenance privileges the maintenance menu will not be accessible.

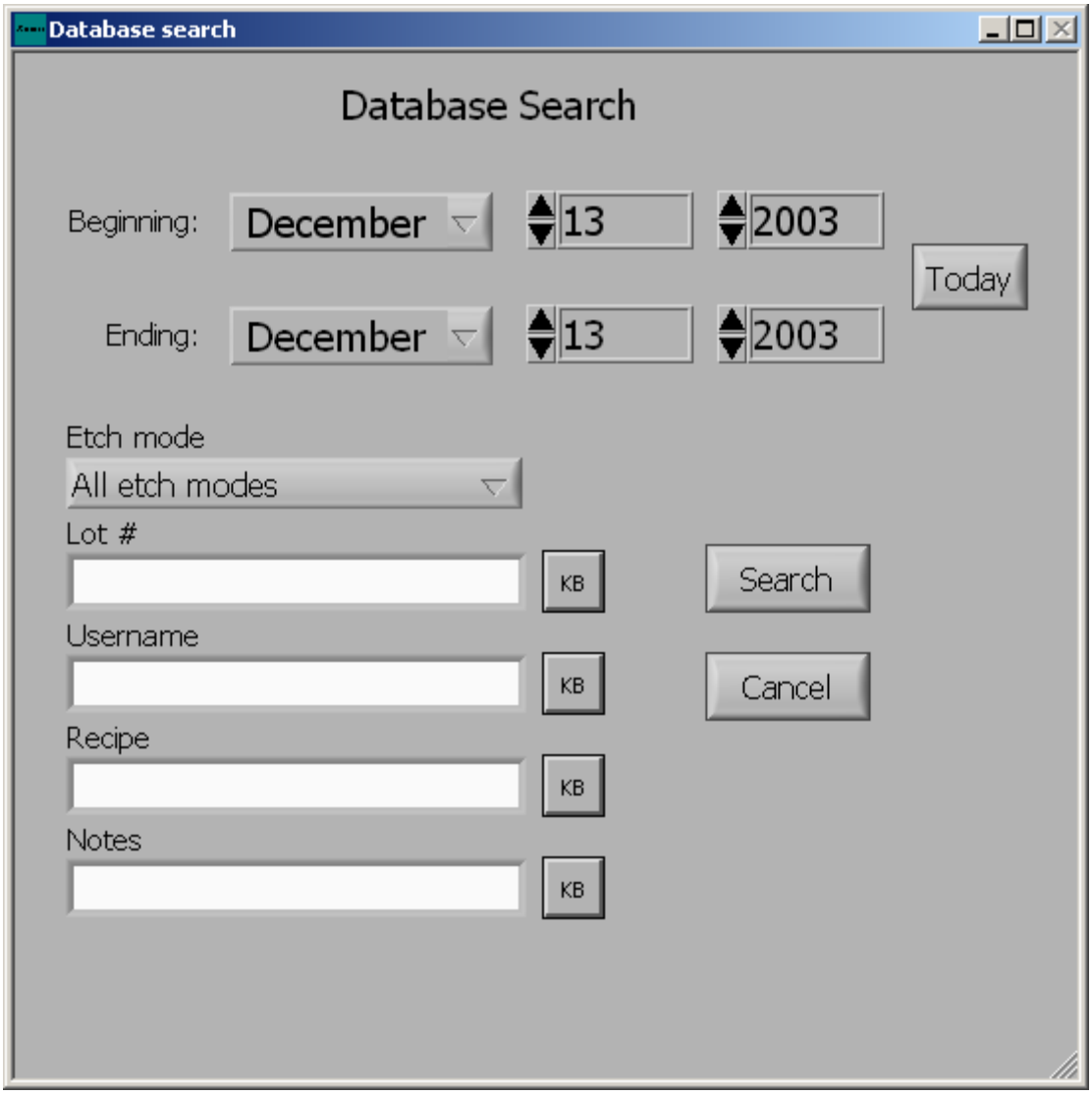
The Maintenance Menu allows for the individual control of the system valves. Clicking on valve icons changes the color between red and green corresponding to closed and open, respectively.

Also, within the maintenance menu there are nine options. These options consist of adding and deleting users, editing the configuration menu, leak-back checking the system, purging the main chamber, gauge recalibrating, changing the xenon difluoride bottles (see page 97), exiting the e1 Series software, viewing the full e1 Series log, and returning to the main menu. Each of these operations will be discussed in the following sections. In addition to the nine options available in the maintenance menu, the approximate amount of xenon difluoride consumed from each bottle is displayed in the middle left section of the screen.



7.10.1 Viewing the Full Log

The full log may be viewed by clicking on the “View Full Log” button within the maintenance menu. The log file is a database that is queried by beginning date and ending date. The “Today”: button will automatically set the dates to the current month, day, and year. The lot number, username, recipe, note’s keyword(s), and/or etching mode used can further specify your search. Wildcard characters (*,?) may be used to fully specify the search criteria.



If the boxes are left blank, clicking the search button will reveal all history info, displayed in a tabular form.

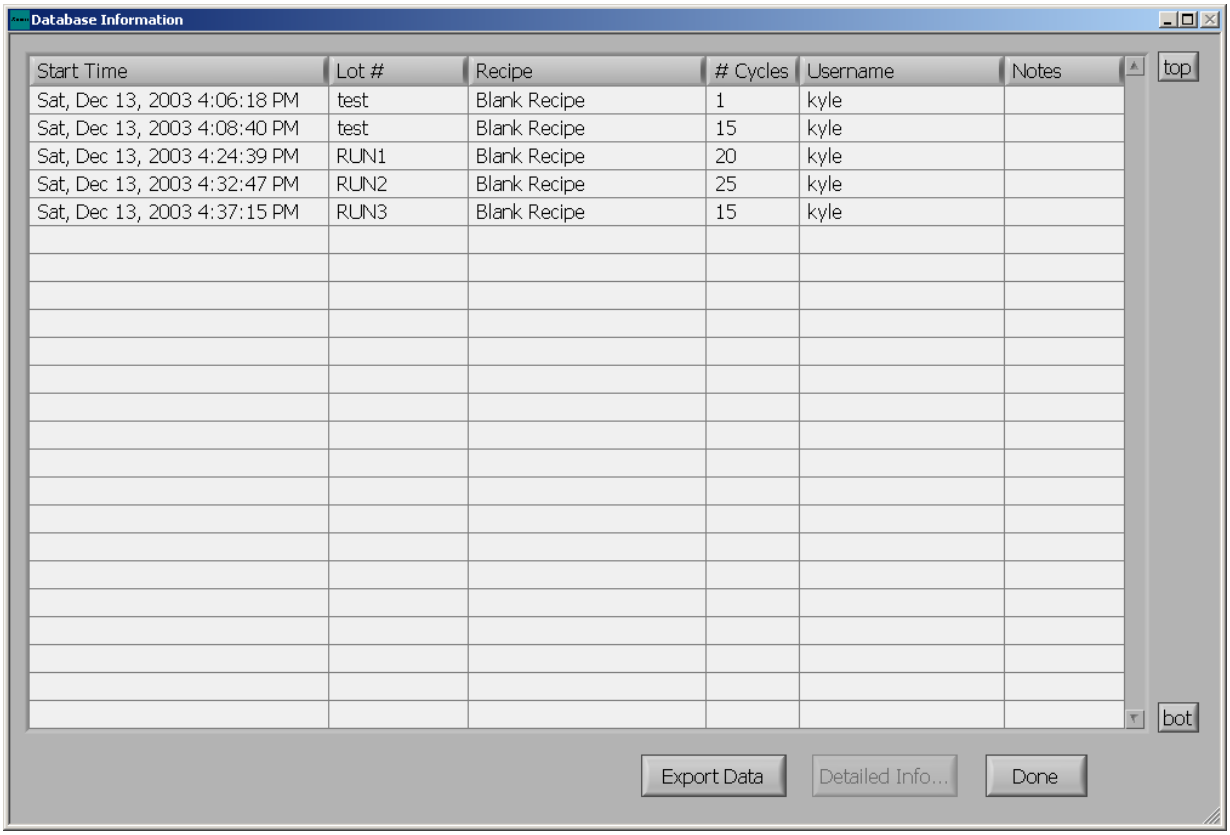
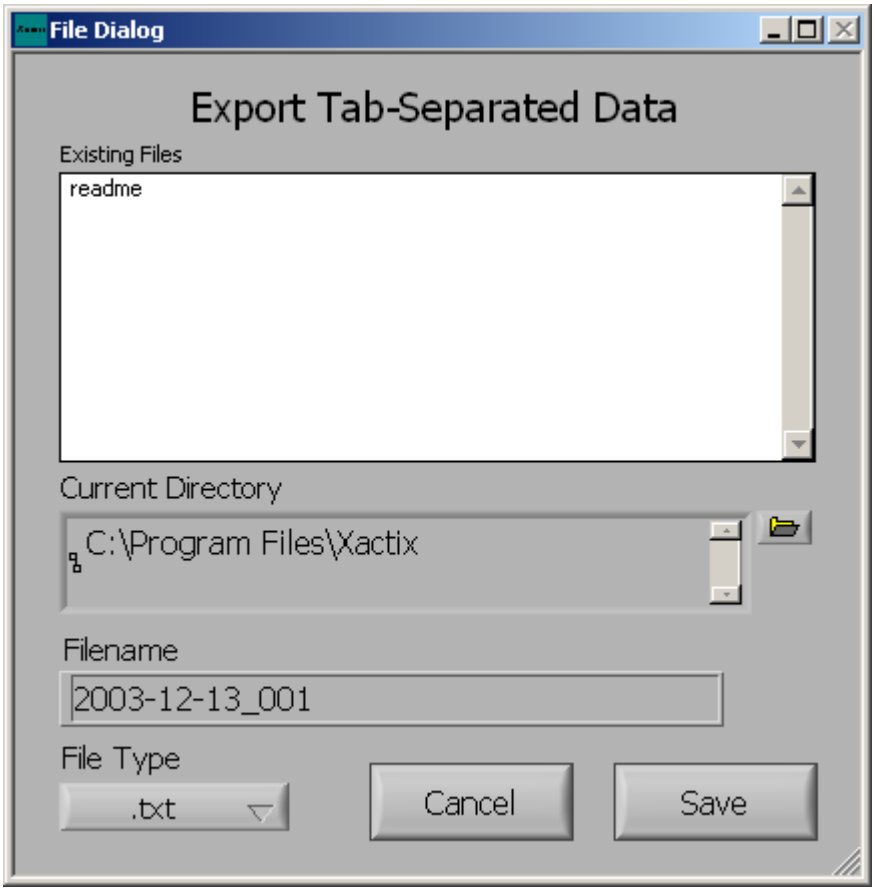
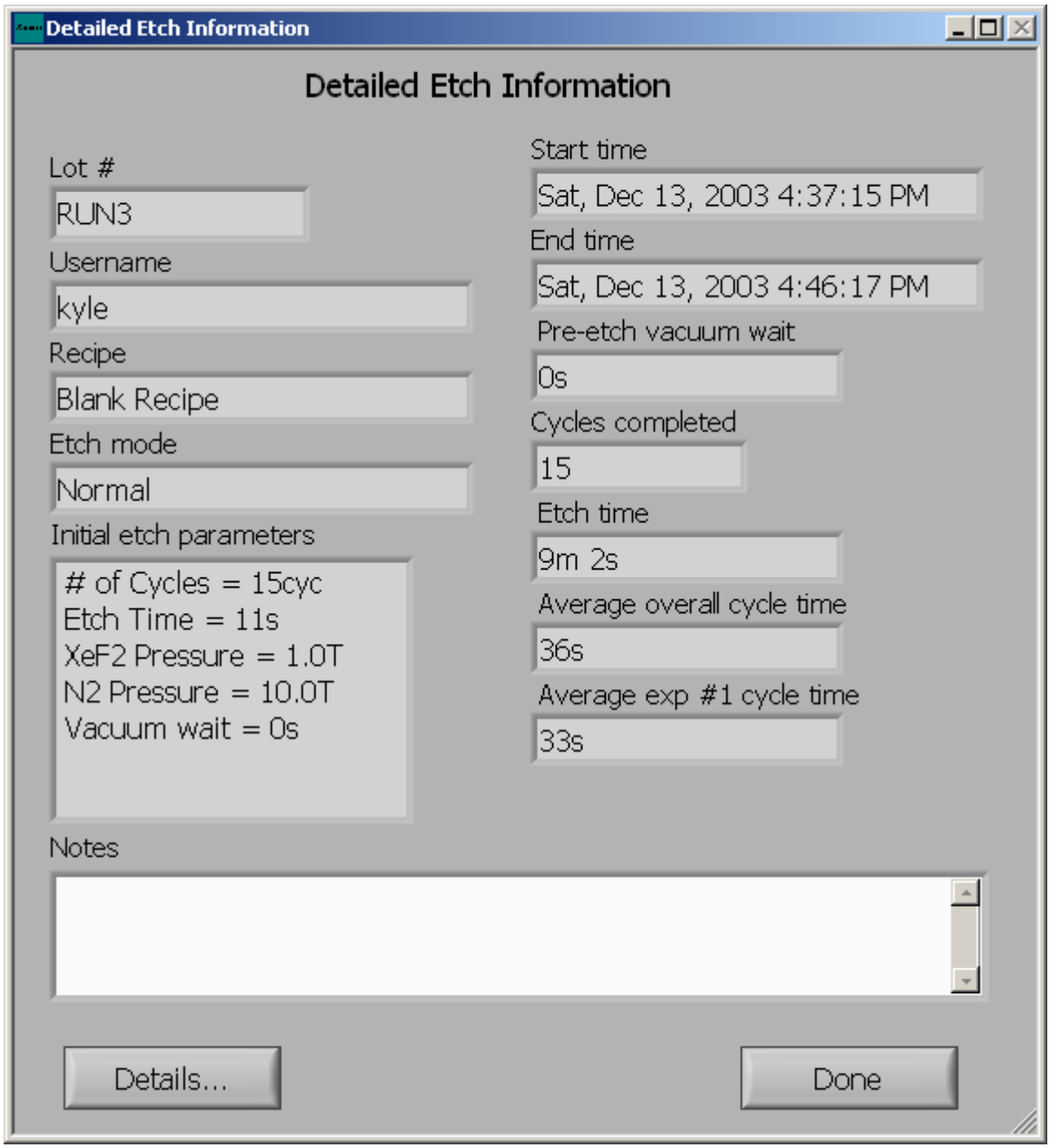


Figure 34. Database Information screen.

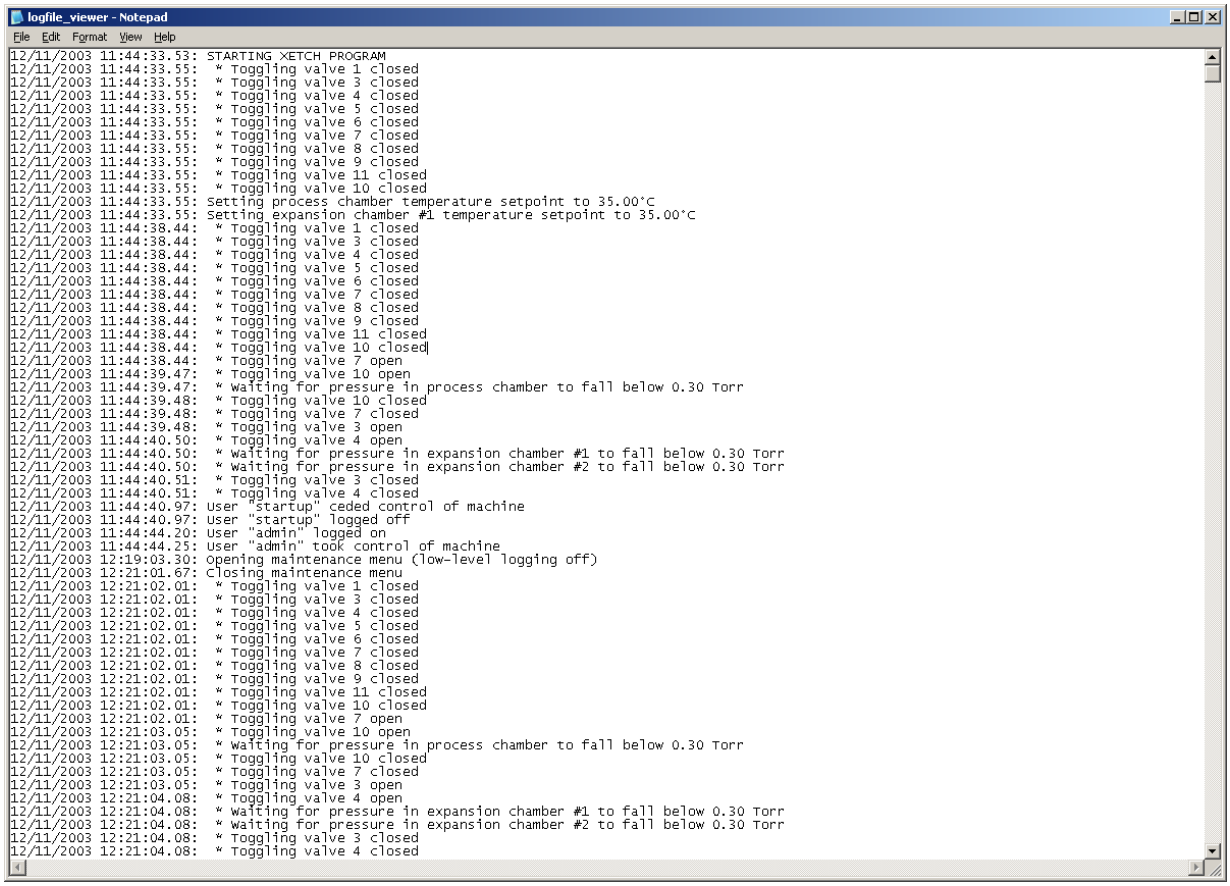
The export data button allows you to export all of the information shown in the table to a tab-separated text file that can be opened in the program of your choice, such as Microsoft Excel, Microsoft Access, and Microsoft Word, as shown below. Choosing a destination folder can be done by clicking on the folders icon at right side of the “File Dialog” screen. A default folder for saving log files and photos may be selected in the “System Configuration Menu”. File names are automatically entered in this form, (2003-12-13_001.txt). This represents the year, month, day, and the number of the export for that day.



Besides being able to export the information, a selection from the displayed in the "database information" screen (see Figure 34), the information for a particular date and time can be accessed by highlighting the row of information desired and clicking the "detailed info" button. Note that the file is automatically scrolled to the bottom of the file, the "Top" or "Bottom" buttons are used to scroll instantly to the top or to the bottom of the log file. The result of the detailed information display is below. One unique feature of this menu is that comments can be typed into the Notes area (however, the number of characters is limited to 250). One other item to note is that the Average Overall Cycle time is not the average of the expansion chamber cycle times, but is computed by dividing the total run time divided by the number of cycles.



For system errors and maintenance related issues, the full log can offer valuable information. To display the details of the full log, click "details" on the "display detailed etch info" screen, shown on next page, to view the log file in its entirety. In the notepad program, the date, time, and actions executed are displayed as shown below. The level of detail included in the details of the full log is controlled by the settings related to the log file in the System Configuration Menu, which is described later.

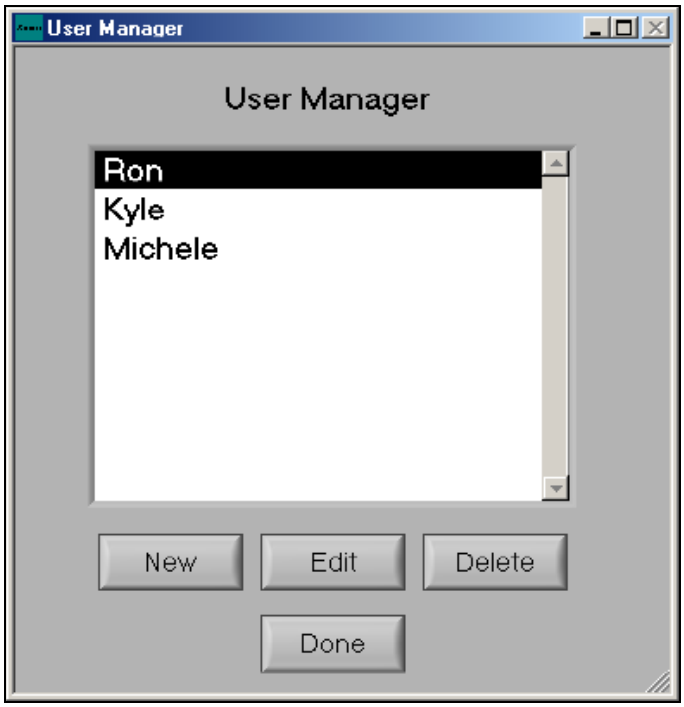


7.10.2 User Manager

The user manager can be used to add, delete and assign privileges to various users.

Only the System Administrator can access the “user manager”.

Users can be added using the “New” button, while current users can be removed using the “Delete” button. To change a user’s privileges the “Edit” button can be used. To exit the User Manager and return to the maintenance menu click on “Done”.



Adding a User

A new user can be added to the system by clicking on the new button within the user manager.

The edit user screen will appear as shown on next page. The name of the user should be entered into the User Name box and a password then entered, if desired. If no password is entered, a reminder message stating that the user has no password will be displayed and if this is OK. The users default recipe can then be selected and the amount of XeF2 can be entered for the user's starting point, if necessary, or is typically left at 0. Later, this value can be examined to show the total quantity of XeF2 used by the user.

Four options (privileges) are available for users.

Maintenance Access gives a user permission to access the maintenance menu thus giving them the ability to execute such functions as changing the machine configuration, changing the xenon difluoride bottle, and viewing the full log.

WARNING

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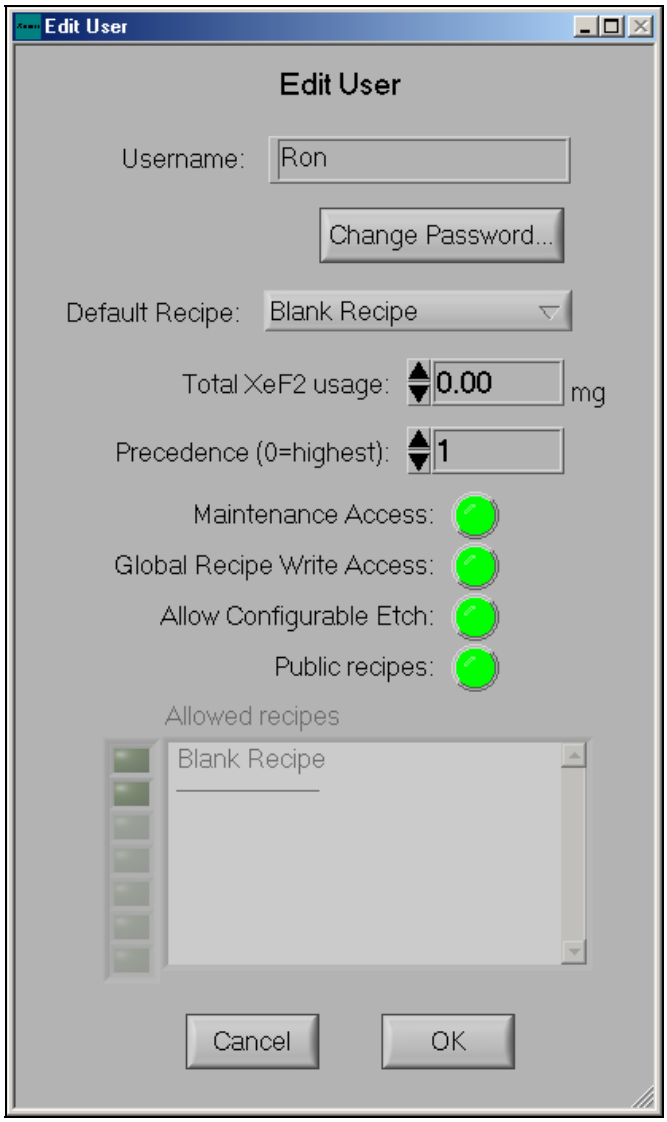
Global Recipe Write Access allows a user to save an etch recipe in the global recipe location so that all other users can select the corresponding etching conditions. This also means that the user could potentially alter the recipes in the global recipe area.

Allow Configurable Etch gives the user the ability to create their own recipe and save it in their file. If none of these options are selected the user may only use the default recipe assigned to them.

Public recipes allows the recipes of the user to be visible to other users.

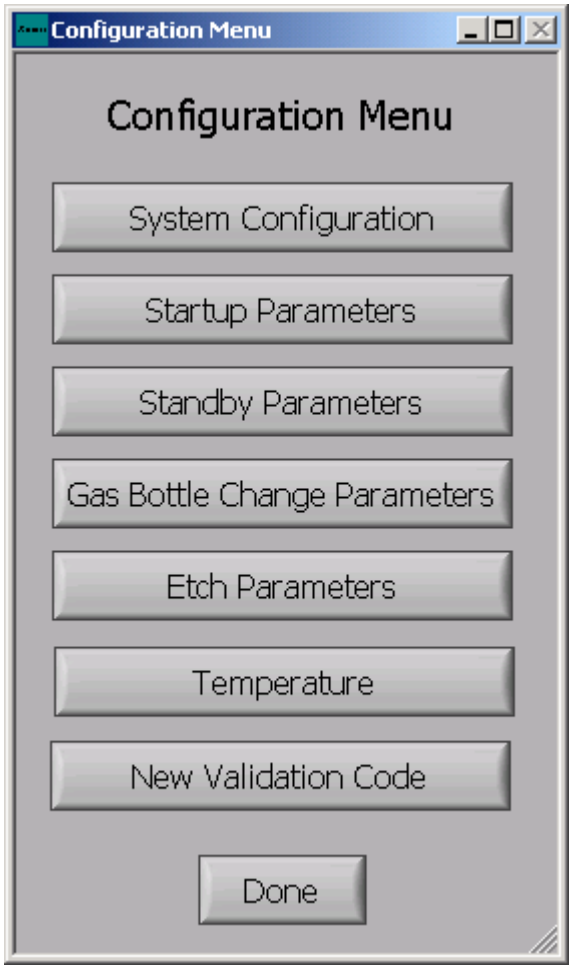
For users with no privileges a default recipe is required. It is recommended that foundry operator accounts be set up with no privileges. A number of allowed recipes can be given to the user and by checking the box next to the recipe name, it can be enabled. For example, a user without the ability to configure their etch can have, say 20 recipes. However, if only 1 is turned on, they will have access to only that 1 recipe. This is useful for those operators that may have a series of lots to process and the Administrator can enable the appropriate recipe for that operator as needed.



7.10.3 Configuration Menu

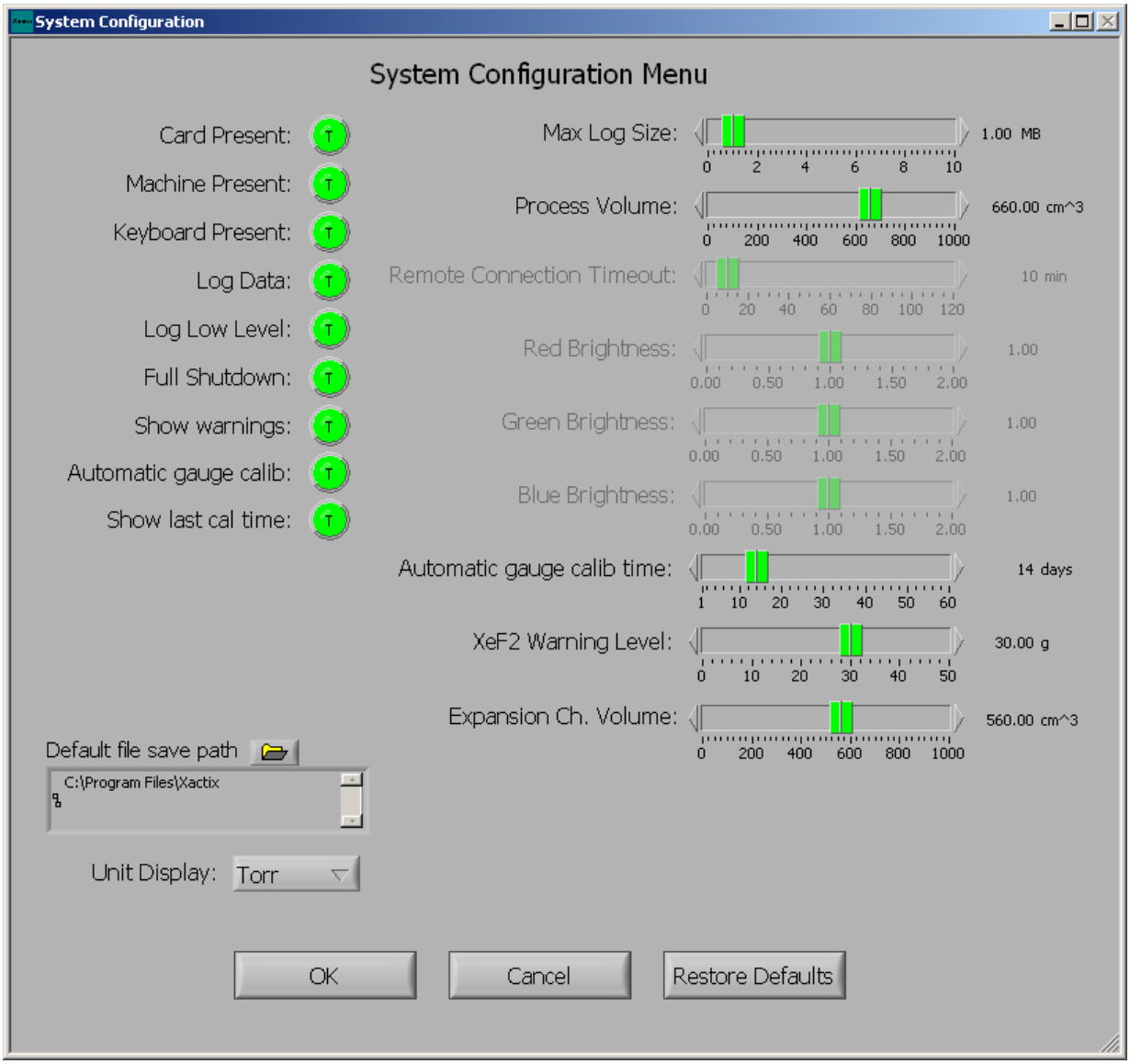
The configuration menu can be edited to change various system operations relating to basic system parameters, startup parameters, standby parameters, maintenance parameters, etch parameters, and validation codes; ***NOTE****: The validation code should only be changed by the system administrator.*

To edit the configuration menu select the “Edit CFG” option in the maintenance menu. The following options will appear as follows:



7.10.4 System Configuration Menu

The system configuration options screen is displayed below. Each of the options is briefly explained:



Card Present

Query for the presence of system controller card. This should normally be true for systems. Otherwise, the software will operate in a simulation mode.

Machine Present

Query for the presence of e1 Series machine. This should also be normally set to true.

Keyboard Present

Query for the presence of an external keyboard. It is suggested to leave this as false, even if there is a keyboard since setting it to true removes many of the on screen keyboard functions that may be convenient.

Log Data

Keeps track of machine operation for incorporation into the log.

Log Low Level

Keeps track of all operating machine details in the full log.

Full Shutdown

Allows for the entire system to be shutdown when the Xetch software is shutdown.

Show warnings

Allows the system to display on-screen warnings. Such warnings include vacuum related warnings.

Automatic Gauge Recalibration

This feature allows the user to decide if and how often a gauge calibration will be executed automatically.

Show Last Calibration Time

Enables system to display how long it has been since last gauge recalibration.

Default File Save Path

Allows the user to define a default folder that log files and images will be saved to.

Maximum Log Size

Maximum space allocated to the log for storage of log data. As the log exceeds this max size, the oldest data is purged. Although it may be tempting to have large log files, they may prove to be difficult to open in most text viewers.

Process Volume

Volume of process chamber. This should be set to 660 cm^3.

Expansion Ch. Volume

Volume of expansion chamber. This should be typically set to 558 cm^3.

Image Brightness

Red brightness, green brightness, and blue brightness settings (used only for the optional upgrade for the image acquisition system).

Automatic Gauge Calibration Time

Sets the number of days between each automatic gauge calibration.

XeF2 Warning Level

If either XeF2 bottle's estimated remaining XeF2 falls below this set point, a warning is displayed on the Main and Etch menus, in addition, in the Maintenance menu, XeF2 usage is highlighted yellow if it is below the setpoint.

7.10.5 Startup Configuration Menu

The startup parameters options screen is displayed on next page. Each of the options is briefly explained.

Process Purge Cycles

Allows the user to set the number of purge cycles for the process chamber during the machine startup.

Process Purge High

Allows the user to set the nitrogen pressure for the process chamber purge cycles during the machine startup.

Process Purge Low

Allows the user to set the vacuum pressure for the process chamber purge cycles during the machine startup.

Exp Purge Cycles

Allows the user to set the number of purge cycles for expansion chamber during the machine startup.

Exp Purge High

Allows the user to set the nitrogen pressure for expansion chamber purge cycles during the machine startup.

Exp Purge Low

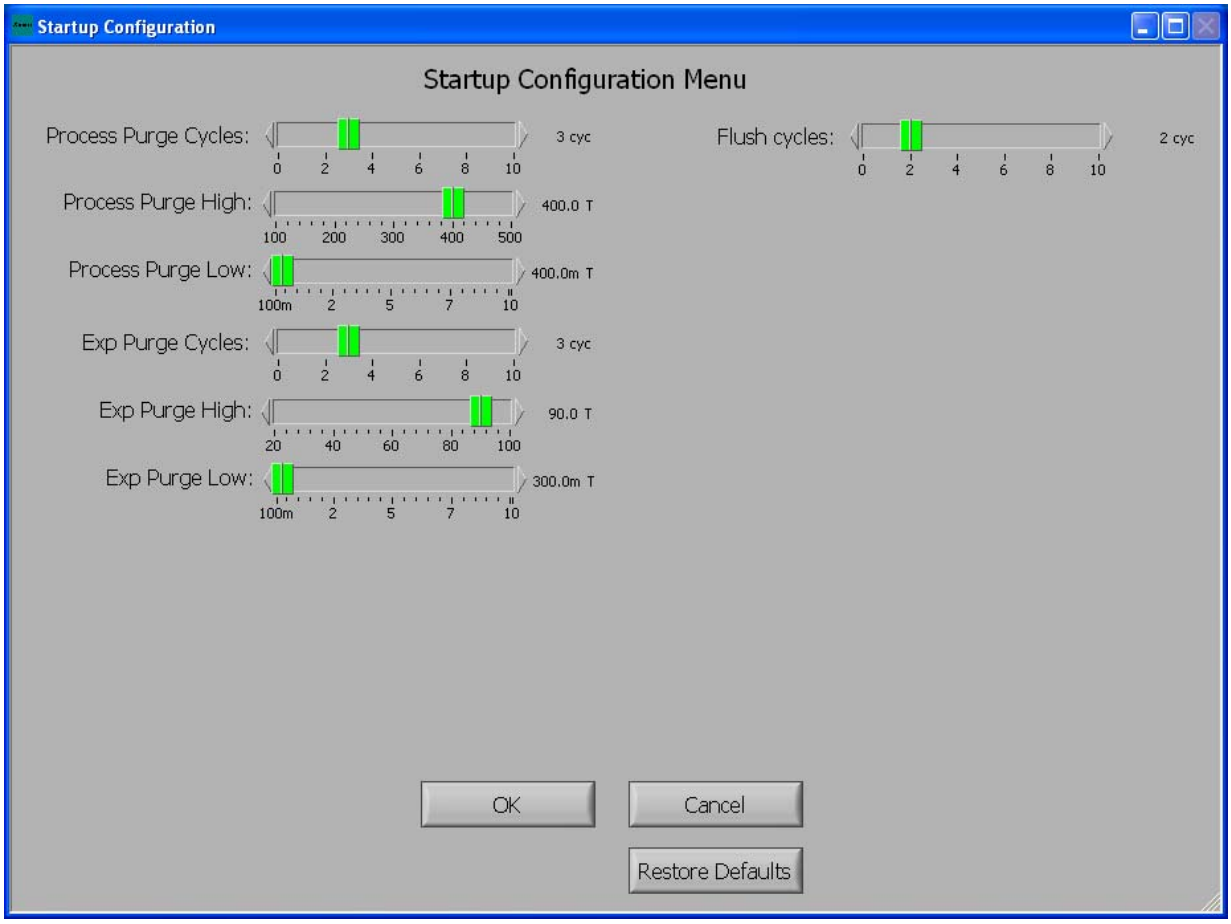
Allows the user to set the vacuum pressure expansion chamber purge cycles during the machine startup.

Flush Cycles

Allows the user to set the number of flush cycles during the machine startup.

A flush cycle consists of:

- 20 seconds that V7, V5, V3, and V11 are open
- 20 seconds that V7, V5, V3, V11, and V6 are open
- *20* seconds that V3, V11, and V6 are open
- 20 seconds that V3 and V8 are open



7.10.6 Standby Configuration Menu

The standby parameters options screen is displayed on next page. Each of the options is briefly explained.

Process Purge High

Allows for the user to set the nitrogen pressure in the process chamber for purging the system during the load/unload cycle.

Process Purge Low

Allows for the user to set the pressure that the process chamber is pumped down to when purging the system during the load/unload cycle.

Process Standby

Allows the user to set the process chamber base pressure for the pump-down process.

Exp Purge High

Allows for the user to set the nitrogen pressure in the expansion chamber for purging the system during the load/unload cycle.

Exp Purge Low

Allows for the user to set the pressure that expansion chamber is pumped down to when purging the system during the load/unload cycle.

Manual Version e1-4.3.0.ae-R0.

Exp Standby

Allows the user to set the base pressure in the expansion chamber for the pump-down process.

ATM Pressure

Allows the user to define the set point for the atmospheric pressure light to come on during the venting process.

V9 Low Pressure Point

Allows user to define the pressure at which Valve 9 opens.

Load Purge Cycles

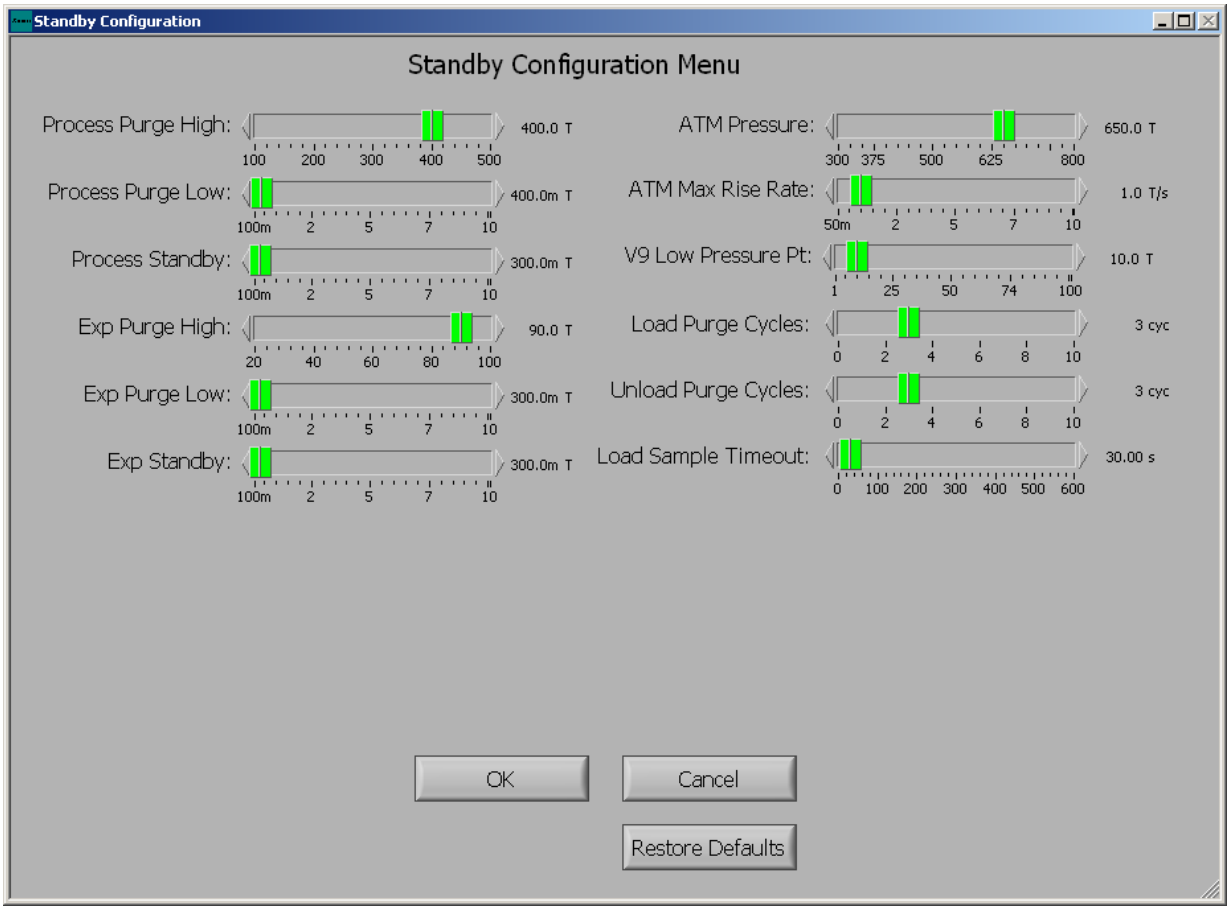
Allows user to set the number of purge cycles for during the load cycle.

Unload Purge Cycles

Allows user to set the number of purge cycles for during the unload cycle.

Load Sample Timeout

Allows the user to set the amount of time for which the nitrogen vent gas continues to when the chamber is at atmospheric pressure.



7.10.7 Gas Bottle Change Parameters Menu

The maintenance parameters options screen is displayed on next page. Each of the options is briefly explained

Pre-Change Cycles

Allows user to set the number of purge cycles prior to disconnecting the XeF2 lecture bottles.

Pre-Change High

Allows the user to set the nitrogen pressure for the purge cycles prior to disconnecting the XeF2 bottles.

Pre-Change Vac Time

Allows the user to set the amount of time that the vacuum valve is open prior to disconnecting the XeF2 bottles.

Closed Bottle Cycles

Allows user to set the number of purge cycles to remove atmospheric gas from the lines following a XeF2 bottle change.

Closed Bottle High

Allows user to set the nitrogen pressure for the purge cycles following a XeF2 bottle change.

Closed Bottle Vac Time

Allows user to set vacuum time for the purge cycles following a XeF2 bottle change.

Post-Change Cycles

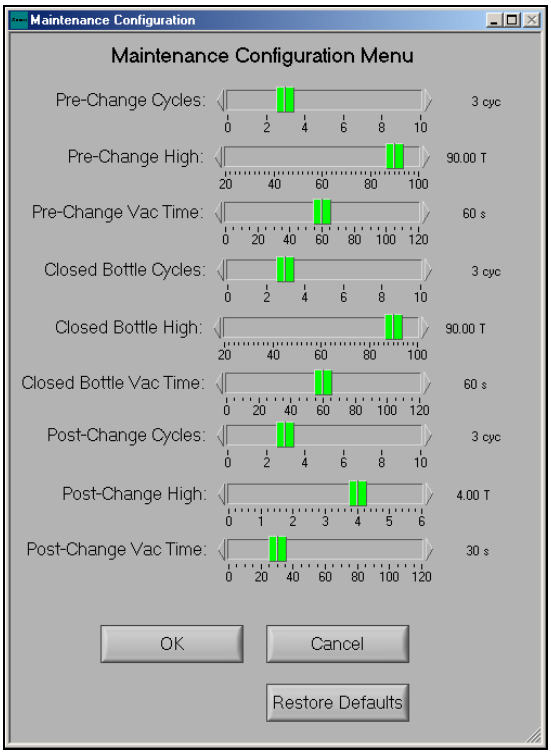
Allows user to set the number of cycles used to ensure that the XeF2 bottle is operating correctly.

Post-Change High

Allows user to set the XeF2 pressure for the conditioning cycles following a XeF2 bottle change.

Post Change Vac Time

Allows user to set the vacuum time for the conditioning cycles following a XeF2 bottle change.



7.10.8 Etch Configuration Menu

The etch parameters options screen is displayed on the next page. Each of the options is briefly explained:

Soft Etch Stop

Allows the user to stop etching; yet allow the current cycle to finish before exiting. As opposed to a hard etch stop; which can still be performed by pressing the “STOP” button twice, which immediately evacuates all chambers closes all valves, and returns to the main menu.

Allow In-Progress Cycle Changes

Allows the user to add additional cycles to an etch while etch is still in progress.

Show overtime warning and Overtime threshold

If this is enabled, a warning message will be displayed to alert the user that the system is taking a longer time than is expected to complete an etch cycle. The overtime associated with this feature is set via the Overtime threshold. Typically, a long time such as 100 seconds is recommended to avoid an accidental warning. For example, if the Overtime threshold is set to 100 seconds and the software expects a cycle to take 30 seconds, if the cycle exceeds 130 seconds, then a warning will be displayed to indicate that there may be a problem.

V3 Keep-open N2 Feature and V3 Keep-open Pressure

This feature is typically used in conjunction with etches that use nitrogen. Enabling this feature by setting V3 Keep-open N2 Feature to True allows the expansion chamber side nitrogen valve (V3) to remain open throughout the etch and can reduce cycle times. However, if V3 is kept open at low nitrogen fill pressures (approximately 3 torr or below), accurate expansion chamber fills may become difficult. Therefore, this feature has a threshold value below which it will not be enabled. This threshold value is set via the V3 Keep-open Pressure setting.

Delay .MPG gen. until etch done

This feature is only related to the systems that have the optional image acquisition system option. Enabling it allows the video file to be created after the etch finishes to minimize the load on the computer processor during the etch.

Wait for pre-etch stability

This feature requires the system to test the expansion chamber fill pressures before exposing the wafers to process gas. The tolerance that the expansion chambers must be filled to is set under the Pre-etch stability threshold below and the number of cycles in a row that must be within the tolerance before starting is under the Pre-etch stability # of cycles. It is recommended that this feature be enabled to ensure maximum run-to-run uniformity. A useful trick is that if you are certain that the pre-cycles are not necessary during a process run, the Stop button can be pressed during the pre-cycle and it will then begin the etch.

Pre-etch stability threshold

This is the tolerance that the Wait for pre-etch stability routine must satisfy before proceeding to etch the wafer.

Pre-etch stability # cycles

If Wait for pre-etch stability is selected, this setting allows the user to set the number of pre-cycles in a row that must be within tolerance before stability is considered to be achieved.

Max stability cycles

If Wait for pre-etch stability is selected, this setting prevents the stability cycles for exceeding a certain maximum. The system will not etch the wafer if stability is not achieved. The purpose of this maximum is to prevent the system from wasting substantial quantities of xenon difluoride in the case that the system is left unattended for a long period of time after initiating a run.

Intermediate Pump-down Pressure

Allows the user to set the intermediate pressure used for expansion chamber through main chamber pump-downs during an etch cycle.

Pressure Estimation Delay

Allows the user to set the delay after filling of the expansion chamber before the pressure is measured. This is done to allow time for the pressure in the expansion chamber to stabilize. This time should be set to the minimum time (usually a few seconds) that it takes for the expansion chamber pressure to stabilize so that it does not extend the cycle time.

Pressure Estimation Tau

The pressure overshoot is filtered using an exponentially weighted moving average filter. This parameter allows the user to set the time constant for that filter. Specifically, it setting it to 10 causes the overshoot correction to take 10 cycles to bring it to the set point. Setting it to 2 causes the overshoot to take 2 cycles to bring it to the set point. Smaller numbers mean that the corrections per each cycle are more extreme than larger numbers so there may be some undershoot.

XeF2 Pressure Estimation # Bins

The pressure overshoot is also recorded separately for different fill targets. This parameter allows the user to set the number of "bins" that the pressure range between 0T and 8T is divided into. For example, 4 bins would mean that the 4 bins would be from 0 to 1.999T, 2T to 3.999T, 4T to 5.999T, and 6T to 8T. During a process, say the fill target is 2.5T, the overshoot for 2.5T would be learned and stored for all processes that fall into the 2nd bin from 2T to 3.999T. Therefore, a subsequent process

that would have a 3.5T setpoint would start with the use of the overshoot information learned from the 2.5T run. This feature only applies to Pressure Estimation Pre-Cycles.

N2 Pressure Estimation # Bins

Allows the user to set the number of pressure overshoot bins for N2 pressure between 0T and 30T. This feature only applies to Pressure Estimation Pre-Cycles.

Max Pressure Estimation Age

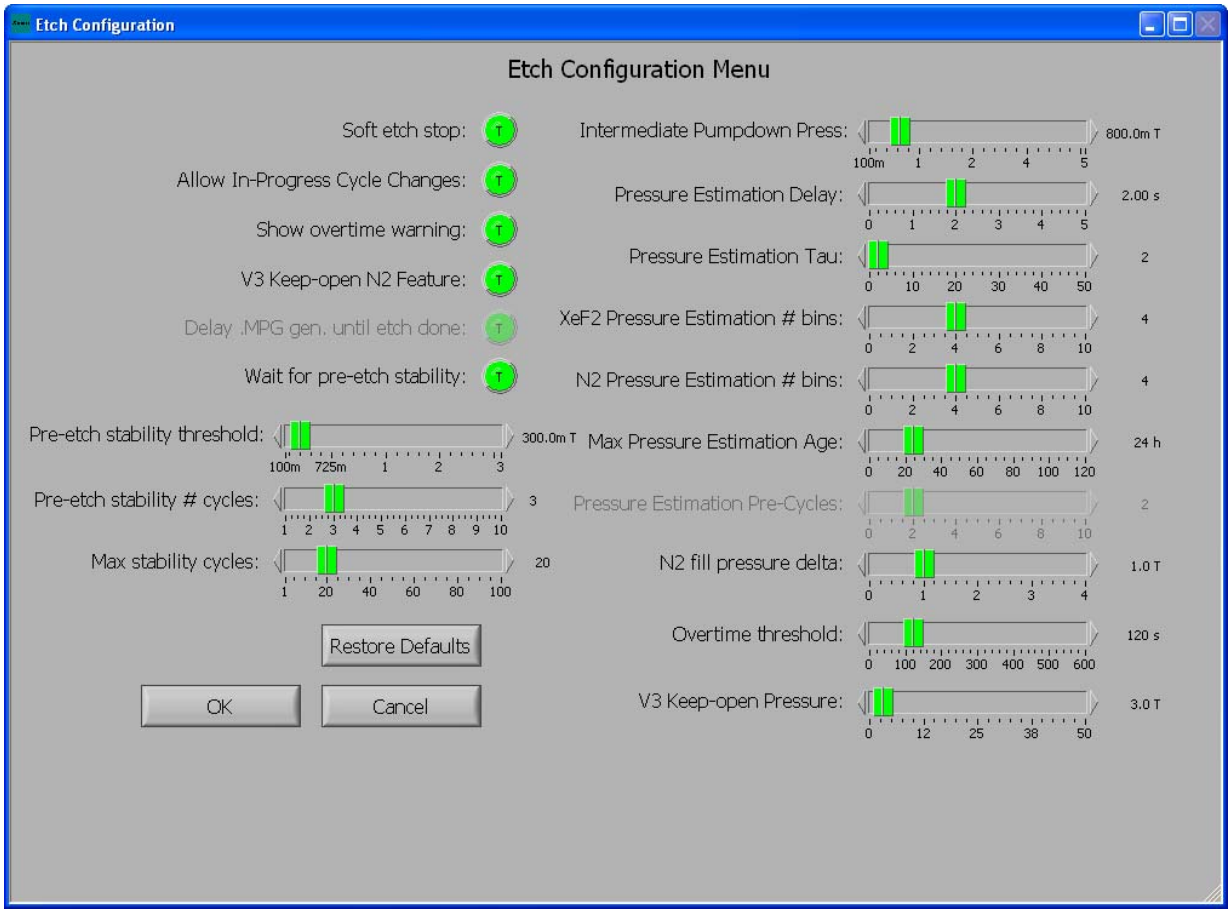
Allows the user to predetermine the longest amount of time, between 0 and 120 hours, that Pressure Estimation Pre-Cycles information expires. This feature only applies to Pressure Estimation Pre-Cycles.

Pressure Estimation Pre-Cycles

Allows the user to set the number, between 0 and 10, of pre-cycle pressure purging cycles and only applies if Wait for pre-etch stability is not selected. This is the number of pre-cycles (cycles that only fill and empty the expansion chamber without exposing the wafer to etch gases) that will be run before starting the etch (please note that the XeF2 Pressure Estimation # Bins, N2 Pressure Estimation # Bins, and Pressure Estimation Pre-Cycles are related to this feature). If a process was not run within a time less than the Max. Pressure Estimation Age that had an XeF_2 and N_2 sepoint within the same XeF_2 and N2 bins, these pre-cycles would be run to determine the overshoot parameters to accurately run the process.

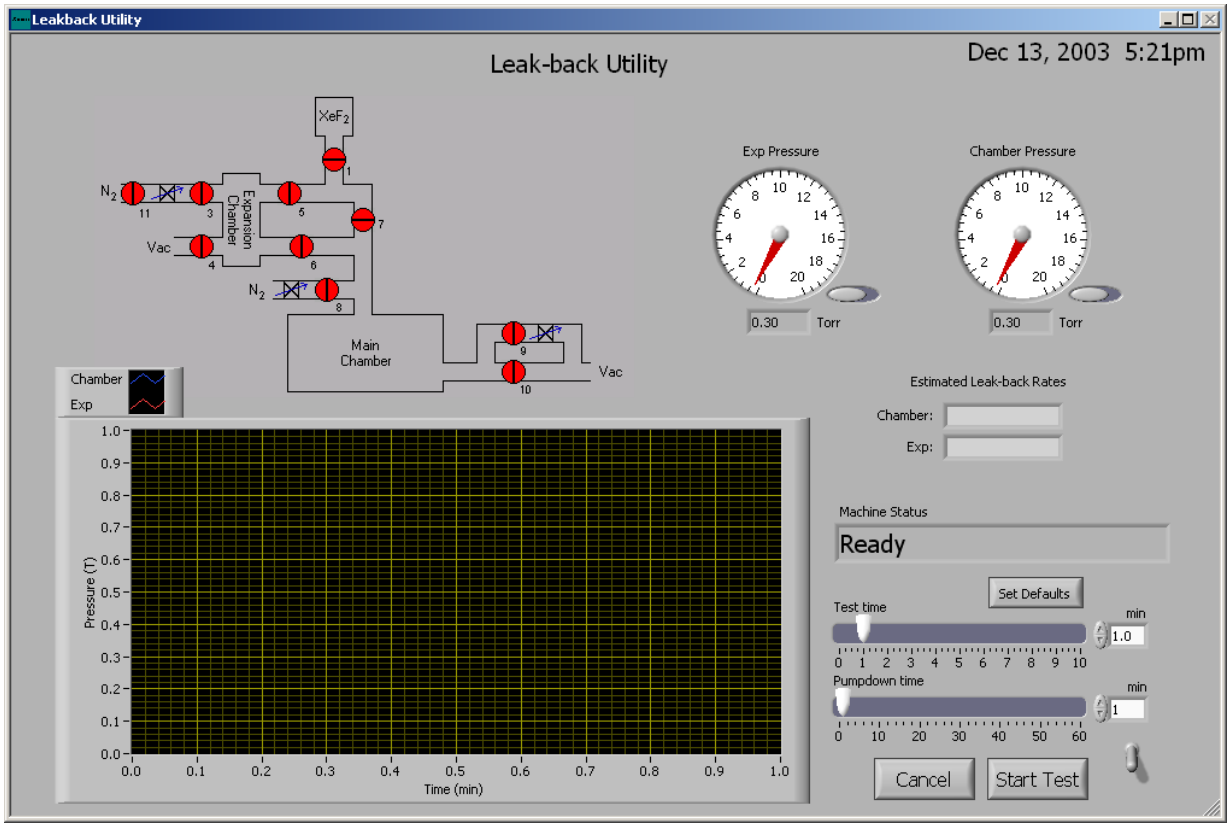
N2 fill pressure delta

This setting relates to the pressure that the nitrogen inlet valve, V11 closes in advance of reaching the expansion chamber nitrogen fill pressure setpoint to minimize the pressure jump during expansion chamber evacuation. This pressure jump is due to the nitrogen pressure that is trapped between V3 and V11 that is released when V3 opens during the expansion chamber evacuation. By closing V11 in advance of closing V3 during the expansion chamber fill, some of this excess nitrogen pressure is bled out of the line which minimizes the evacuation pressure jump.



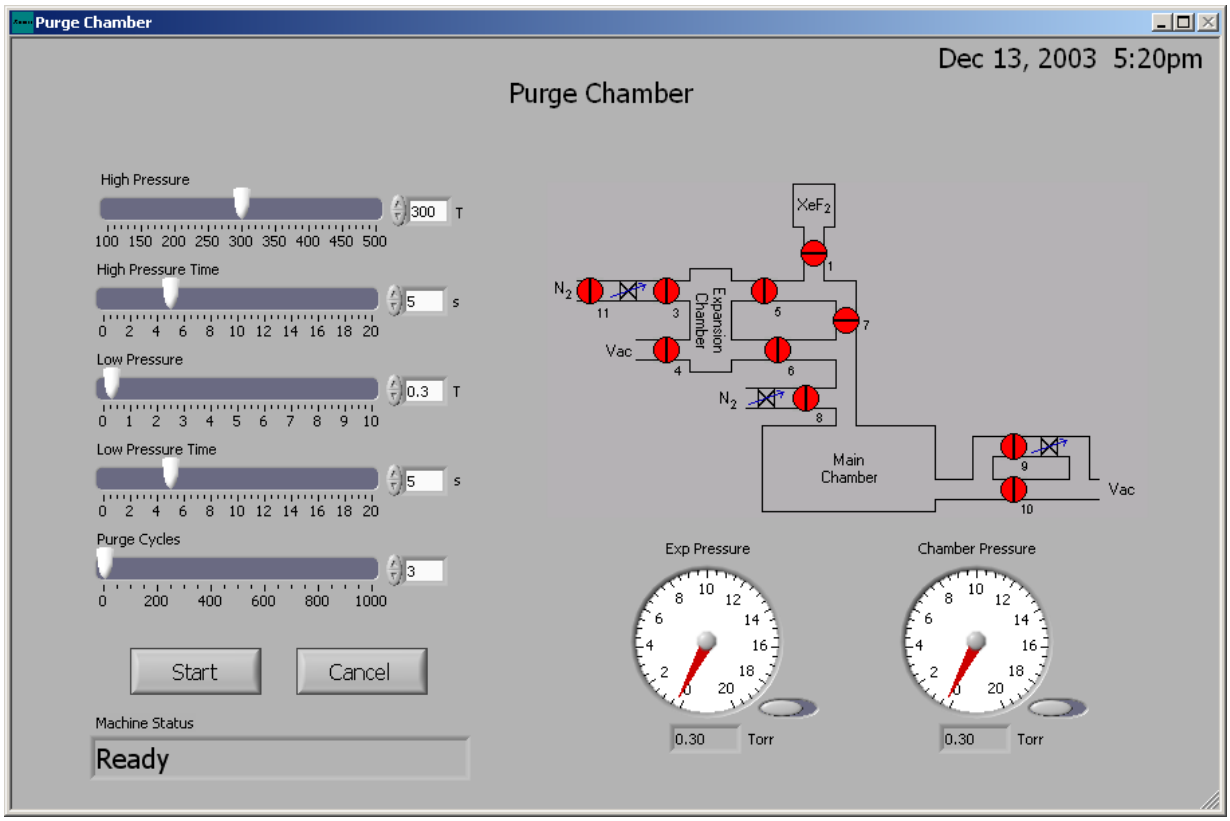
7.11 Leak-Back Utility

To test the leak-back rate of each of the chambers, the Leak-back Utility can be used. This program pumps down all chambers, and then closes all valves for a pre-set amount of time. It then estimates the leak-back rates for each chamber and displays them. To use this utility, first choose the duration of the test, the duration of the pumpdown before test, and then press “Start Test”. The test will be performed, and the rates will be displayed. When the test is complete and you have observed the rates, press “Done” to return to the Maintenance Menu. This test can be misleading for the main chamber, however, since most apparent leaks are actually trapped gas in the showerhead. Maximum test time and long pumpdown (60 min) time should be used for best results. The main key to distinguishing between a leak and trapped gas is that a leak will have a steady, straight line with no sign of the pressure rise slowing, whereas the rate of rise for trapped gas will decrease as the pressure rises. Also see Section 9.11 for an alternative method of leak testing the main chamber.



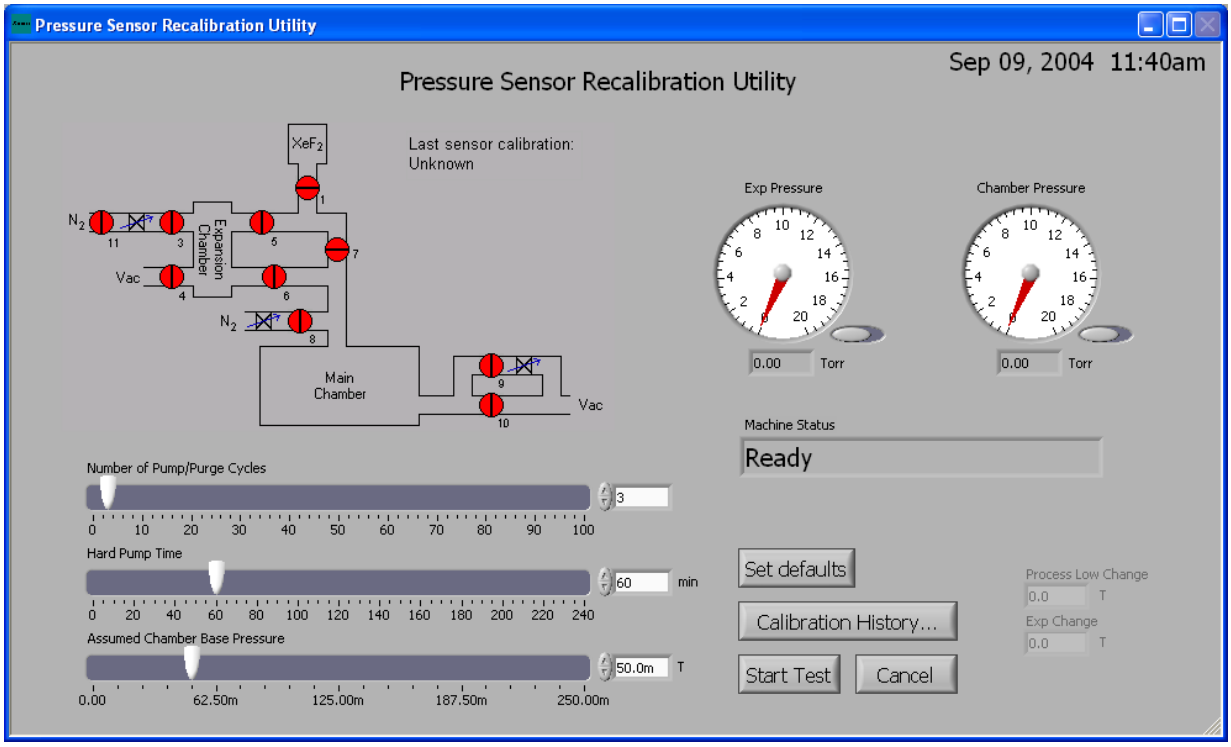
7.12 Main Chamber Purge

To repeatedly pump and purge the main chamber to remove residual gas or water vapor, the Chamber Purge Utility can be used. First, set the parameters for the purge routine, including N2 fill high-pressure, high-pressure time, pump-down low pressure, low-pressure time, and number of purge cycles. Then press, “Start” to start the cycle. At any time, the “Cancel” button can be used to end the routine and return to the Maintenance Menu.



7.13 Pressure Sensor Recalibration Utility

The pressure sensors may “drift” over time indicating less accurate readings. The gauge recalibration utility is a method to periodically recalibrate them. To recalibrate the sensors, set the number of purge cycles, length of pump time, and assumed chamber base pressure. The manometers are zero calibrated to .05 T or 50 mT, which is the assumed base pressure of the system. Pressing the “Calibration History” button accesses a log file for the recalibration function. The “Set Defaults” button can be used to save recalibration settings for easy one-touch use. Set the preferred settings and press “Set Defaults”, this will allow these parameters to be saved and appear each time calibration is performed unless otherwise set. When desired parameters are set press “Start Test” button and calibration will begin. Occasionally executing the calibration a second time may be needed to achieve calibration. An automatic calibration function may be set to “True” in the configuration menu under “System Configuration”. This function will automatically recalibrate the capacitance manometers at a low-usage time, typically at night. The last calibration time is then displayed on the main menu.



7.14 Video Capture Option

7.14.1 Overview

The optional video capture integrates image capturing through a camera attached to the microscope with the Xetch software. Specific features include:

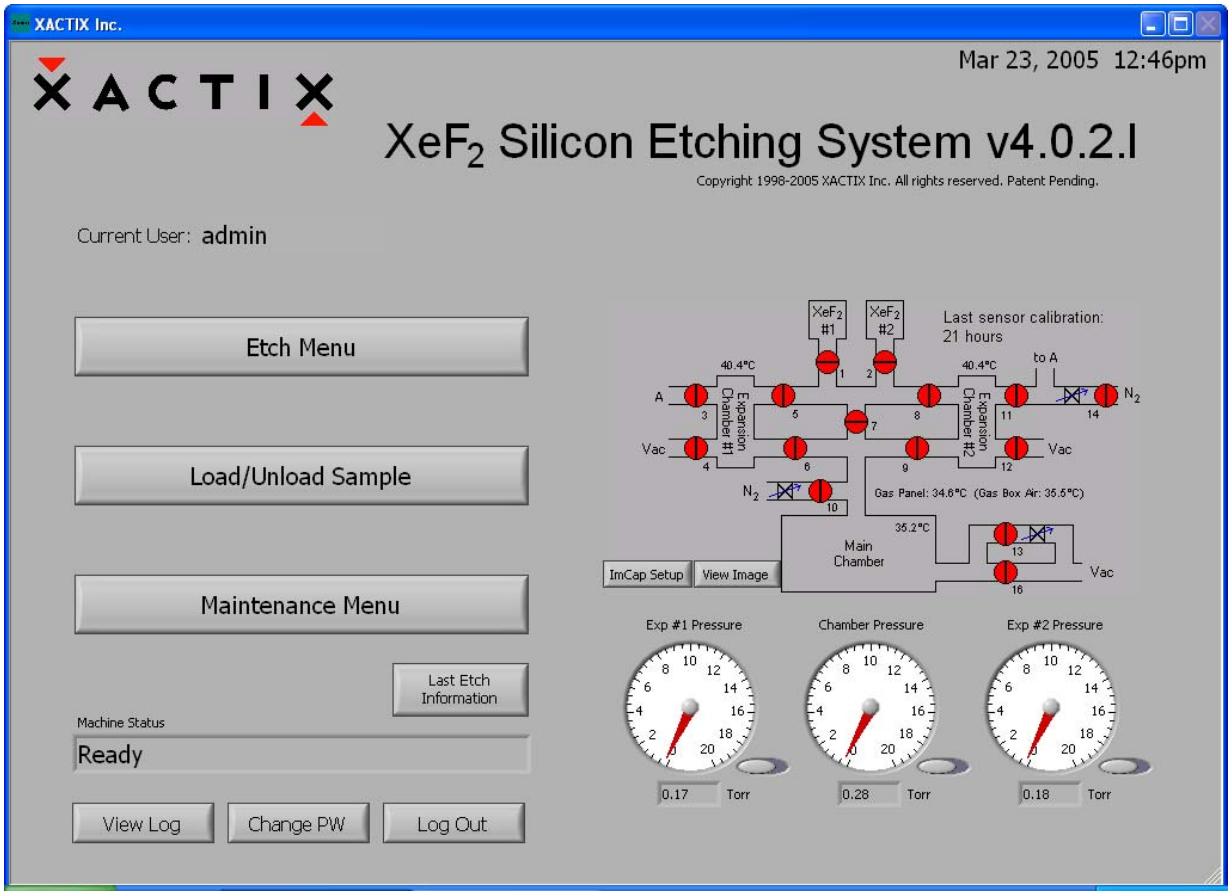
- Snap images at a user settable number of etch cycles
- Snap images at user adjustable time interval
- Images can be saved as either JPG (compressed) or BMP (raw) formats
- Images captured during an etch process are stored in a folder unique to that specific etch run

Note: The screen shots in this section are from the X3 software hence two expansion chambers and two source bottles are shown in the diagrams whereas the e1 system has one expansion chamber and one source bottle. Please ignore these additional items shown in the diagrams.

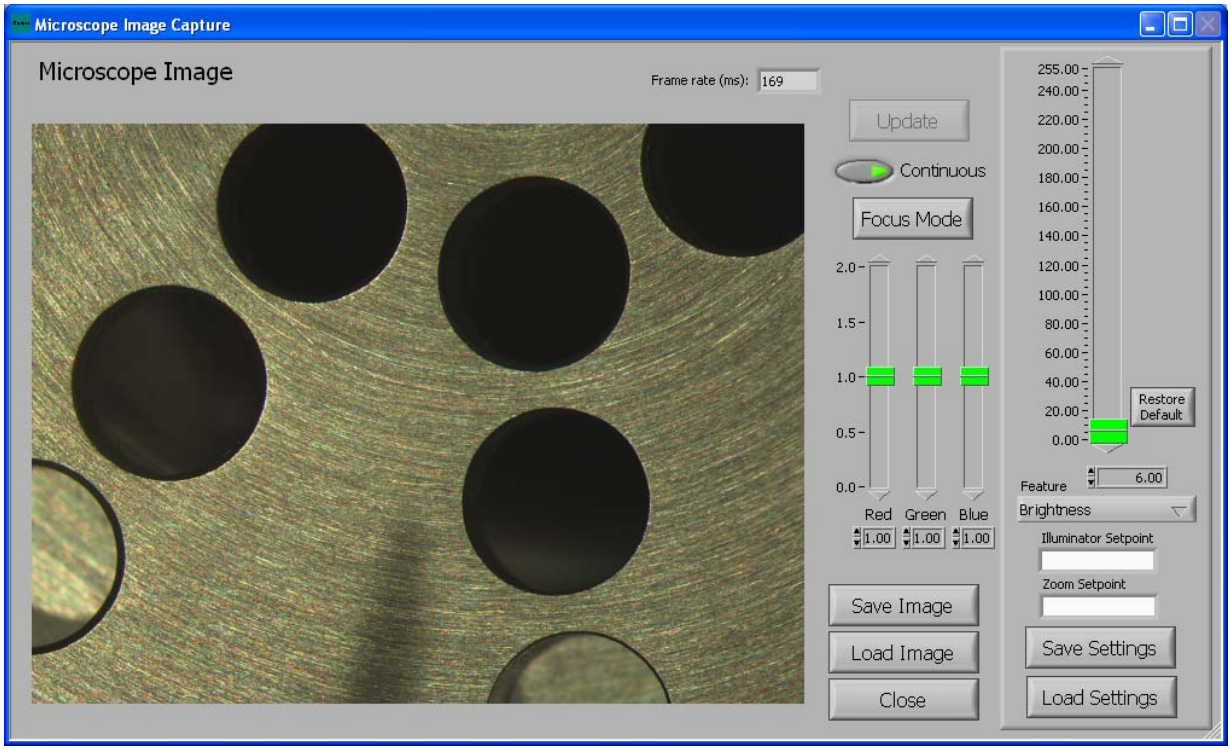
7.14.2 Capturing Images

To capture images through the microscope, the slider near the rear of microscope, must be in the video setting. This causes the image seen through the right eyepiece of the microscope to be routed to the camera. The left eyepiece of the microscope will continue to operate normally.

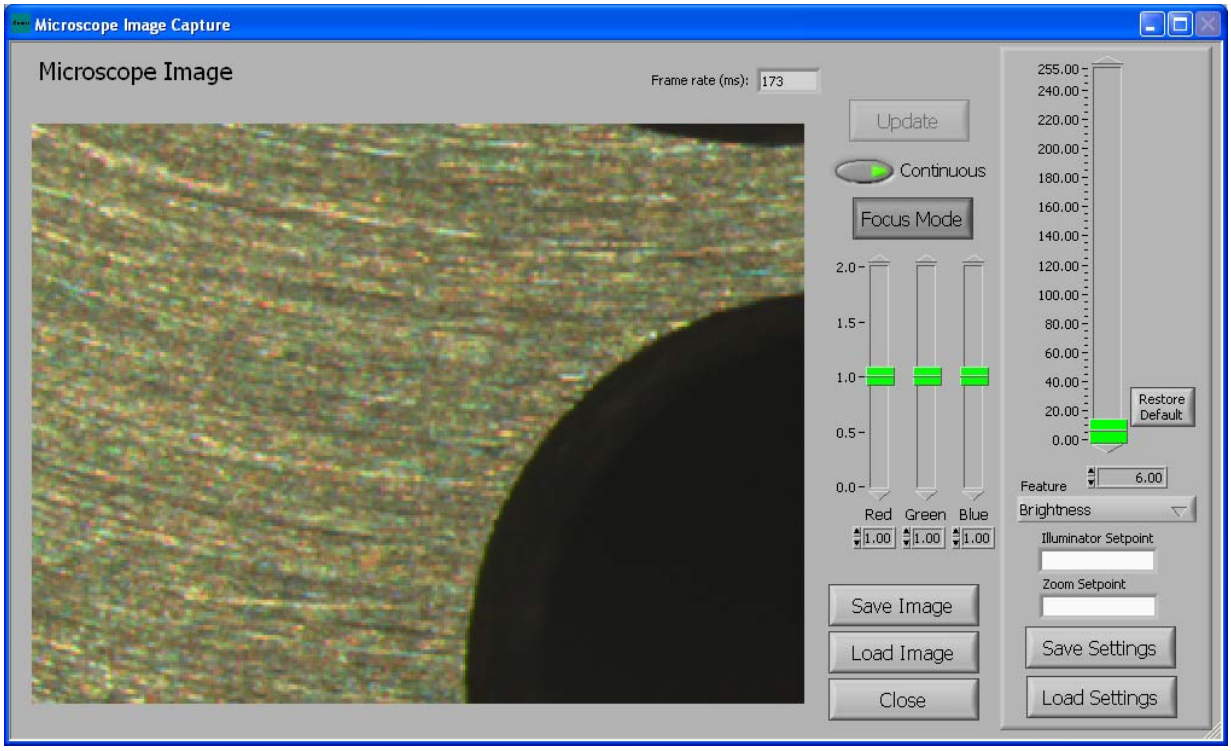
The image capture feature is accessed through either the Main Menu or the Etch Menu via the View Image button shown below:



Pressing the View Image button brings up the following menu:



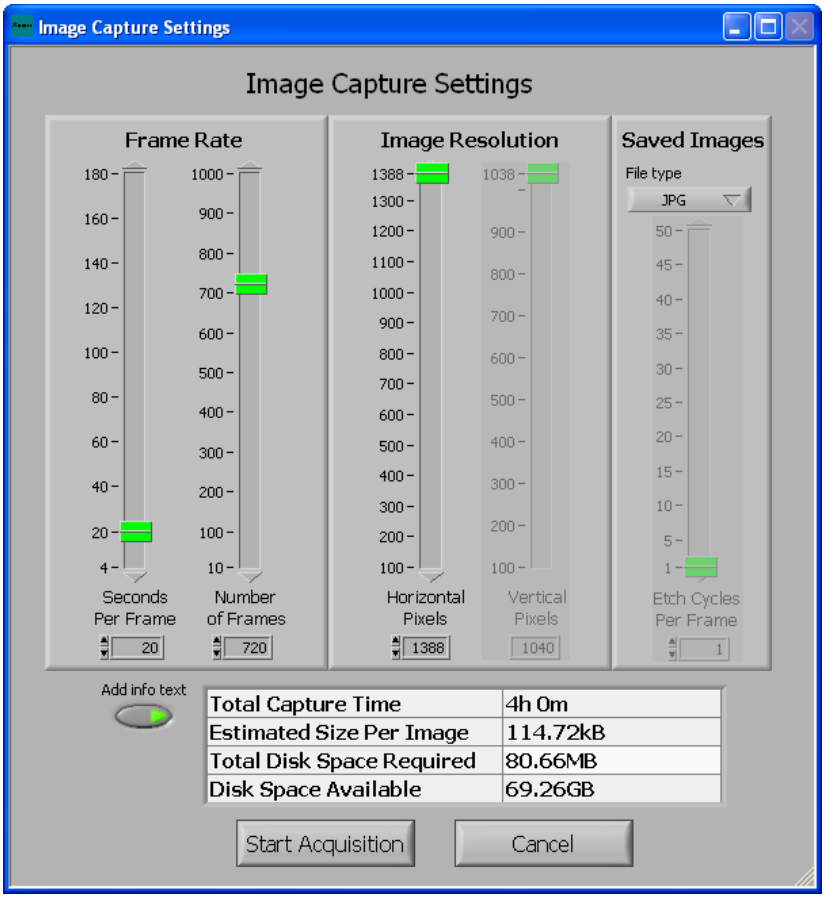
Pressing the Focus Mode button zoom in the center of the image so that the microscope can be accurately focused.



Other features of the above menus is that the images can be continuously updated, as shown, or if the feature is disabled, the image can be updated through the Update button. Colors can be adjusted through the Red, Green, and Blue sliders. Images can also be saved or loaded through this menu. Colors can be adjusted through the Red, Green, and Blue sliders.

On the right hand side, specific features of the camera can be accessed using the pull-down menu and the sliders. Also note that the image settings can be stored and since the illuminator setting (the setting on the illuminator remote control) and the zoom setting of the microscope affect the image, these parameters can be stored for later use. This is useful when trying to capture images with a consistent appearance.

Images can be captured at a certain interval by going through the ImCap Setup menu on the Main Menu:

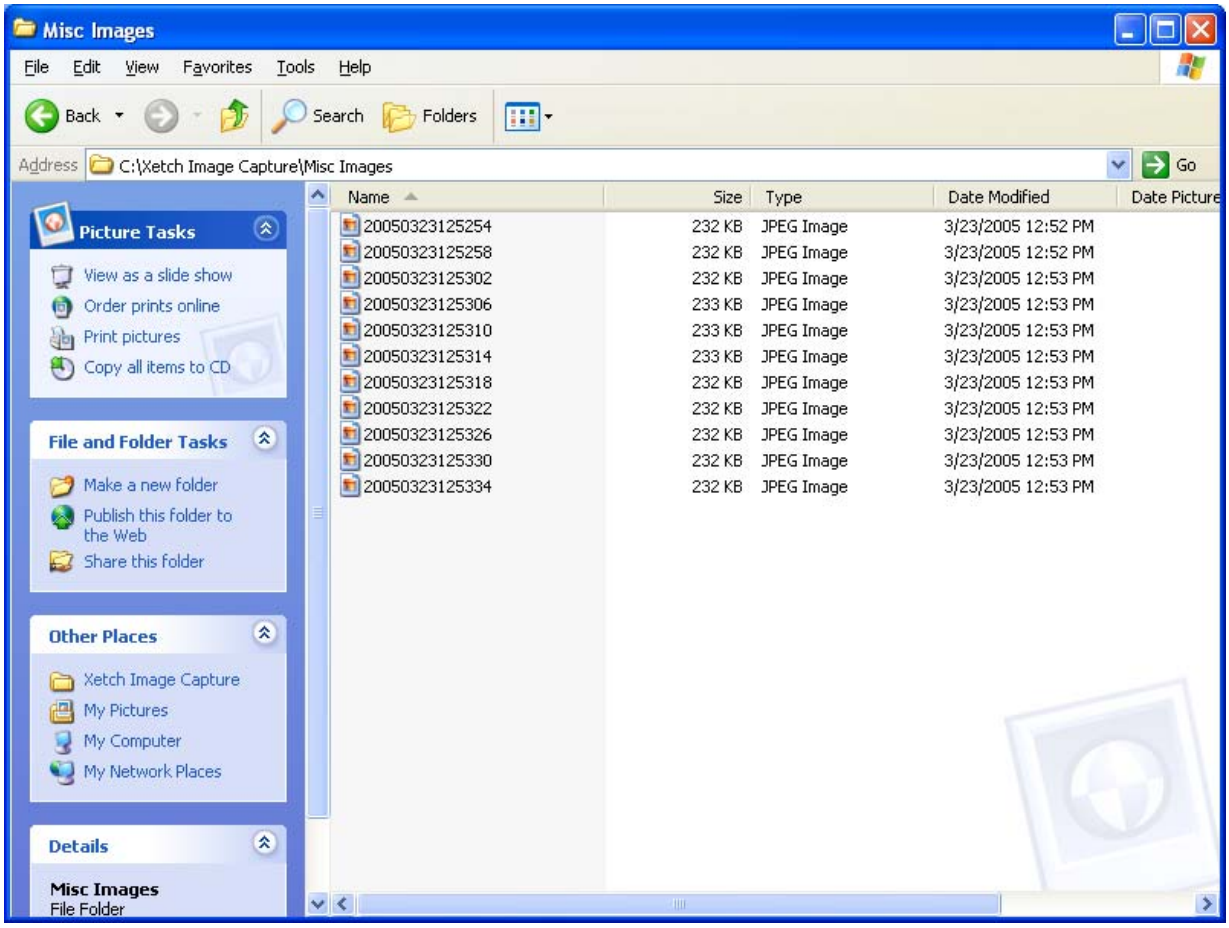


The Seconds Per Frame setting sets the frequency that images are taken after pressing the Start Acquisition button. Number of Frames is the maximum number of images that will be taken. Add info text includes some information about the system's status on the captured image.

The resolution of the stored image is set by the Image Resolution setting. The type of image stored can be either JPG, which is a compressed image, or BMP, which is the raw image (no compression). Note that since the setup of the imaging is being done outside of the Etch Menu, that the Etch Cycles Per Frame slider is not active.

Estimates for the time of image capturing and image size relative to available disk space are also listed.

Images captured in this mode are stored in the Misc Images directory below:



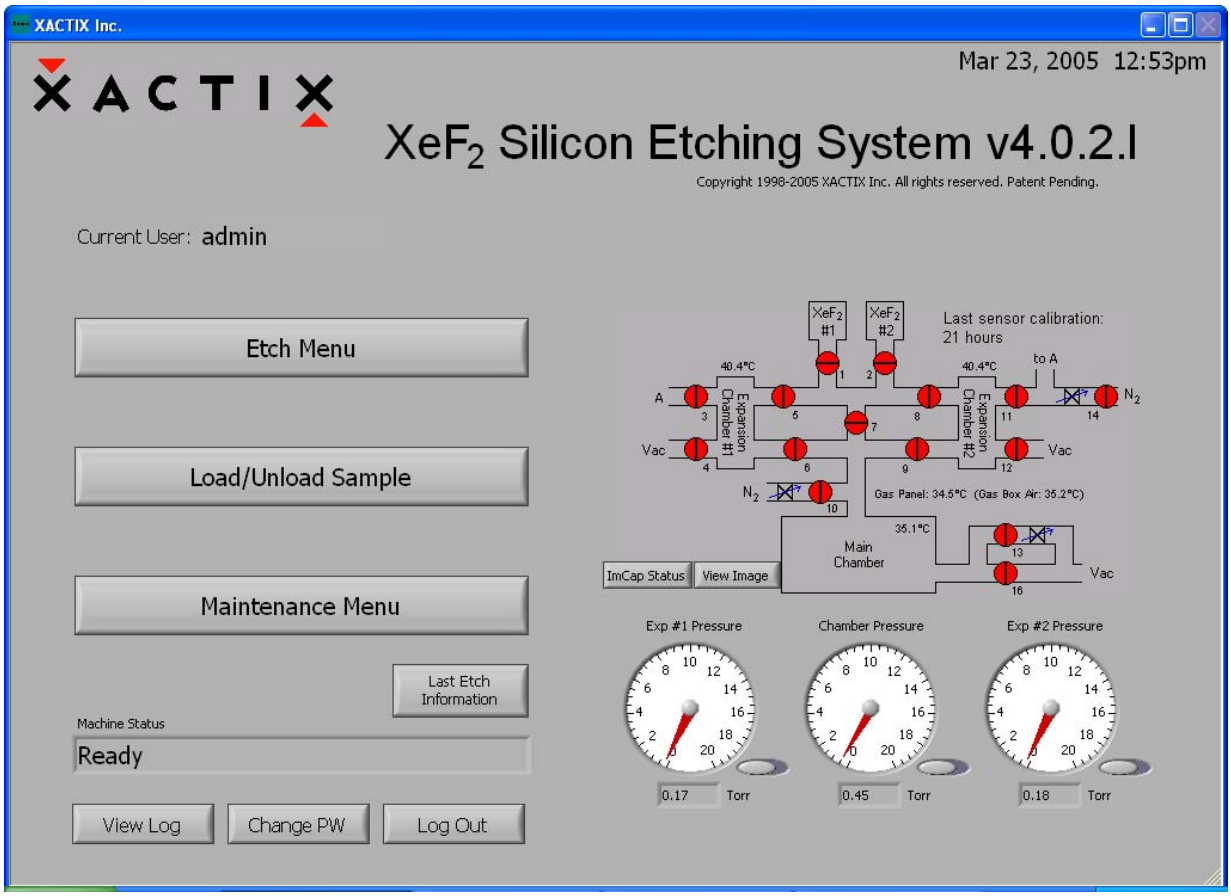
and are sorted by the format:

YYYYMMDDHHMMSS

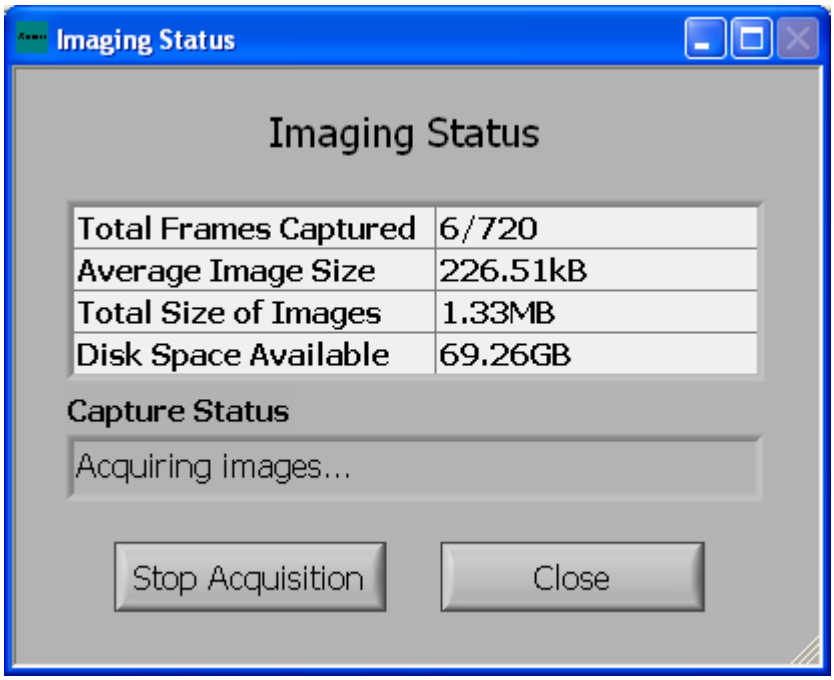
Where YYYY is the year, MM is the month, DD is the date, HH is the hour in 24 hr format, MM is the minute, and SS is the second of the image capture.

Note: it is because of this naming procedure that maintaining accurate time and date for the system is critical.

The status of the image capture can be obtained by pressing the ImCap Status button, which appears when images are being captured.

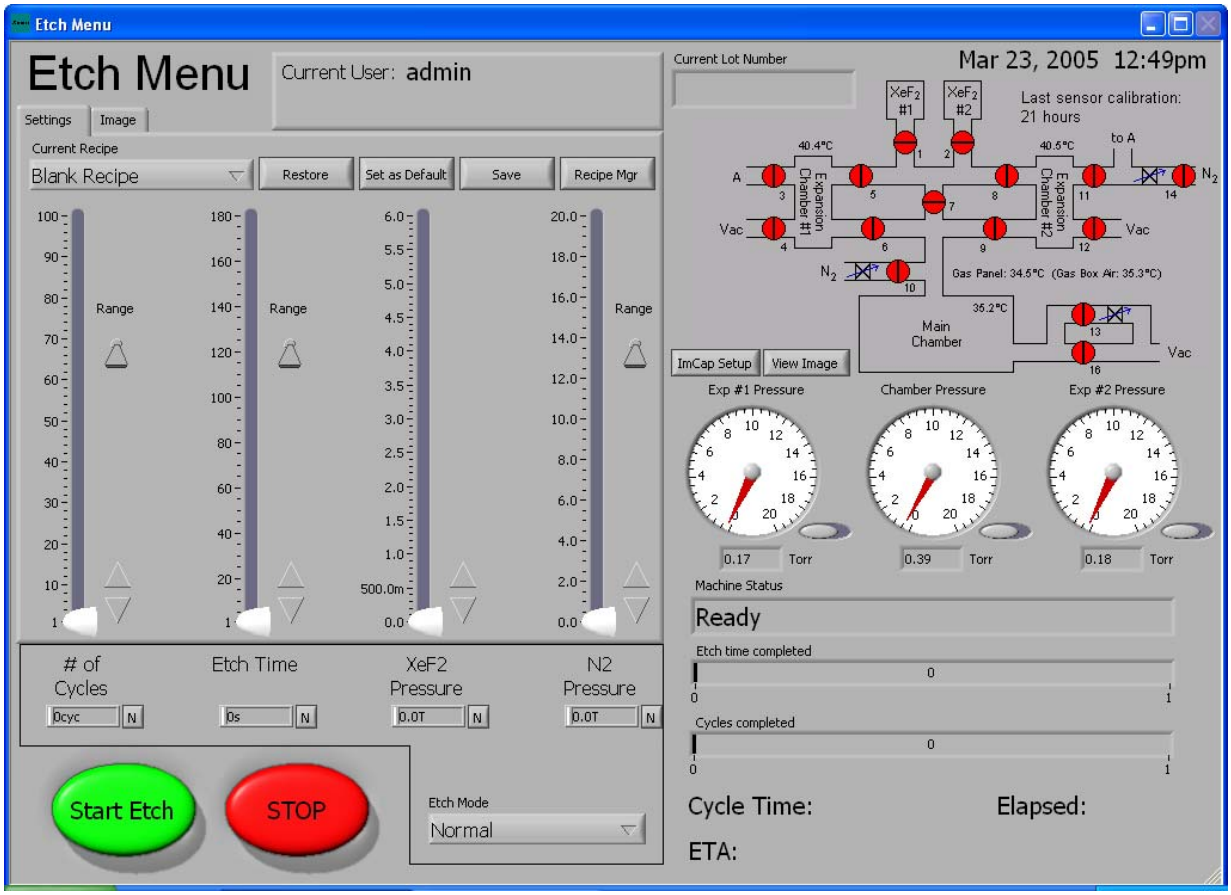


The window that appears when pressing this button is:

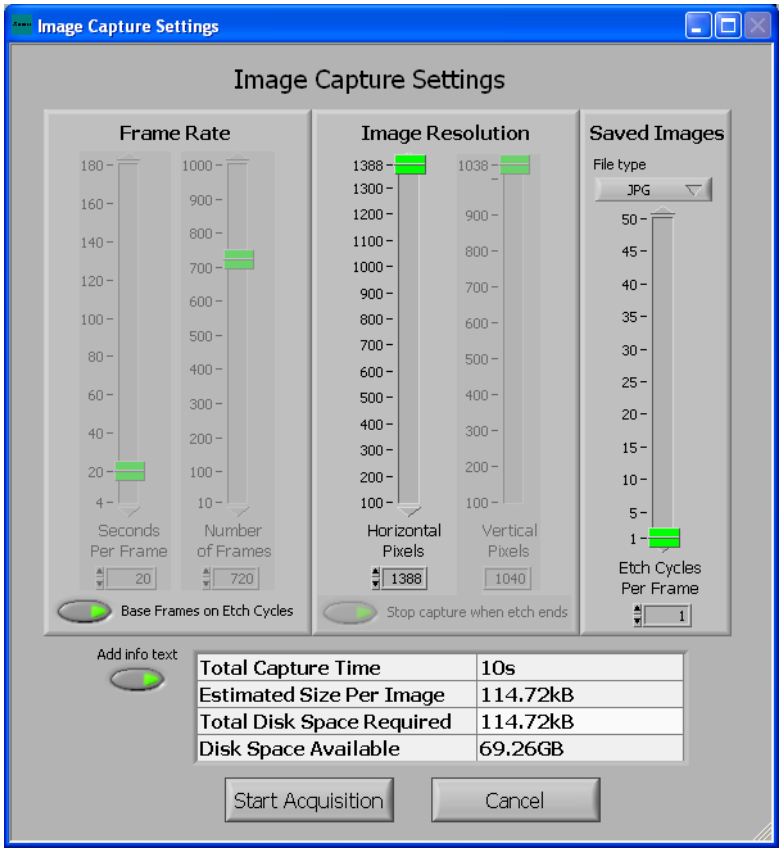


which summarizes the status of the image capturing and also allows the ability to stop the image capture by pressing Stop Acquisition.

Images can also be captured through the Etch Menu:

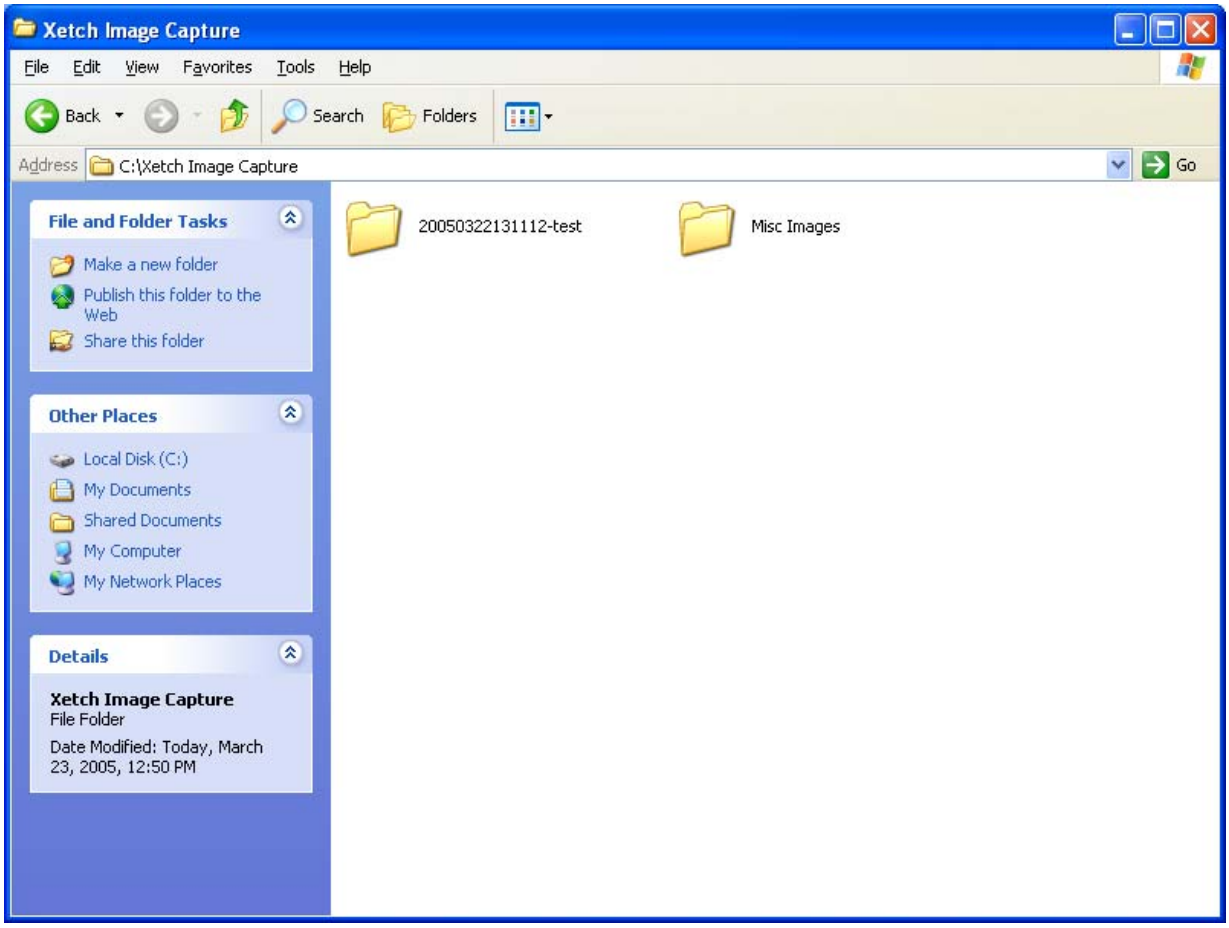


through a similar procedure to that from the Main Menu. The critical difference is that the ImCap Setup screen enables the Etch Cycles per Frame slider as shown below. This feature snaps an image at a specified number of cycles.



Pressing Start Acquisition will enable images to be captured during the etch.

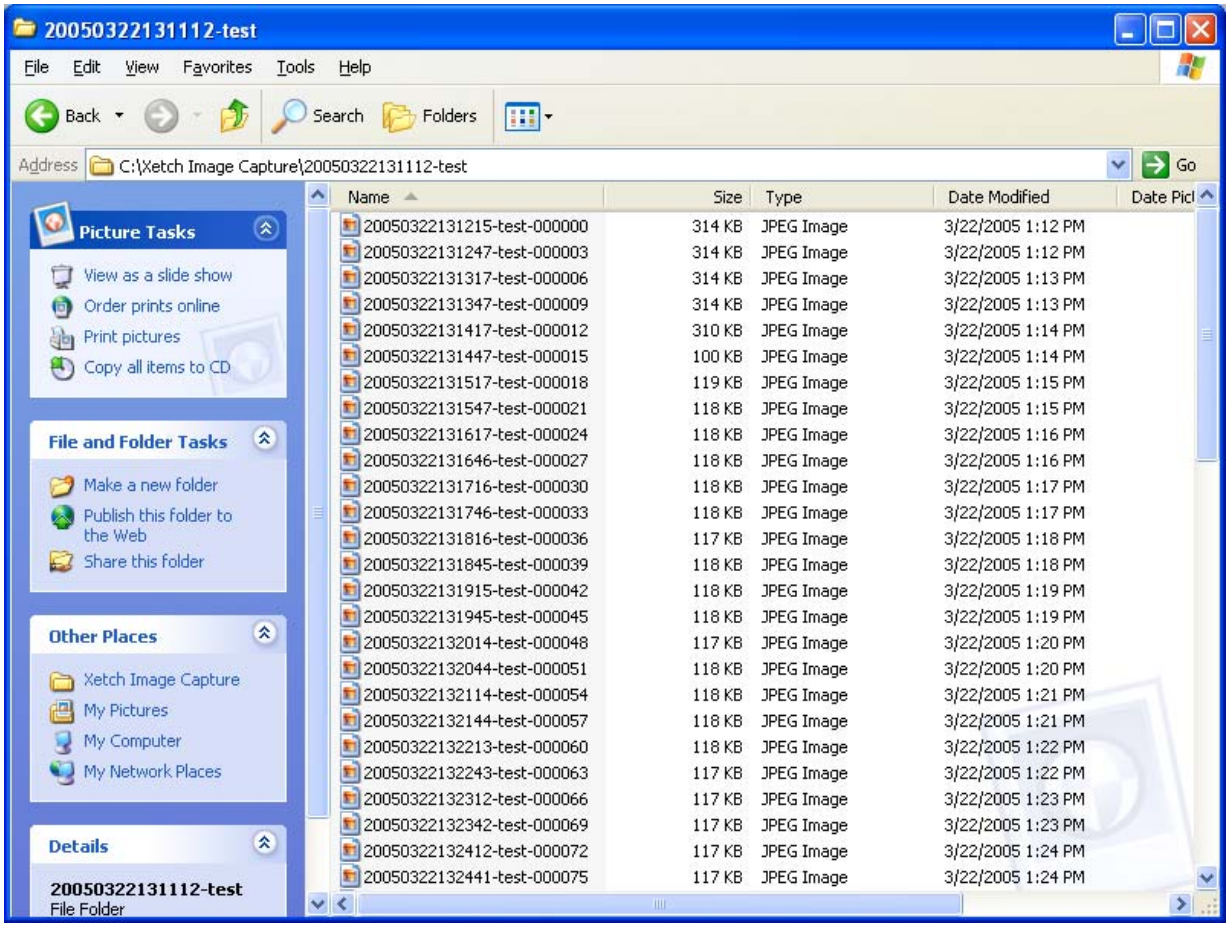
The images are stored in directories such as:



where YYYYMMDDHHMMSS-LOT

Where YYYY is the year, MM is the month, DD is the date, HH is the hour in 24 hr format, MM is the minute, SS is the second of the start of the etch, and LOT is the lot name.

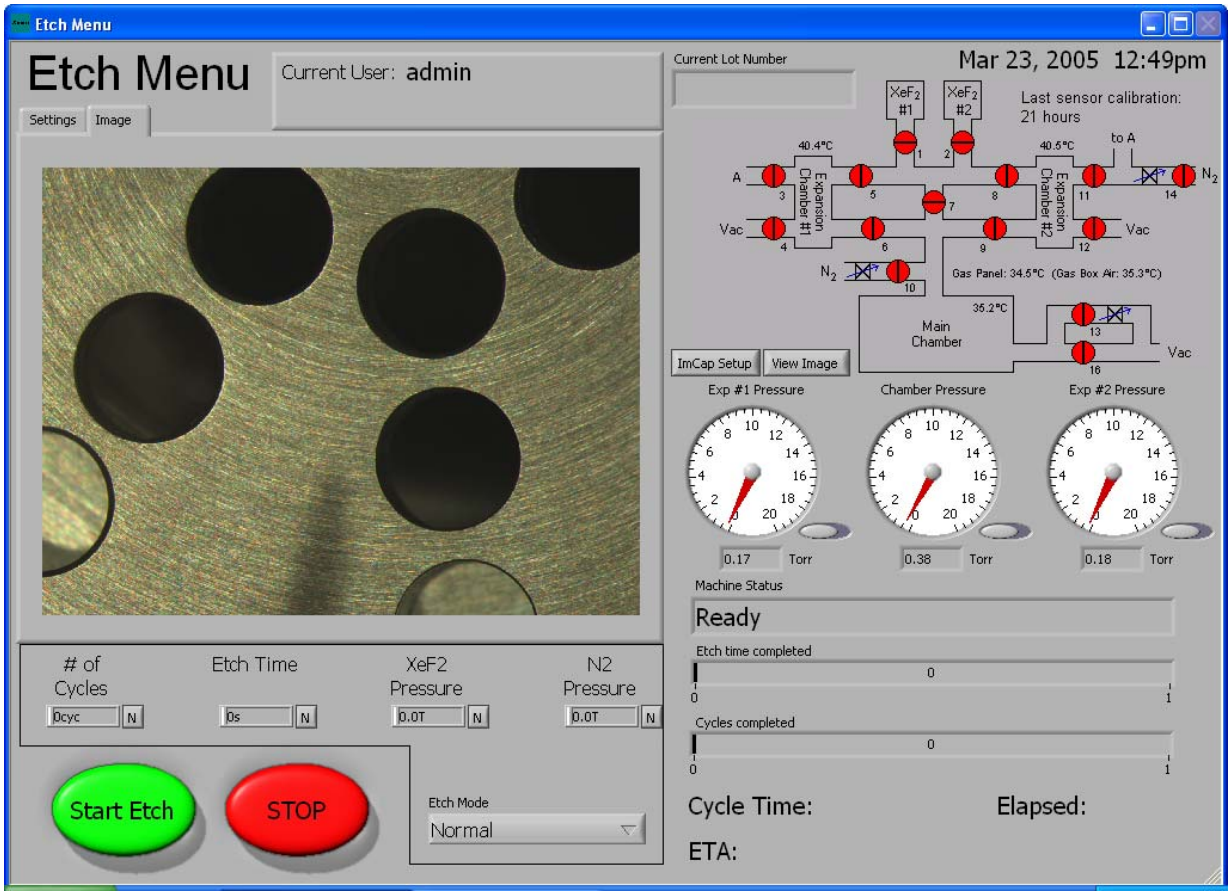
Inside of the directory, the images are stored in the following format:



where YYYYMMDDHHMMSS-LOT-XXXXXX

Where YYYY is the year, MM is the month, DD is the date, HH is the hour in 24 hr format, MM is the minute, SS is the second of the start of the etch, LOT is the lot name, and XXXXXX is the cycle number.

As a side note, the image can be viewed on the Etch Menu by pressing the Image tab.



Another note about viewing and capturing images during etching is that special provisions are made in the software to avoid capturing an image when a critical etch operation is occuring. This is necessary since image capturing is very processor intensive. In addition, critical etch operations are put on hold until an image capture is complete. This avoids deteriorating etch performance; however, you may experience some delays on the image refresh. Generally, when the software is preventing an image refresh when looking at the View Image window, a Wait note is displayed.

8 XeF_2 Bottle Change

8.1.1 Bottle Change General information

XeF_2 Counter Reset

Before proceeding with a bottle change, be aware that the XeF_2 usage display will be reset to zero once the bottle is changed. You may wish to record the usage displayed before changing for your records. The usage information can be found by clicking the Maintenance Menu. The information is located at the top left under *Approx. XeF_2 Usage*.

Parts List

- Swagelok Gaskets (www.swagelok.com)
  NI-4-VCR-2-VS or NI-4-VCR-2-GR-VS
- 5/8” and 3/4” Standard Wrenches
- Latex Gloves

Time allocation

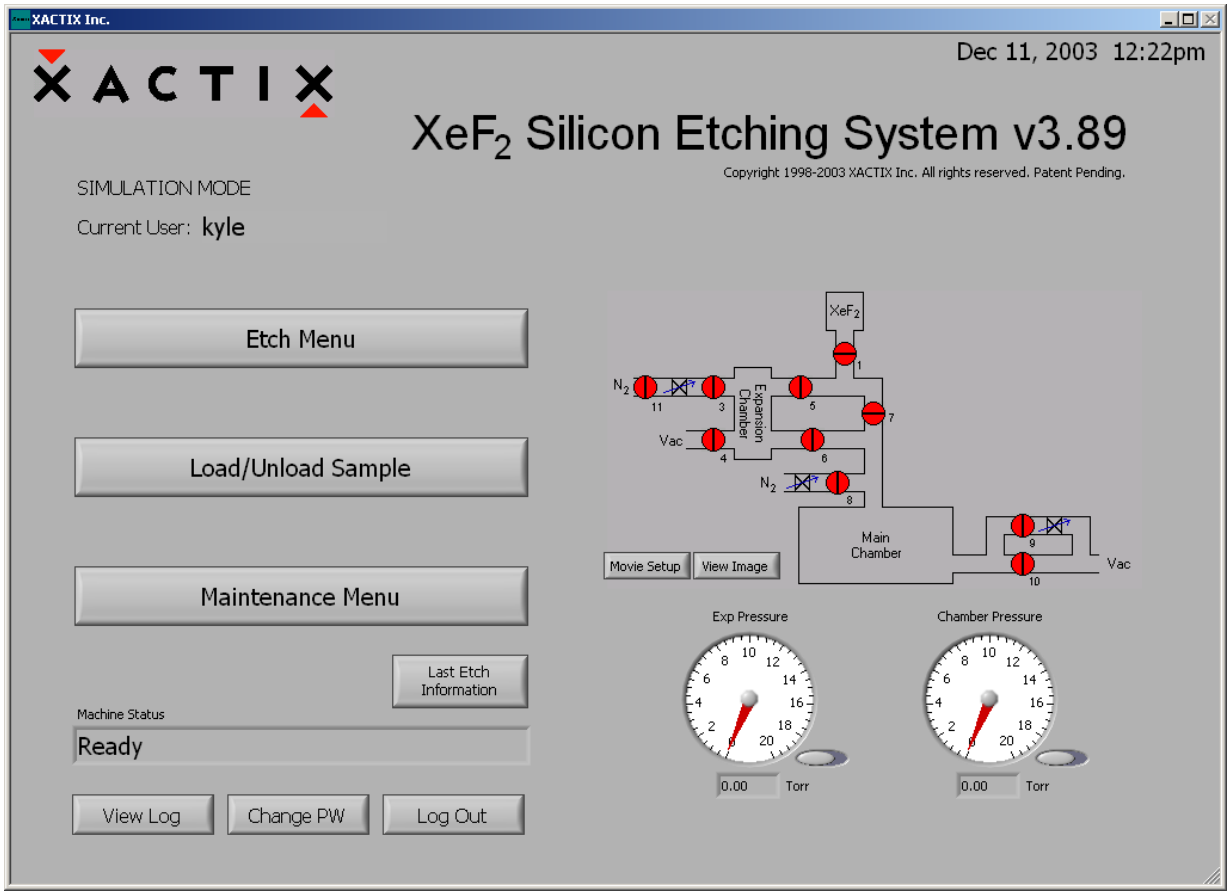
The time to complete the bottle change is typically between 20 to 30 minutes.

8.1.2 Changing XeF2 Bottle

WARNING

IT IS IMPERATIVE THAT THESE DIRECTIONS BE FOLLOWED EXACTLY TO SAFELY CHANGE THE XENON DIFLUORIDE BOTTLE.

Beginning from the Main Menu screen, click on *Maintenance Menu*.



To change the gas bottle click on the top right button, *Change XeF_2 bottle*, shown in Figure 36.

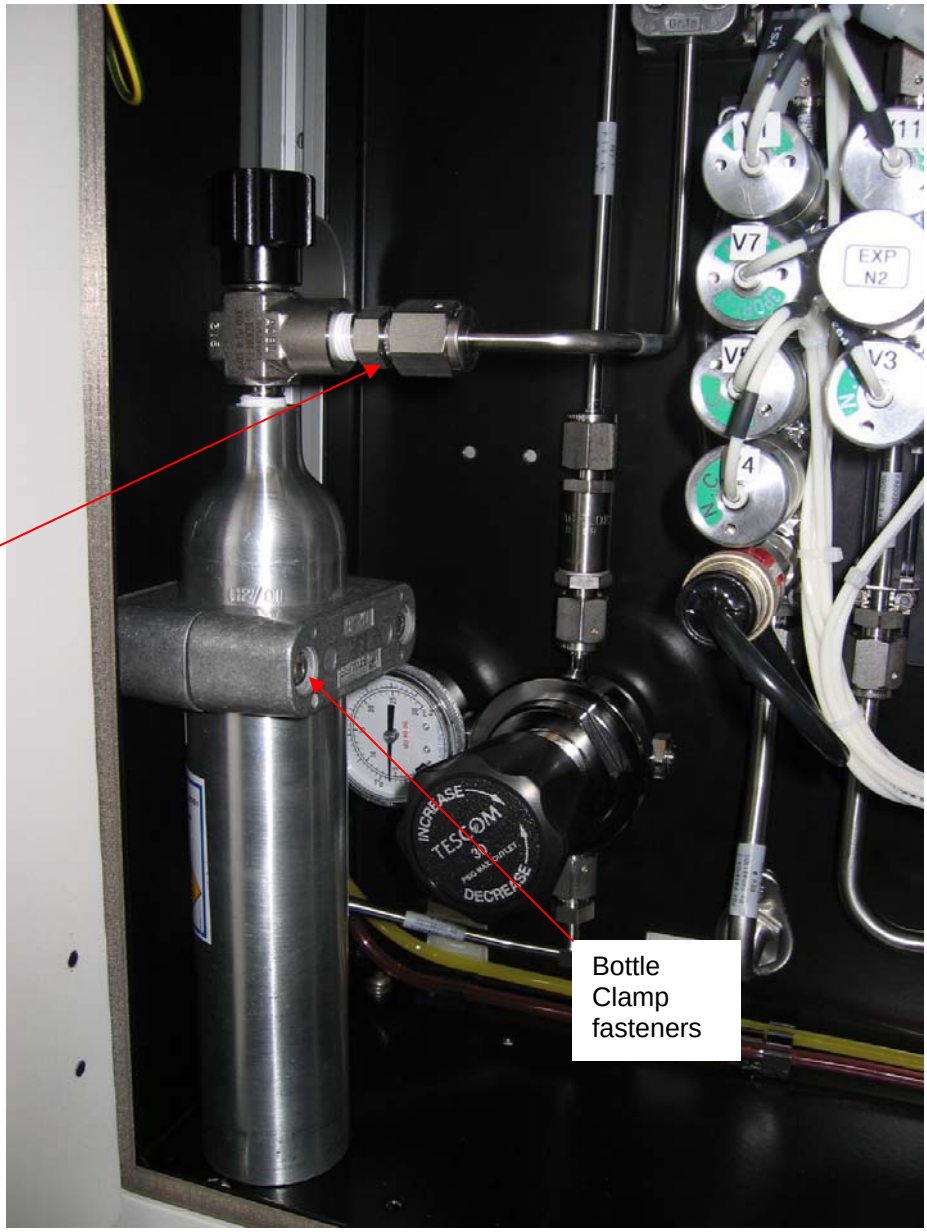


Figure 35. Bottle connection location.

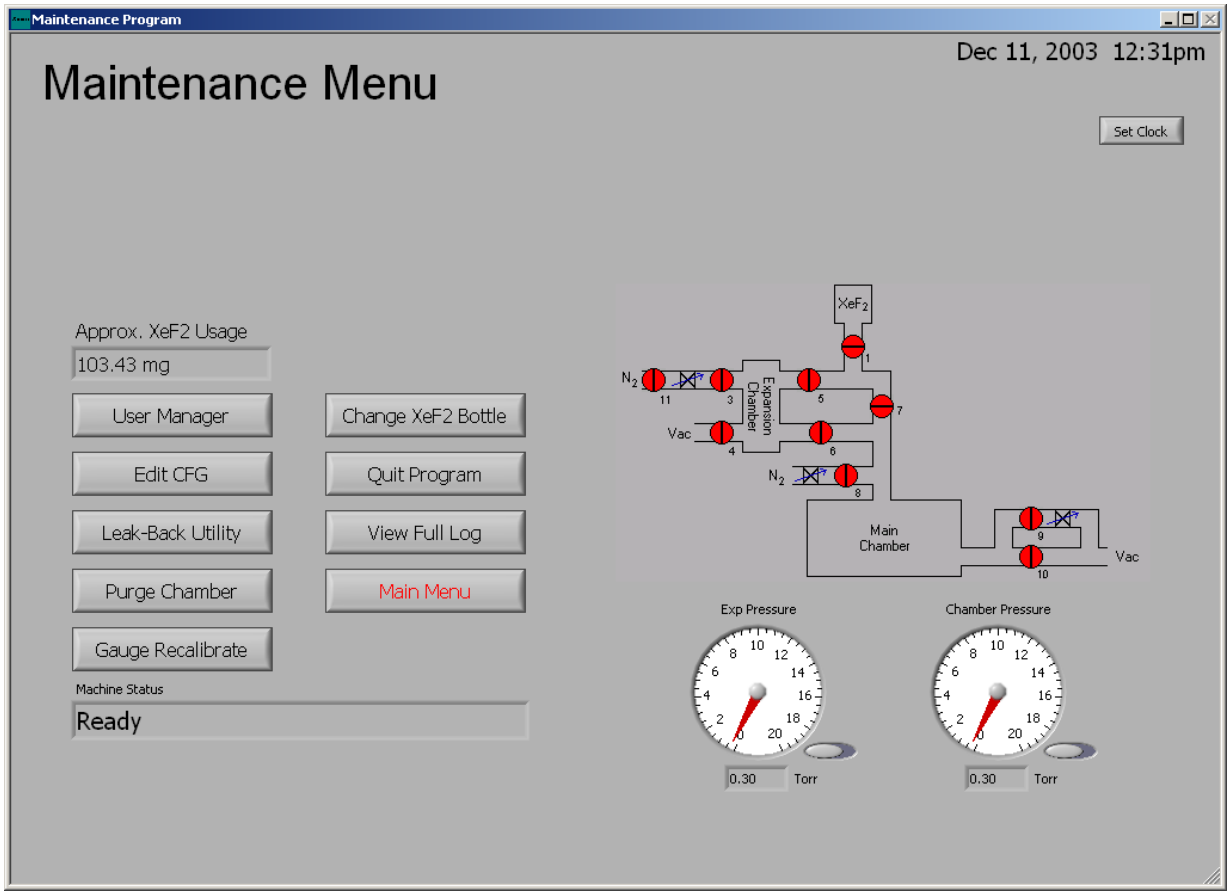


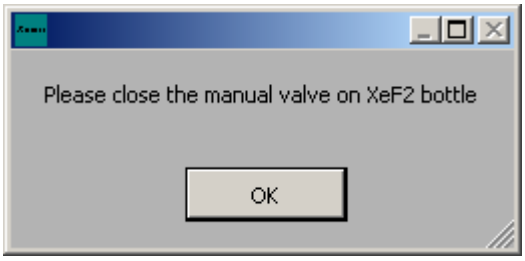
Figure 36. Maintenence menu.

The e1 Series will automatically test the pressure of the bottle. This provides a test method to qualify XeF_2 pressure at any point in time as shown below.

Please note that the 2 Torr value used below is an illustration and your organization may decide to choose another pressure value to make the bottle change determination.

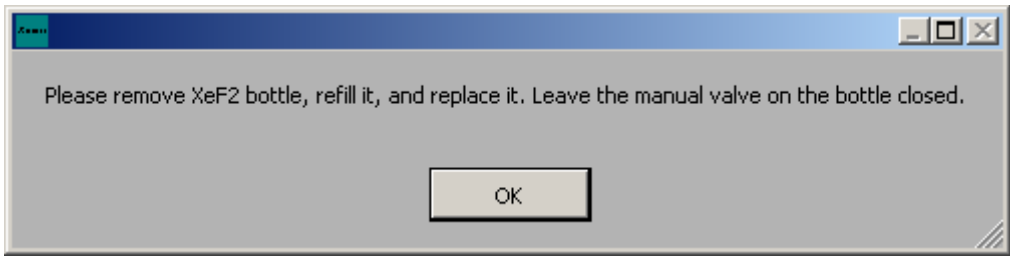
For example, if the pressure displayed is above approximately 2 Torr, click NO and you will be returned to the maintenance menu. If the pressure is below approximately 2 Torr, click YES, and the bottle change will continue.

If you have chosen to change the XeF_2 bottle, you will be instructed to close the manual valve on the bottle. Once you have closed the bottle valve, click OK as shown below.



NOTE: Clicking Stop Button At Lower Right Can Stop Process At Any Time

The e1 Series will proceed to clear out or purge the lines to assure all XeF_2 gas is removed from the system lines. This will take approximately 5 minutes. You will then be instructed as below to remove the gas bottle, refill it, and replace with full bottle. Be sure to leave the manual valve closed.



Removing Gas Bottle

To remove the XeF_2 bottle you have chosen, use a 3/4" standard wrench on the female or larger nut. You will also use a 5/8" standard wrench on the male or smaller nut that is attached to the bottle. The male nut is held firmly, while rotating the wrench on the female nut to loosen the female nut.

WARNING

THERE MAY STILL BE RESIDUAL XENON DIFLUORIDE IN THE REMOVED BOTTLE SO BE CERTAIN THAT THE BOTTLE VALVE REMAINS CLOSED.

Replacing Gas Bottle

Before reattaching the gas bottle after verifying the old gasket is removed, a nickel-plated Swagelok gasket (NI-4-VCR-2-VS) must be inserted between the male and female nuts to insure a good seal (see A. in Figure 37). A retainer gasket (NI-4-VCR-2-GR-VS) is also available and acceptable to use on the Xetch, the retainer gasket makes completing the seal less complicated by attaching itself over the VCR fitting gland. The un-retained gaskets require balancing the fittings until finger tight is established but can certainly be used successfully. Use latex gloves when handling the gaskets to prevent dust or grease degrading the seal's performance. If the gasket falls on the floor or is suspected of having scratches, THROW IT AWAY. If not, you could damage the VCR gland or face. Mate the male and female nuts to finger tight by turning female nut clockwise (see B. in Figure 37). Mark the male and female nuts position with a line across each to establish 1/8 turn (see C. in Figure 37). Then holding the lower male nut firmly with the 5/8" wrench, turn the upper female nut with the 3/4" wrench clockwise 1/8 turn (see D. in Figure 37). Note that over tightening may damage the VCR gland and under tightening may result in poor gasket seal.

CAUTION

The steps on the next page must be followed exactly to ensure proper gasket installation.

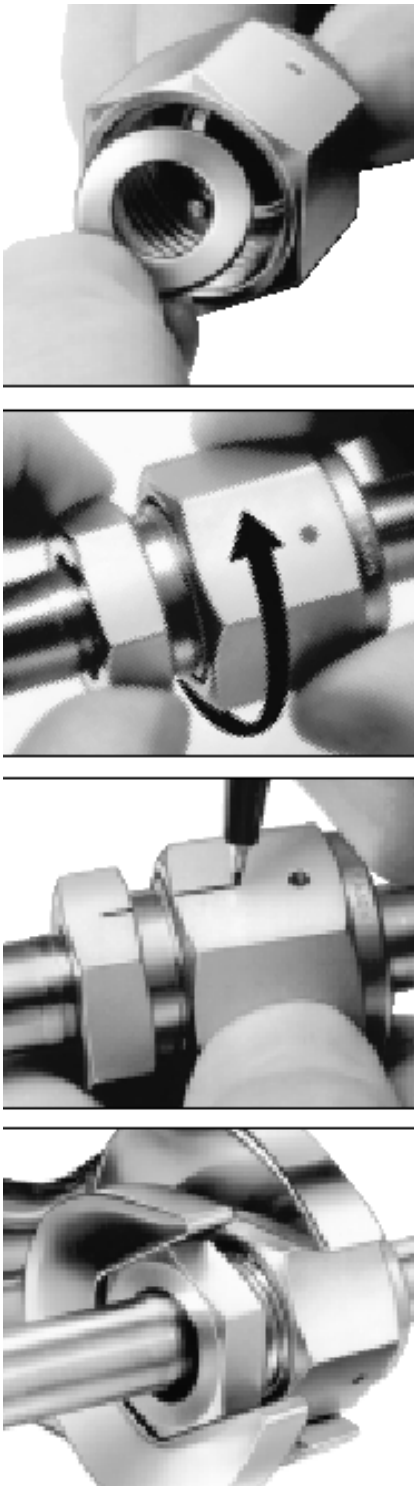
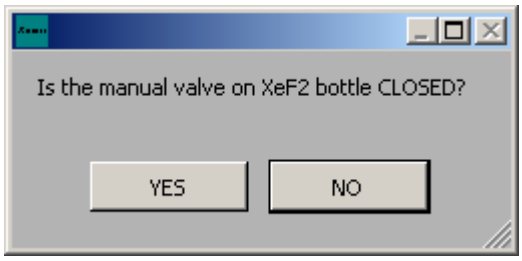


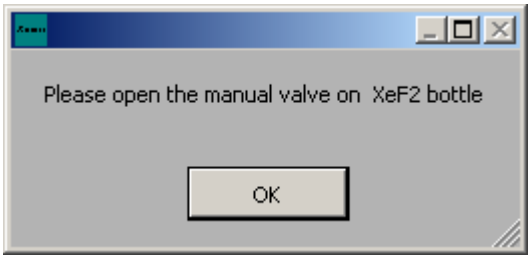
Figure 37. VCR Gasket Assembly Procedure (Image from www.swagelok.com).

The e1 Series will ask you to double check that the manual valve is closed on the bottle. When positive that valve is closed click “YES”. If you decide not to change bottle and continue, click “NO”. If NO was selected you will be to the previous screen and must click “YES” once bottle is removed, refilled, and replaced.



Once again, the e1 Series will purge the lines to ensure a clean system before any XeF_2 is present, and leak test fittings to ensure a proper seal. If the seal leaks, a failure prompt will appear. Recommended steps would be to restart the leak-test up to three times by clicking yes, then check that the female nut is sufficiently tight. If leak still exists, replace the gasket.

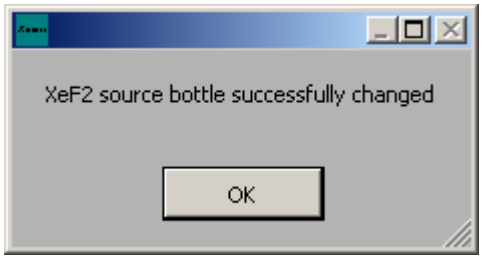
If leak-test is passed Click “YES”, and you will be prompted as shown to open manual valve on bottle. Turn manual valve counter clockwise to open. Click “OK” when task is complete.



At the end of the bottle change, the software will request the mass of the XeF_2 in the replaced cylinder. This information will be used to issue and optional warning if the XeF_2 is estimated to be running low.

8.1.3 Completing Bottle Change

If the e1 Series accepts all parameters the bottle will then have been changed successfully. Click “OK” as illustrated on the prompt screen below.



If it is desired to test the integrity of the bottle and valve connection and the bottle valve, it is suggested to run the procedure described in Section 9.10.2.

9 Service & Maintenance

WARNING

SERVICE AND MAINTENANCE SHOULD ONLY BE PERFORMED TO THOSE INDIVIDUALS WHO UNDERSTAND THE RISKS OF EXPOSURE TO XEF2 AND ARE FULLY TRAINED IN THE MAINTENANCE ACTIVITIES FOR THE SYSTEM.

9.1 Lockout / Tagout

To ensure that power is removed from the system and cannot be accidentally energized, a Lock-out / Tag-out procedure should be used. To perform a Lockout / Tagout, it is recommended to place an electrical plug lockout and tagout (see Figure 38) on the system's electrical power plug (from the Power Controller Box, Figure 13).

Figure 38. Electrical plug lockout and tagout.

9.2 Adjusting Nitrogen Flow Rates

9.2.1 Main Chamber

The fill rate of the Main Chamber is determined by the nitrogen regulator setpoint (see Figure 18). It is normally set to 10 psi, but may be set to higher or lower pressures. Higher pressures will increase the vent rate of the chamber and lower pressures will decrease the rate. The actual rate of nitrogen flow is actually controlled by an orifice with a small hole which by varying the inlet pressure (via the regulator), meters the nitrogen flow rate.

Note that the regulator does not bleed off pressure and therefore reducing pressure will require the flowing of nitrogen through the system to see a drop in pressure. It should also be noted that changing this pressure will also affect the nitrogen fill rate of the expansion chamber and therefore some adjustment to the needle valve may be necessary.

9.2.2 Expansion Chamber

The fill rate of the expansion chamber is normally controlled by adjusting the needle valve shown in Figure 39. Be careful not to overtighten the valve since it can lead to serious damage.

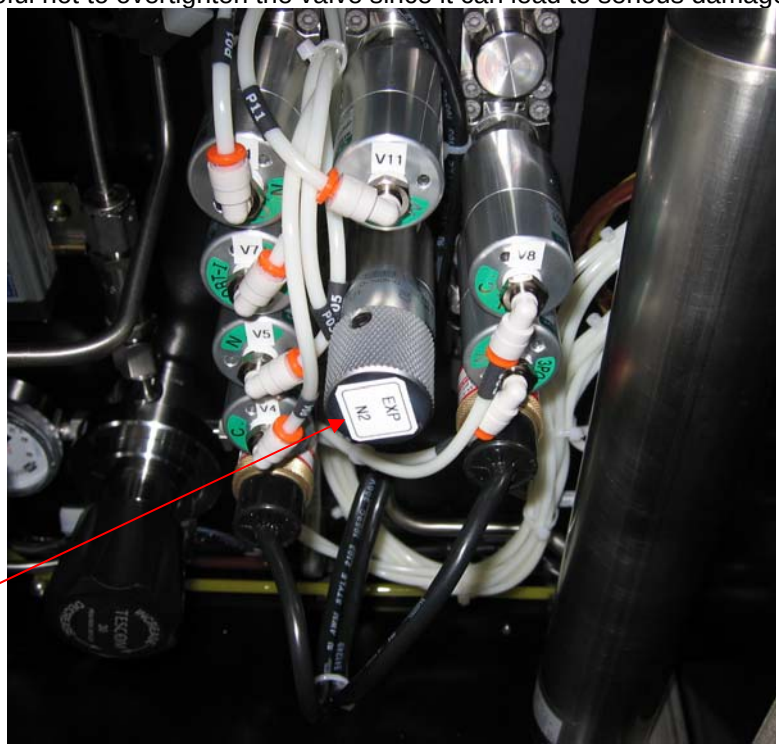


Figure 39. Needle valve located in the gas box.

If it is not possible to fully control the flow through this adjustment, it may be necessary to also adjust the nitrogen regulator setpoint (see Figure 18).

9.3 Roughing Pump

The e1 Series ships with an Edwards XDS5 dry scroll pump. This pump does not use oil and therefore the maintenance is considerably less than a rotary vane pump. The primary maintenance is the replacement of the tip seal, which Edwards typically recommends performing this less than 30 minute operation on an annual basis. Please see the XDS5 manual for more details.

9.4 Showerhead hole plugs

For maximum uniformity, the showerhead can be plugged with Teflon plugs. A length of Teflon beading is supplied with the tool and small pieces, approximately 1 cm long should be cut as needed as shown in Figure 40. The cuts should be on a 45 degree angle to aid in the insertion of the plug into the showerhead.

Figure 40. Teflon beading and pieces that have been cut from it using a razor blade.

Insert the plug into the showerhead with pliers as shown in Figure 41. ***Be very careful not to scratch the showerhead.*** The plug should only be inserted far enough to hold the plug in place. The excess of the plug can be trimmed using wire cutters as shown in Figure 42, ***leaving approx. 1-2 mm exposed so that the plug can be easily removed.***

Figure 41. Plug insertion with pliers.

Figure 42. Cut off excess teflon.

9.5 Gas Box Heater

A small heater is supplied with the system to slightly elevate the temperature of the gas box (see Figure 43). The primary purpose of this heater is to maintain the gas box at a warm temperature (25-30 deg C). The need for heating is most critical for very cold facilities since the sublimation pressure of xenon difluoride is very temperature sensitive and low temperatures will reduce the maximum xenon difluoride pressure. The heater is a Positive Temperature Coefficient heater (PTC) which means that as it gets warmer, its heat output falls which prevents the gas box from overheating. If it is desired to disconnect the heater, it can be disconnected at the connector shown in Figure 44.

Figure 43. Gax box heater.

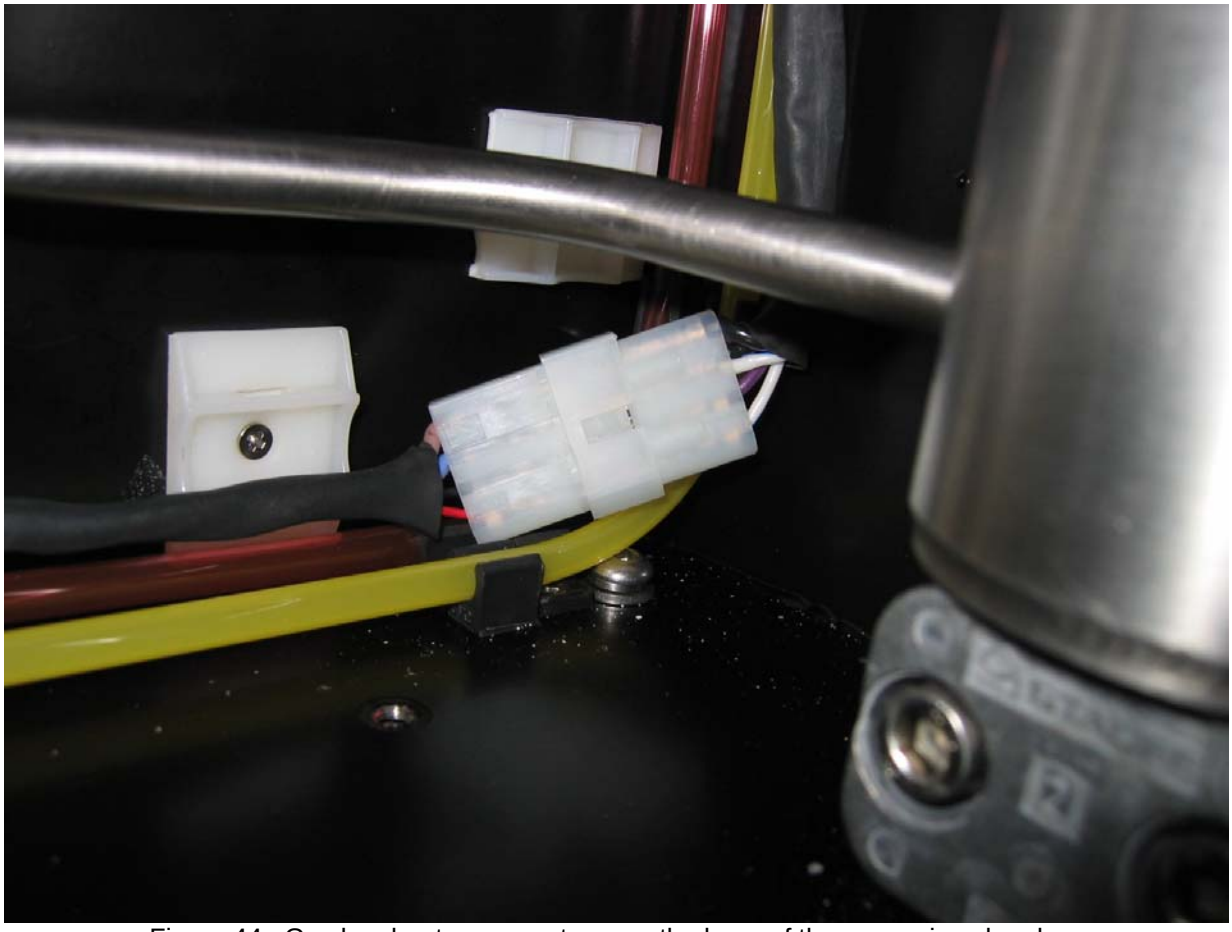


Figure 44. Gas box heater connector near the base of the expansion chamber.

9.6 Vacuum Interlocks

The e1 Series has two vacuum interlocks, one to make certain that the chamber is below approximately 375 Torr of pressure before permitting the source bottle valve (Valve 1) on the gas panel to open. The other interlock prevents all valves on the gas panel from opening if the pressure at the main vacuum line is above approximately 375 Torr.

9.6.1 Chamber interlock

The purpose of the chamber interlock is to make certain that there is not an accidental release of xenon difluoride from the source bottles via the chamber. The operation of the interlock is performed by first detecting if the vacuum pressure is below approximately 375 Torr using the chamber vacuum switch shown in Figure 45. If the pressure in the chamber is above 375 torr, valve 1 will not have power to open. It should be noted that this sensor is tested every time that the chamber is vented. If there is a sensor failure, a warning message will be displayed (note that it is necessary for the Show Warnings setting to be enabled in the System Configuration Menu any warning messages to be displayed). This test is performed by the computer verifying that the chamber vacuum switch trips during venting,

9.6.2 Vacuum interlock

The purpose of the vacuum interlock is to prevent any valve from opening if the vacuum to the system is insufficient. The logic is that if there is not sufficient vacuum to the system, it is not safe to allow the opening of valves. The primary causes of this interlocked situation would be a pump failure or a break in the connection between the system and the pump. The operation of the interlock is performed by first detecting if the vacuum pressure is above or below approximately 375 Torr using the main vacuum switch shown in Figure 45. If the pressure is below 375 torr, all valves, except possibly valve 1 (see above) are ***permitted*** to operate. Otherwise, even if the computer sends a signal via the DeviceNet

interface to open any of the valves, they will not have the power to open. If there is a main vacuum failure, a warning message will be displayed (note that it is necessary for the Show Warnings setting to be enabled in the System Configuration Menu any warning messages to be displayed).

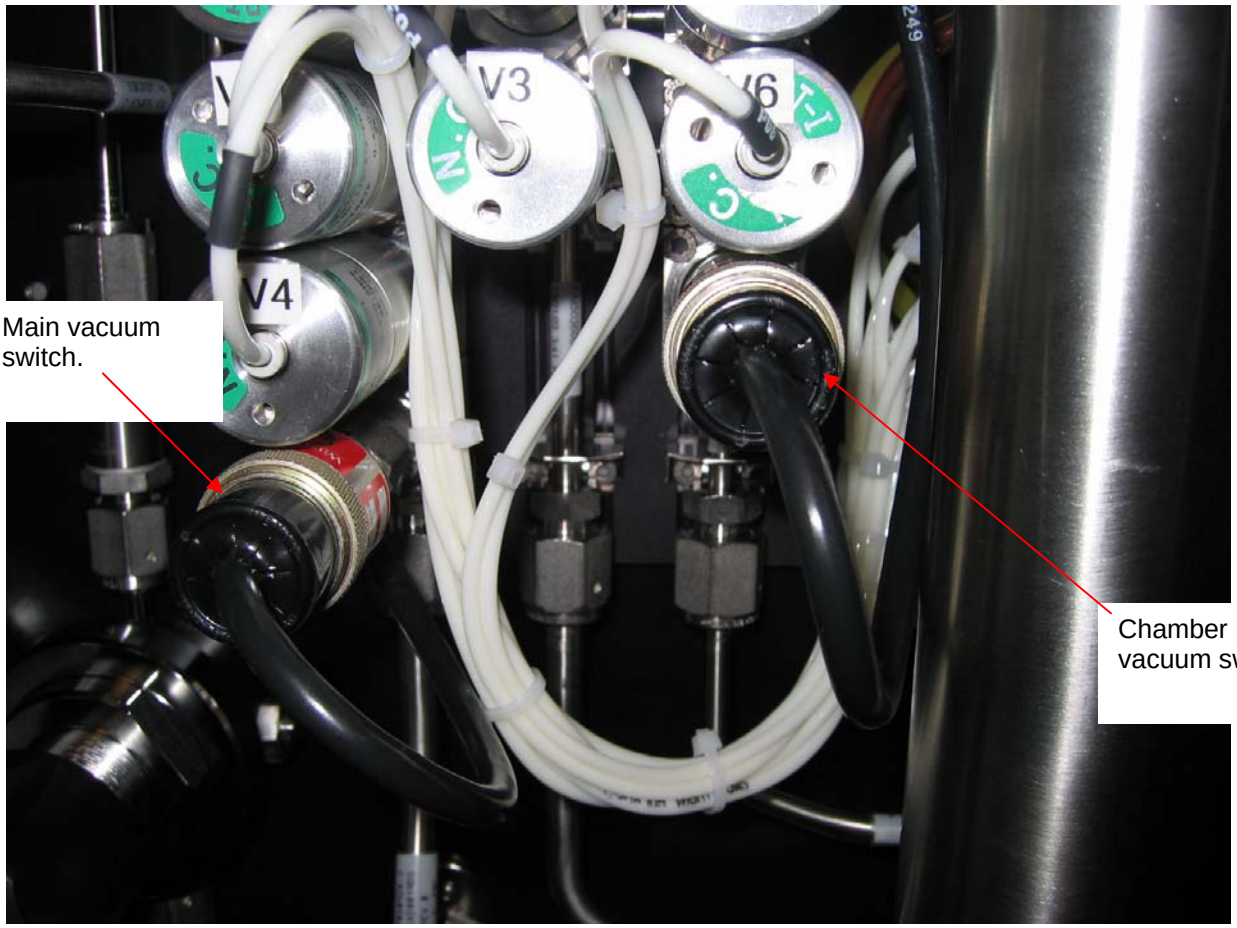


Figure 45. Vacuum interlock switches.

9.7 Manual valve operation

Figure 46. Valve manifold which is mounted on the outside of the gas box towards the front of the system.

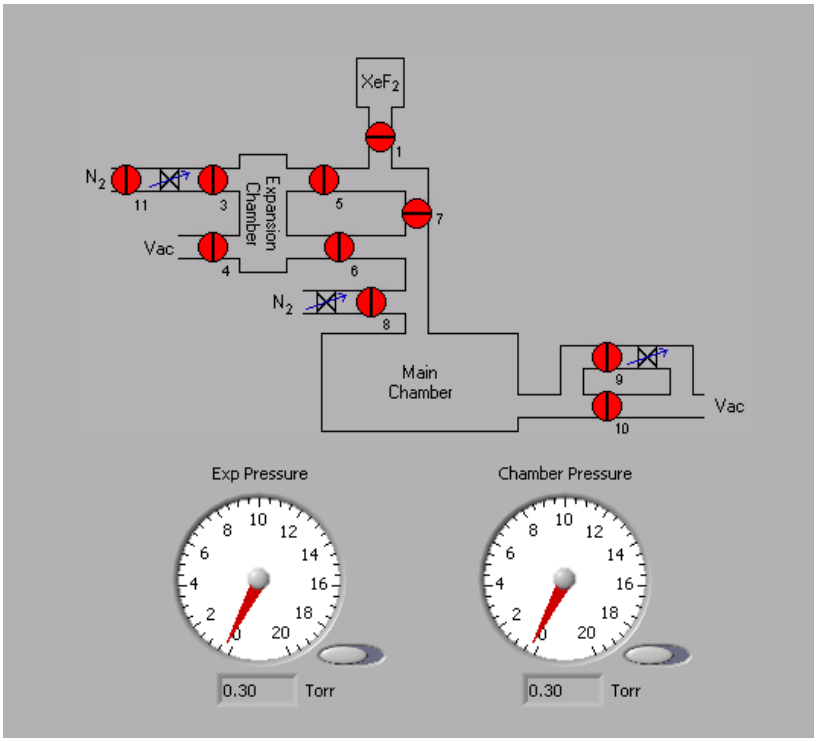


Figure 47. Valve diagram.

WARNING

MANUAL OPERATION OF THE VALVES COULD LEAD TO DAMAGE TO THE EQUIPMENT OR HARM TO PERSONNEL. MANUAL VALVE OPERATION IS INDEPENDENT OF INTERLOCKS AND SHOULD ONLY BE PERFORMED BY TRAINED PERSONNEL.

In service or maintenance circumstances, only to be performed using trained personnel, where manual operation of the valves is necessary, manual valve operation can be accomplished using a small allen wrench or other small, pointed object. The valve manifold, see Figure 46, has 16 buttons that can be pressed to force a valve to open. For reference, the valve diagram for the system is shown in Figure 47.

9.8 Ventilation shroud interlock

The ventilation shroud is interlocked via a safety switch/lock mechanism as shown in Figure 48. This mechanism is controlled via the PC and the input/output signals related to this interlock are communicated through the device shown in Figure 49.

If it is necessary to override the Ventilation shroud interlock, a pair of keys is provided that are used to unlock the shroud.

Figure 48. Ventilation shroud interlock with key to override lock.

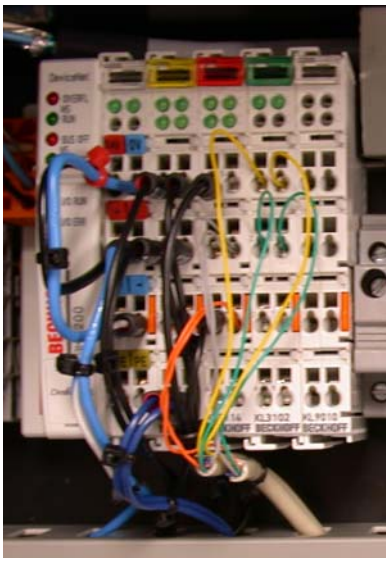


Figure 49. I/O signals are communicated via this unit to the PC.

9.9 System startup through Normal issues

If the software startup through the Normal starup procedure does not complete within 1 hour of starting the software, there may be a problem. Please follow the below steps:

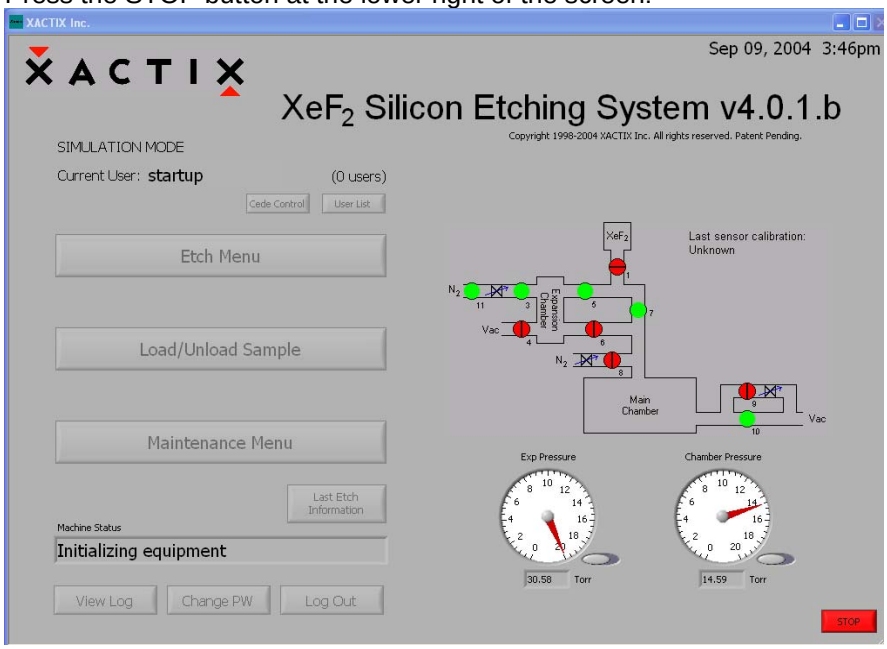
1. Be certain that the system (not the computer) has been powered on for more than 4 hours
2. The room temperature should be less than 75 deg. F (24 deg. C). Reduce the room temperature to achieve this and wait for 1-2 hours.
3. If the problem is not solved by this point, record the pressure reading values of:

   Main Chamber: _____ Torr

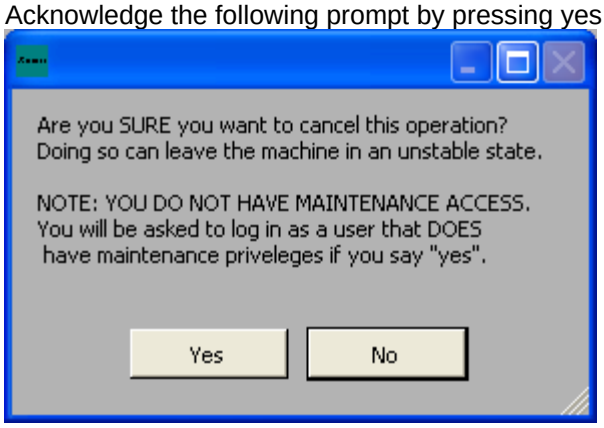
   Exp. Chamber: _____ Torr

email these values to support@xactix.com . Continue on with the procedure.

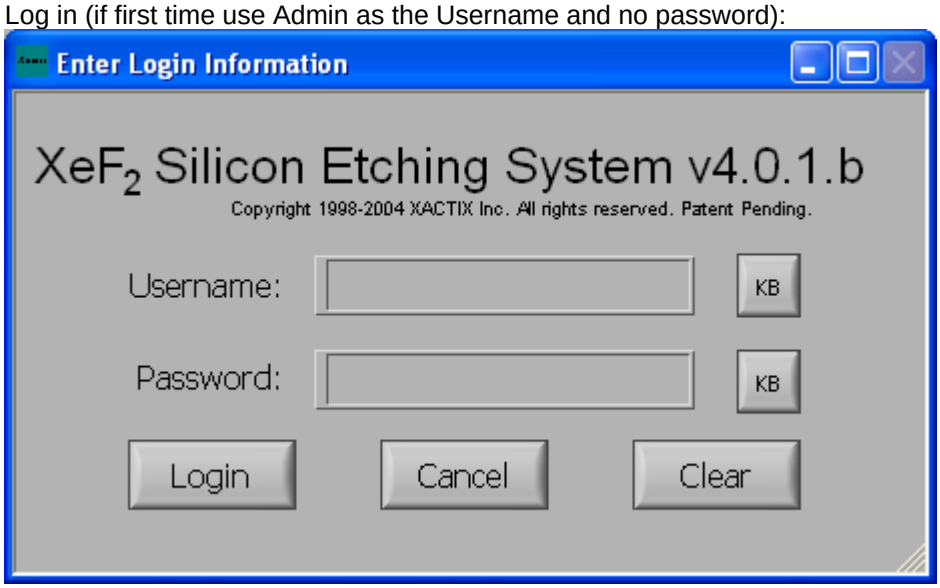
4. Press the STOP button at the lower right of the screen:



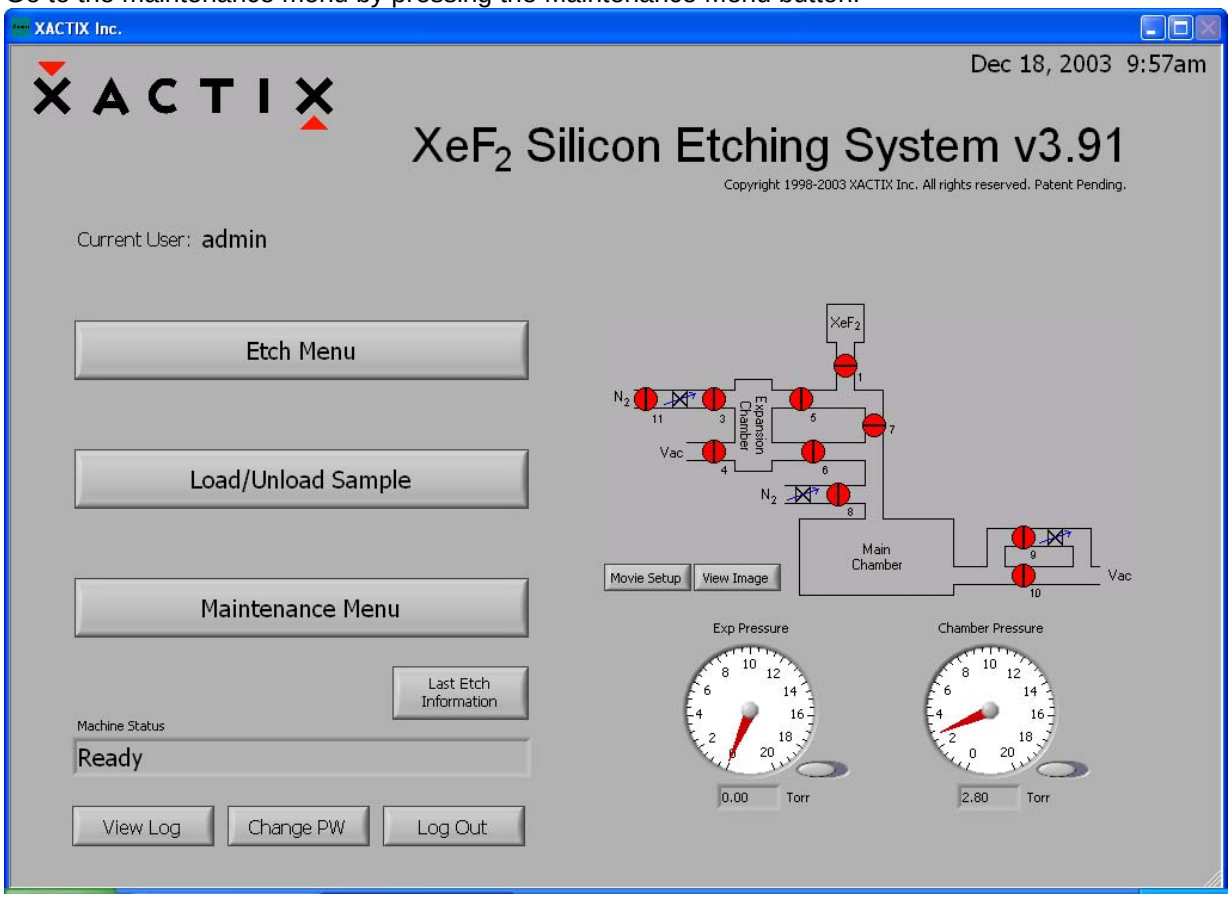
5. Acknowledge the following prompt by pressing yes:



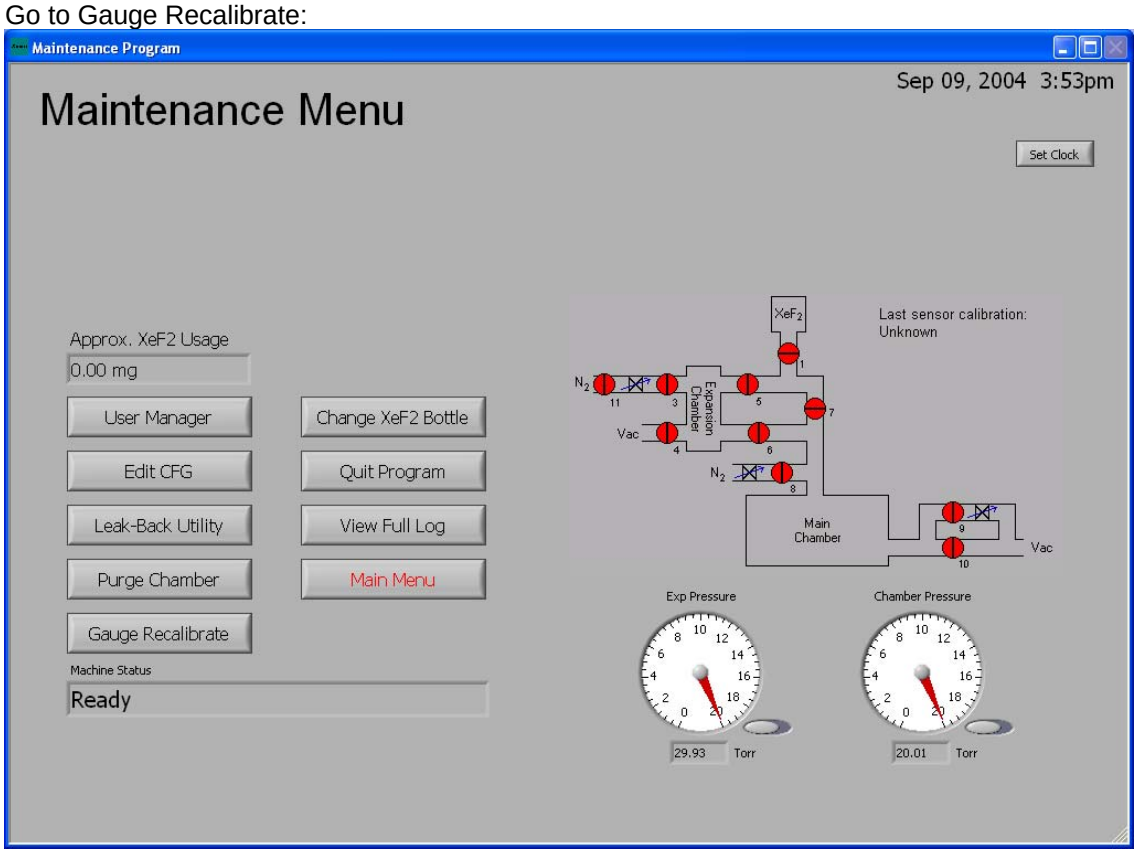
6. Log in (if first time use Admin as the Username and no password):



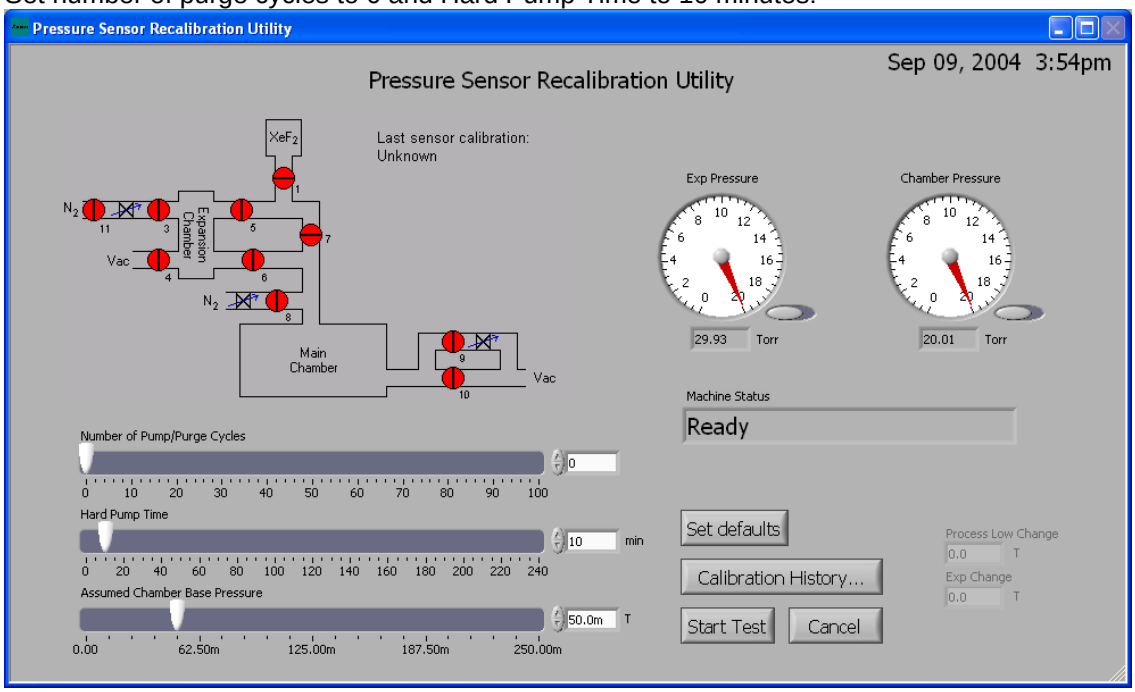
7. Go to the maintenance menu by pressing the Maintenance Menu button:



8. Go to Gauge Recalibrate:



9. Set number of purge cycles to 0 and Hard Pump Time to 10 minutes:



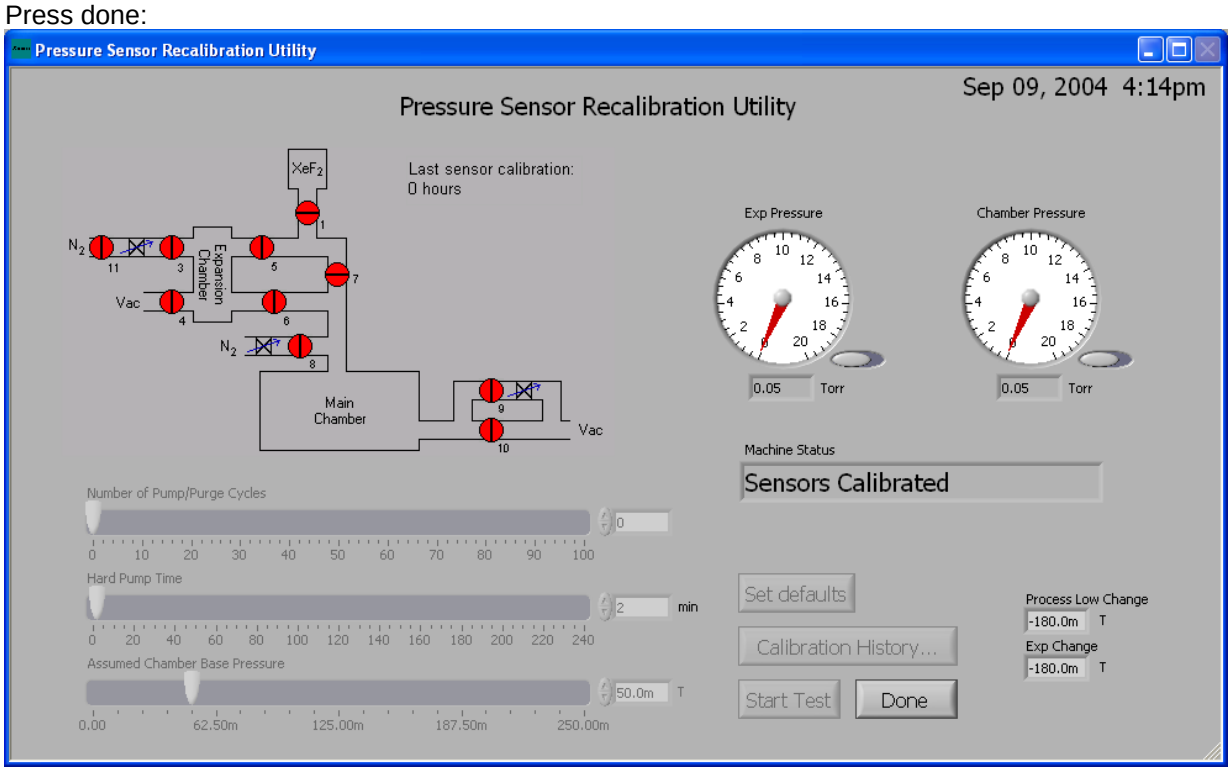
10. Press Start Test and wait for procedure to end. Record the:

    Process Low Change: _____ Torr

    Exp Change: _____ Torr

    which are the values displayed at the completion of the Pressure Sensor Recalibratioin Utility (see below) that correspond to the offsets of the gauges. Please send these values to support@xactix.com and continue on with the procedure.

11. Press done:



12. The Main Menu will be displayed. Go to the Maintenance Menu and press Quit Program. Acknowledge the prompt by pressing YES to quit the program.
13. Restart the Xetch software, which can be found in the Start menu or at C:\Program Files\Xactix\xetch.exe
14. Allow the system to start up through normal mode
15. Rerun the Gauge Calibration utility, but this time use the defaults of 3 purge cycles, 60 minutes of Hard Pump, and 50 mTorr base pressure

9.10 XeF2 Bottle/Valve/Fitting Leak

If a leak at the bottle, the valve, or the fitting is suspected, follow the procedures in this Section. See Figure 50 for possible leak areas that are described in this Section. Note that newer bottles have a welded VCR fitting which virtually eliminates failure area 1 below. Furthermore, diaphragm valves are also now being used which are much less likely to have leaks inside of the valve itself.

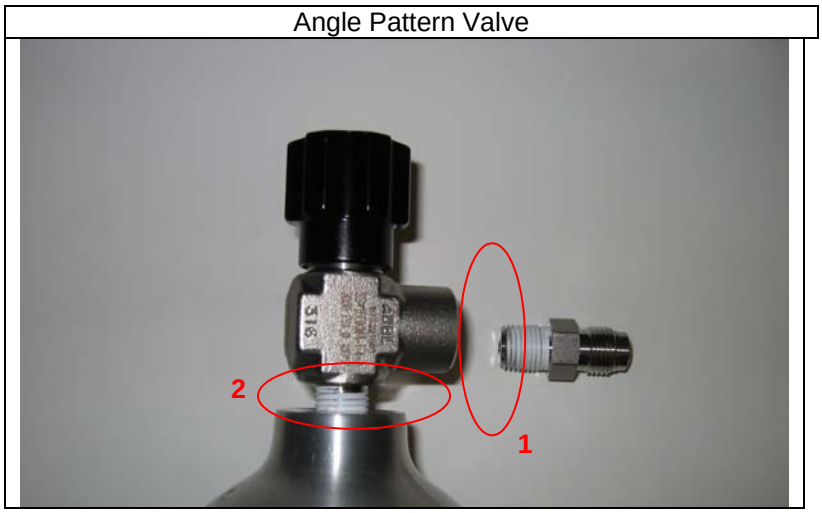


Figure 50. Possible leak areas. Item 1 is the connection between the ¼" NPT to VCR adapter and Item 2 is the connection between the bottle valve and the bottle.

9.10.1 Leak check bottle #1 connection and NPT to VCR adapter

Step Number	Step	Completed (Initials)	Notes
9.10.1.1	Using the Maintenance Menu (see Section 7.10), Open V4 for 10 minutes		
9.10.1.2	Close V4		
9.10.1.3	Wait 25 minutes. If the pressure in the expansion chamber does not rise by more than 0.2 Torr over this period then the expansion chamber is considered to be leak tight. If it does exceed this pressure change, there may be a leak in the expansion chamber.		
9.10.1.4	Close the manual valve on the XeF2 bottle.		
9.10.1.5	Open valves 4, 5 and 1		
9.10.1.6	Wait 5 minutes to complete pump down.		
9.10.1.7	Close V4.		

9.10.1.8	Wait 25 minutes. If the expansion chamber pressure changes by 0.2 Torr or more then there is a probably leak in the connection to the bottle or at the NPT to VCR adapter. Tighten the VCR connection slightly and see if that solves the leak. If not, continue to pump for another 5 minutes to remove any XeF2 left in the lines and close the valves. Loosen the VCR connection to the bottle and check the tightness of the NPT to VCR adapter in the bottle valve. Replace the gasket at the bottle VCR fitting and rerun the leak test starting at Step 9.10.1.5.		
9.10.1.9	If this procedure continues to fail, remove the bottle and install a VCR plug with a new VCR gasket. Rerun the procedure starting at Step 9.10.1.5.		
9.10.1.10	If Step 9.10.1.9 passes, remove the NPT to VCR adapter, remove any Teflon tape, re-apply a fresh wrap of Teflon tape, and re-install into the system. Rerun the procedure starting at Step 9.10.1.5 and this should solve the problem. If Step 9.10.1.9 does not pass, it may be necessary to use a helium leak detector to check for other leaks.		

9.10.2 Bottle and valve leak check for bottle

Step Number	Step	Completed (Initials)	Notes
9.10.2.1	Go to maintenance menu if not already there		
9.10.2.2	Make sure the valve on the bottle is open		
9.10.2.3	Open V5, V4, and V1 and pump down for 1 minute.		
9.10.2.4	Close V4		
9.10.2.5	Monitor the pressure in expansion chamber 1, writing down the pressure readings every minute, it should initially quickly rise, the level off to a stable pressure typically between 2 and 12 Torr within 10 minutes. If the expansion chamber pressure continues to rise at more than 0.02 Torr/minute beyond this point then there may be a leak, otherwise, the bottle and line are considered to be leak tight. Continue to watch the pressure rise for a total of 30 minutes for signs of the leak slowing down. Email these results to support@xactix.com .		01min: 02min: 03min: 04min: 05min: 06min: 07min: 08min: 09min: 10min: 11min: 12min: 13min: 14min: 15min: 16min: 17min: 18min: 19min: 20min:
9.10.2.6	If there is a large leak, then it is probably at the connection between the valve and the bottle. Close the main bottle valve, open V1, V4, and V5 and pump for 10 minutes. Close the valves and remove the bottle. Try to tighten the valve into the bottle. If some tightening is possible, reinstall and re-run the above test starting at Step 9.10.2.1. If not, then the XeF2 vendor should be contacted so that they can fix the problem.		

9.11 Main Chamber Leak check

If a main chamber leak is suspected, perform the following sequence of tests. Most apparent leaks are actually trapped gas in the showerhead and are not usually leaks.

Step Number	Step	Completed (Initials)	Notes
9.11.1	Using the Maintenance Menu (see Section 7.10), Open V10 for 30 minutes		
9.11.2	Close V10		
9.11.3	Wait for 2 hours. If the pressure in the main chamber does not exceed 10 Torr, the chamber is considered to be leak tight.		
9.11.4	If the main chamber is exceeds this pressure, check that there is no debris on the main o-ring on the chamber. If any debris is found, remove the debris and rerun the test start at step 9.11.1. Contact XACTIX at support@xactix.com if this does not address the problem.		

10 Contact Info

We thank you for your business and value the trust you have placed in our Company.

We always welcome suggestions and comments regarding our products and our services. Please feel free to contact:

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