Evactron® 25/45 De-Contaminator RF Plasma Cleaning System

Operator's Manual

04/14/2010 Version

XEI Scientific, Inc.

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SAFETY

Interlock mechanisms control the RF Generator. To satisfy the interlock conditions, it is required that the RF cable be connected. Additional safeguards are provided for the protection of the vacuum system. The Oxygen Radical Source must be connected to the RF Output in order for the RF to turn on. The cable between the Controller and the ORS should not be disconnected when the RF is on. Doing so will disable the RF generator.

The AC power is controlled by energizing the "POWER" switch. Loss of AC power will disable the unit and cause the valves to close thus protecting the vacuum system.

The RF Plasma produces UV radiation at low levels inside the ORS chamber. In a closed vacuum system, this UV radiation cannot escape and is not an issue. In a system with glass or plastic windows the radiation is filtered out and is not an issue. In a quartz windowed chamber, UV filters such as eye glasses must be used to block the radiation from reaching the naked eye.

LOCK-OUT, TAG-OUT Procedure: If your company requires a Lock-out, Tag-out, the following procedure may be used. 1. Remove power cord from AC Input in rear panel. 2. Place Lock-out device into AC Input. An example of this device is sold by LabelMaster, Part # H-LO320 (www.labelmaster.com, address: LabelMaster, ATTN: Customer Service, 5724 North Pulaski Road, Chicago, IL 60646, phone number: 1-800-621-5808). 3. Lock-out Evactron De-Contaminator power with the lock-out device and a company approved lock. Tag-out with label per your company's procedures.

CAUTION: Electro Static Discharge (ESD) may cause the unit to malfunction. If an ESD event occurs, the unit is designed to cease the cleaning operation and close the gas valve. To restart the cleaning cycle, bring the pressure in the vacuum chamber to above 2 Torr.

Safety Symbol Legend:

Symbol	Meaning
~	Alternating Current
⚠ (lightning)	Caution, Risk of Electrical Shock
⚠	Caution, Risk of Danger
⏛	Fuse

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Evactron® 25/45 De-Contaminator

Manual

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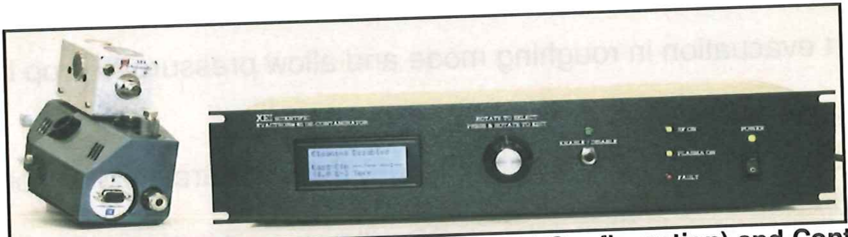

Evactron 45 Oxygen Radical Source (Horizontal Configuration) and Controller

Evactron 25 Oxygen Radical Source (Horizontal Configuration) and Controller

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1. Operating Instructions Quick Start, BASIC Cleaning Procedure

1.1. Turn Evactron De-Contaminator On.

1.2. The green light above Enable button should be on. If it is not, press the Enable Button.

1.3. Check that the Clean Time (in hh:mm:ss format) on the display is the desired length of time. Use the Encoder knob to set the Clean Time. Refer to Section 6 for instructions.

1.4. The factory setting for the N2 PURGE is OFF. If N_2 is connected to the ORS, use the Encoder knob to set it to ON, set the Purge Time to the desired value. Refer to Section 6.

1.5. Set the desired values for pressures and RF power. Factory settings are 0.4 Torr (53 Pascal) and 14 Watts. Refer to Section 6.

1.6. Set the number of Cycles to the number of times that you wish for the cleaning process to repeat. This would typically be 1. Refer to Section 6.

1.7. Vent Chamber to > 2 Torr. Observe vacuum pressure readout on Evactron Controller.

1.8. Restart evacuation in roughing mode and allow pressure to drop below 2 Torr.

1.9. The rest is automatic:

- 1.9.1. When pressure drops below 2 Torr, the pressure stabilization display will appear.
- 1.9.2. When pressure is stabilized, RF will turn on the controller will wait for ignition.
- 1.9.3. The plasma will ignite, produce oxygen radicals and clean the chamber. The timer for cleaning will count down to 0 seconds.
- 1.9.4. RF will turn off, and, if selected, the purge will start. The timer for the purge step will count down to 0 seconds. If the number of Cycles is >1, Steps 1.9.1 to 1.9.4 will repeat until the number of Cycles requested by the user has been completed.

1.10. The instrument will then wait until the chamber pressure drops to or below 50 mTorr. The Evactron D-C is ready again to start another cleaning.

1.11. Repeat cleaning if needed.

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2. Introduction

2.1. The Evactron® 25/45 De-Contaminator (D-C) eliminates Hydrocarbon contamination (HC) by generating localized plasma inside a vacuum chamber. The Evactron 45 Controller is designed to rack mount into a Tool's electronics rack, and it can be operated by the Tool's computer. The Evactron 25 Controller is a tabletop model, and it can also be operated by the Tool's computer. The difference between the 25 and 45 models is the chassis type. All other parts and the operation are the same between models. Oxygen radicals, created from an oxygen containing gas such as room air by the plasma, remove HC from the chamber's interior surfaces and any specimens in the chamber. The Evactron 25/45 D-C is controlled and monitored by front panel controls or through an RS232 interface.

2.2. The Evactron 25/45 D-C controls the system chamber vacuum to a preset level by adjusting a leak to a vacuum gauge reading that maintains chamber pressure at optimum plasma efficiency during cleaning periods. Evactron 25/45 D-C maintains stable RF power by a feedback loop from the power sensor to a preset RF level.

2.3. The Evactron 25/45 D-C consists of two major components: the Oxygen Radical Source (ORS) and the Controller that are connected by a cable bundle. The ORS is mounted to a port on the SEM Chamber or other vacuum chamber. Evactron cleaning takes place on the line of flow between the ORS and pumping port. An interface flange may be needed between the KF40 flange of the Evactron and the port.

2.4. The Evactron 25/45 D-C cleaning process occurs separately from the Tool's analytical functions. If a sample, a wafer or other specimen, is in the chamber during cleaning, it will also be cleaned.

2.5. The Evactron 25/45 D-C is designed for operation from either a remote computer or the front panel. Microprocessor control allows the use of a front panel encoder for setting parameters in menus on the front display. An RS232 interface allows for the programming of operating parameters from a computer. If the control computer does not have a standard RS-232 port, a USB-to-serial converted may be used instead. XEI recommends the Edgeport/1 from B&B Electronics Manufacturing Company. (www.BB-elec.com, 1-815-433-5100).

2.6. The user goes through a series of steps to start the cleaning process. The cleaning process is enabled by first pressing the Enable button or through the computer interface. Second, the evacuation system controls of the target vacuum system are used to start Evactron Cleaning. By raising the pressure of the vacuum chamber to above 2 Torr or 270 Pa and then restarting evacuation, the cleaning process is initiated. Upon completion of the cleaning process, the Evactron returns control to the vacuum system.

2.7. The Evactron 25/45 D-C cleaning process consists of one or more of the following cycles. These cycles can be repeated multiple times. A cycle consists of a series of sequential states, during which the chamber pressure is stabilized, the plasma is ignited, the plasma is run in order to clean the system, and, if requested, a purge is run in order to remove the products of remote plasma cleaning. When a multiple cycle run is set up, the Evactron 25/45 D-C will repeat these operations every time an Evactron cleaning cycle is started.

2.8. Pressure set-points for plasma ignition state, the plasma cleaning state, and purge state can be selected from a menu on the front panel or from external computer control. The set-point for the forward RF power during the plasma cleaning state can also be selected. Duration times for the plasma cleaning and post-plasma purge states are independently set.

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3. Electrical

3.1. Power

3.1.1. Input power: 90 to 250VAC, 50/60Hz, 150W. Integral IEC 320 panel mounted connector.
3.1.2. Fuse: 2 A GDC, 5x20 mm Slow Activity, Short Circuit Current Rating is 35 A
3.1.3. RF output power is rated to 20 Watts @13.56 MHz maximum and normal operating power is 5-20 Watts. The Controller provides 24 VDC for the pressure gauge and outputs for the variable leak valve and purge gas inlet valve.
3.1.4. The DC power output is regulated within 0.5%.

3.2. Configuration and Performance

3.2.1. The Evactron 25/45 D-C ORS consists of a shut-off valve, an electrically controlled variable leak valve, a three-way valve, a Solid-State MicroPirani gauge, RF impedance match circuit, and plasma-generating electrode designed for mounting on a suitable chamber port by a KF40 adaptor flange.
3.2.2. The Evactron 25/45 D-C is designed for indoor use only. Its operating temperature range of operation is 0° - 35° C (32° F – 95° F), and its storage temperature range is -20° - 70° C (-4 ° F – 158° F). It can operate in relative humidity up to 90% maximum non-condensing and up to 3700 m (12,000 feet) above sea level altitude.
3.2.3. The Evactron 25/45 D-C Controller includes AC to DC power, RF power control and electronics to drive/control the ORS and communicate with an external controller.
3.2.4. Input and Output Connections:
3.2.4.1. AC Input (J1): Switched.
3.2.4.2. RF Output (J2): BNC jack carries power to ORS matching network - interlocked for safety.
3.2.4.3. Match (J3): Locking coaxial connector for plasma indicator.
3.2.4.4. Pressure Gauge (J4): Female DB9 connector provides power and reads output to and from pressure gauge.
3.2.4.5. Valves (J5): Round 8-pin connector for valves on oxygen radical source (ORS) and control for vacuum and gas.
3.2.4.6. Remote Interface (J6): Male DB9 connector for serial remote computer interface.
3.2.5. Indicator lights: Power on, Enable switch, RF On, Plasma On, and Fault.
3.2.6. One set of cables connects the Controller to the ORS and a null modem RS232 cable connects the Controller to the Tool computer. An AC power cord connects the Controller to Tool AC power.
3.2.7. An Encoder Knob located on the Controller front panel allows the user to set the operating parameters.
3.2.8. The controller always displays the chamber pressure. When a cleaning cycle is running, the Controller displays Forward and Reverse RF Power

4. Mechanical

4.1. Configuration

4.1.1. The Evactron 25/45 D-C ORS is mounted on a port of a convenient vacuum chamber or chamber lid port determined by the Tool operator.
4.1.2. The Evactron 25/45 D-C ORS KF40 flange mounts to the designated port with an adapter flange. XEI Scientific, Inc. usually provides the Adaptor Flange at an additional, nominal charge. To fabricate the correct Adaptor Flange, a drawing of the port cover flange showing necessary dimensions must be supplied to XEI Scientific, Inc.
4.1.3. The Evactron 25/45 D-C ORS consist of two detachable pieces. One piece is a 2 inch long Assembly with KF40 flanges on both ends containing a Micro Pirani gauge, a three-way valve, a shut-off valve, and a variable leak valve to control vacuum pressure. The second piece has one KF40 flange and consists of the Evactron D-C electrode, an integrated feed through and RF match circuit.

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4.1.4. The Evactron 25/45 D-C ORS has an optional covering, or shroud, around its components. This covering is for aesthetics and is not necessary for operation of the ORS. For the Horizontal Configuration the shroud consists of two pieces. The first piece is attached to the ORS hardware. The second piece surrounds the KF40 flanges and can be detached by the user. Attached to the first piece is the electronic connection for the valves in the ORS. Air holes around the covering insure adequate ventilation of the valves in the ORS. For the Vertical Configuration the ORS hardware and the electronic connection for the valves are attached to the shroud components. There is no removable component.

4.1.5. The inlet for the gas used in remote plasma cleaning is located on one inlet of the three-way solenoid valve at the end of the gas manifold on the ORS. Room air can be used for remote plasma cleaning; a filter is attached to the inlet to prevent particulates from entering the chamber. This filter can be removed using two wrenches in order to attach an external tank of gas to the female 1/8 NPT fitting.

4.1.6. Nitrogen for purging is supplied through the inline inlet fitting on the three-way solenoid valve. A ¼" Swagelok fitting is provided on this inlet.

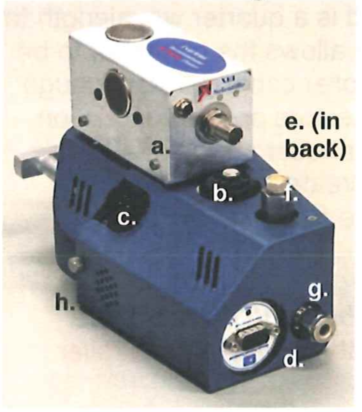
4.1.7. The 19" W X 3 ½" H X 10 ½" D (50cm W X 9cm H X 18cm D) Evactron 45 D-C Controller is rack mounted in the Tool electronics rack.

4.1.8. The 9" W X 5 ½" H X 7" D (23 cm W X 14 cm H X 19 cm D) Evactron 25 D-C Controller is a tabletop model.

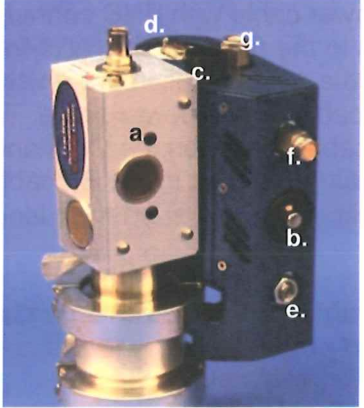
4.1.9. CAUTION: The shut-off and three-way solenoid valves will get hot and should not be touched during operation.

Evactron 25/45 ORS Configurations

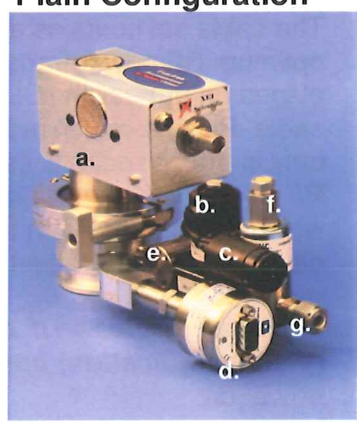
Horizontal Configuration



Vertical Configuration



Plain Configuration



a.	b.	c.	d.	e.	f.	g.	h.
RF Impedance Match	Electronically Adjustable Leak Valve	Electronic Valve Connection	Micropirani Gauge	Shut-off Valve (in back) CAUTION HOT	Plasma Gas Inlet (with filter)	Purge Gas Inlet CAUTION HOT	Thumb Screw for Detaching Bottom Piece of Covering (horizontal configuration only)

5. Installation (and Removal)

To Install:

1. Vent chamber, evacuate and check pump down time.

2. Vent chamber again.

3. Remove Port flange and mount KF40 adapter flange using the o-ring from the port flange.

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4. Mount the ORS Plasma device on the adapter flange.

The ORS can be mounted by gently sliding the boltless side the KF40 clamp around the fitting. In most cases, removing the bottom piece of the ORS shroud in the Horizontal Configuration is not required. If necessary, the bottom piece of the ORS shroud in the Horizontal Configuration, which surrounds the KF40 flanges, can be detached to aid mounting the ORS. Remove the holding screw and detach the bottom piece by gently squeezing both sides of it.

The bottom piece of the ORS shroud in the Horizontal Configuration of the covering can be reattached by 1) Lining up the screw holes on both pieces. The tab on the bottom piece fits below the screw hole on the top piece. 2) Gently squeezing the bottom piece and inserting the slot, located on the side of the bottom piece opposite the screw hole, into the slot hole. Make sure that the slot is firmly and completely inside the slot hole. 3) Reinsert the thumb screw into the screw hole.

5. Tighten the KF40 clamps.
6. Check and compare vacuum pump down time.

Mounted on the ORS is the RF impedance match which adjusts the impedance to maximize power to the plasma. This match is set at the factory for your ORS and RF supply.

7. Install Controller in convenient spot in equipment rack (Model 45) or tabletop (Model 25).

The rack mounting screws are provided for the Model 45.

The cable set contains an RF power cable with BNC connectors and is a quarter wavelength for optimum RF power transmission to the plasma. This 12.5-foot cable allows the controller to be placed on or near the SEM console. Also supplied are a valve controller cable, a Pirani gauge cable, Plasma-match indication cable, and a power cable. The connectors permit connection only in the correct places. The cables between the ORS and the controller are bundled. The **RF power cable must not be coiled**. Loops in the RF cable may create an inductive coil, which will interfere with the RF circuit. Do not shorten or lengthen the RF cable as this will disrupt normal operation.

8. ***Install Cables – RF cable, valve cable, MicroPirani Gauge cable, and Match cable (plasma indication) bundle and power cable.*** **Do not** connect cables with the controller power on.

The back panels of the Evactron 25 and 45 D-C are shown on the next page.

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Evactron 25 D-C Back Panel

Evactron 45 D-C Back Panel

9. ***(Optional) Install the null modem RS232 cable (supplied with the instrument) between the port labeled "REMOTE INTERFACE" and a PC serial communications port.*** A USB-to-serial converter may be used if a serial communications port is unavailable.

10. ***(Optional) Install Remote Plasma Gas line:*** A tank of oxygen containing gas can be used in place of room air. The plasma gas inlet is through the coil body of the second solenoid valve. Remove the filter from the 1/8" NPT fitting in order to install the gas line. CAUTION: Pure oxygen gas should not be used in systems evacuated with oil filled vacuum pumps.

11. ***(Optional) Install Optional N_2 Purge line:*** A Nitrogen Purge for removing CO, CO_2 and water vapor after plasma cleaning may be connected to the gas manifold. This connection is at the end and in-line with the gas line through the valves. A ¼" swagelock fitting is proved for this connection. The N_2 purge is operates with the RF power and plasma off. **The Pressure in the Nitrogen feed line should be no more than 1 PSI. DO NOT exceed 60 PSI.**

To Remove (Uninstall) the Evactron De-Contaminator:

To safely remove the Evactron De-Contaminator from the instrument or tool: **1.** Turn off the power switch. **2.** Disconnect the power cord form both ends to de-energize the Evactron De-Contaminator controller chassis, and remove the power cord to separate location to prevent reconnection. **3.** Remove the cables between the ORS and controller and any interface cable. **4.** Remove the controller. **5.** Vent the vacuum chamber, remove the ORS, and place a blank flange on the vacuum port. The clamp between the ORS and the port is best removed by unscrewing the clamp and then gently sliding the clamp around the KF40 flange until it can be easily removed. The Evactron is now ready to be inspected, reinstalled on another tool or packed for shipment. NOTE: There are no user serviceable parts inside the Evactron De-Contaminator controller and it should not be opened. If there are any problems with your De-Contaminator, please see the service and warranty section of this manual.

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6. User Interface

1. The Evactron 25 and 45 D-C front panels are shown below.

Evactron 25 Front Panel

The text Display on the top center of the Evactron 25 D-C shows the current settings. The Encoder knob, used to select and change settings, is directly below the Display. The Enable button is to the right of the Encoder knob; the ready light above the button indicates whether the Evactron 25 D-C has been enabled. Indicator lights (RF ON, PLASMA ON, FAULT) are to the right of the Display. The power switch is to the far left.

Evactron 45 D-C Front Panel

For the Evactron 45 D-C, the text Display on the left shows the current settings. The Encoder knob, used to select and change settings, is in the middle of the front panel. The Enable button is to the right of the Encoder knob; the ready light above the button indicates whether the Evactron 45 D-C has been enabled. Indicator lights (RF ON, PLASMA ON, FAULT) are to the right of the Enable button. The power switch is to the far right.

The PC is connected to the Evactron 25/45 D-C via the RS-232 cable shipped with the instrument. A Windows program named "Evactron Control and Status" is supplied with both models enabling the user to interface with the instrument. A c-based communication interface library is also supplied enabling users to write their own software to interface with the instrument. Documentation for both the program and the communications library is provided with the software in the CD shipped with the Evactron 25/45 D-C.

2. When the Evactron 25/45 D-C is turned on and enabled, and if the N2 PURGE is turned ON and no faults are detected, the Display will show

```
Plasma       HH:MM:SS
Purge        HH:MM:SS
Last Cln MM/DD HH/MM
1.2 E-3 Torr
```


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If the N2 PURGE is turned OFF, then the Display will show

```
Plasma        HH:MM:SS
N2 PURGE OFF
Last Cln MM/DD HH/MM
1.2 E-3 Torr
```

If the Evactron 25/45 D-C is disabled, the Display will show

```
Cleaning Disabled

Last Cln MM/DD HH/MM
1.2 E-3 Torr
```

The Plasma time is the amount of time the Evactron 25/45 D-C will have the plasma on in order to clean the chamber. The purge time is the amount of time the purge will run. The Last Cln shows the date and time that the last clean cycle was started. The bottom row will show the current pressure. Pressures above 500 Torr will be represented by the text "Atmosphere" as the read-back. Pressures below 1mTorr will be displayed as "<1.0 E-3".

3. Entering and Using the Configuration Mode: Pressing the Encoder knob allows the user to change operating parameters (set points) by placing the controller into the configuration mode. The configuration mode can be entered when the Evactron 25/45 D-C is either enabled or disabled, but not when it is running a cleaning process. The instrument will be off-line until the user completes configuration changes. A series of screens are used to change set-points on the Evactron 25/45 D-C.

There are a row of menu options on the bottom of each configuration screen. Each menu option is bracketed by square brackets. Selecting [SAVE] on the bottom row of each menu will save any changes, and return the user to one of the displays in section 2 above. Selecting [CNCL] returns the user to the previous menu aborting any changes in the current screen. The selection to the right of [CNCL] allows the user to proceed to the next configuration screen, and will save any changes made in the current screen.

Once in the configuration mode, the user can choose which menu option to select by rotating the Encoder knob. The display will flash a row of dashes (– – – –) on the chosen menu option. When the flashing dashes are seen on the desired menu option, press the Encoder knob to select that option.

4. Changing Set-points with the Encoder Knob: Above the menu options are the set points that can be changed in a particular screen. To change the set point, rotate the Encoder knob until the flashing dashes are seen on the set point to be changed, then press, and, while holding the Encoder knob in the pressed position, rotate the Encoder knob. While changes to set-points are made, an arrow pointing to the right (→) will appear to the left of set-point. Once the set point is at the desired value, release the Encoder knob.

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5. The first screen seen upon entering the configuration mode allows the user to change the **duration times** for both plasma and purge states.

```
Plasma time  HH:MM:SS
Purge time   HH:MM:SS
Cycles  NN  =HH:MM:SS
[SAVE][CNCL][SETPT1]
```

Running the Evactron 25/45 D-C multiple cycles:
Additionally, the user can run a cleaning cycle multiple times by changing the number of Cycles, located below the purge time. When changing the number of cycles, the time display to the right of the Cycles setting will show an estimate of the total process time. The number of cycles may not cause the total process time to exceed 99 hours, 59 minutes, 50 seconds.

NB: If the N2 PURGE is OFF, the Purge time and Cycles set-points will not be displayed. Refer to the next two sections on how to change N2 PURGE.

6. Selecting SETPT1 in the menu above allows the user to change the **pressure and power set-points** on the Evactron 25/45 D-C.

The range of pressures allowed is between 50 mTorr (7 Pascal) and 1 Torr (130 Pascal). In the Purge state the pressure range is extended up to 2 Torr (270 Pascal). The RF power can range from 5 to 20 Watts. It is not recommended to run the Evactron D-C at high power (>16W) for extremely long periods of continuous use (>2 days).

```
Ignite    400 mTorr
Plasma   400 mT 14Watts
Purge    600 mTorr
[SAVE][CNCL][SETPT2]
```

Three different pressure set-points can be changed by the user.
Ignite: The pressure used to start the plasma. Certain pressures, especially below 200 mTorr, are conditions under which the plasma will not easily ignite.
Plasma: The pressure used to clean the chamber with the plasma.
Purge: The pressure used to run the Evactron 25/45 D-C in purge mode. This pressure setting will not be displayed if the N2 PURGE is OFF (see next menu).

NB: If the system has slow pumping speed, the Evactron 25/45 D-C might not reach the pressure set-points for the plasma and purge states before the end of their respective duration times. Also, setting the pressure too low may cause too little or no flow of gas through the ORS, especially if the system has slow pumping speed. This will affect the efficiency of the Evactron cleaning process.

7. Selecting SETPT2 in the menu above allows the user to **toggle ON or OFF the N2 PURGE**, and to change the pressure units shown in the display. To change the N2 PURGE state, rotate the Encoder knob until the flashing dashes are seen on the N2 Purge option and then press the Encoder knob once.

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The purge state helps remove H_2O and CO_2 from the chamber after plasma cleaning and results in faster pump down. If N2 PURGE is ON, and no N_2 or other gas line is connected, then air will be used by default.

The SETPT2 menu also allows the user to change the pressure units seen on the display screen and the Evactron Control and Status program. The units currently used by the Evactron 25/45 D-C are seen to the right of "Pressure" on the display. The pressure units which can be used are Torr, Pascal or mbar, and they can be changed in the same way as the set points in the previous screens.

NB: Although the display will show pressure in units of Pascal or mbar, the microprocessor always uses Torr pressure units to operate the Evactron 25/45 D-C. This may result actual run time pressure not precisely matching set point pressures during operation.

```
N2 Purge ON(OFF)
Pressure  Torr

[SAVE][CNCL][CLOCK]
```

8. Pressing the [CLOCK] field allows the user to change the **date and time settings** in the Evactron 25/45 D-C.

```
Time HH:MM:SS
Date MM/DD/YY

[SAVE][CNCL]
```

Changing these settings can be done the same way as in previous displays.

9. For initial cleanings of new or badly contaminated tools, 14 hour or overnight cleaning times maybe used. However, many tools do not allow themselves to be maintained at Evactron 25/45 D-C operating pressures for extended periods of time, and they will shut off. XEI Scientific, Inc. urges users to consult with the Field Service Engineers of their tool before using the Evactron 25/45 D-C for an extended time.

WARNING: Do not clean longer than 15 minutes if pumping through a Turbo Pump operating at full speed as either the Turbo pump may overheat due to high gas load or the vacuum interlock system on your tool may shut off.

7. Operation

7.1 The Evactron 25/45 D-C can be operated via the front panel, the Evactron Control and Status application, or by custom software using the Communications Interface Library.

7.2 Make sure that the chamber to be cleaned can be successfully pumped down before using the Evactron 25/45 D-C. Insufficient pump speeds and leaks can greatly affect the performance of the Evactron 25/45 D-C.

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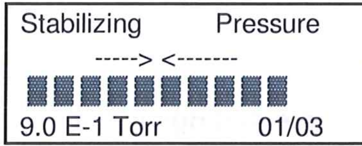
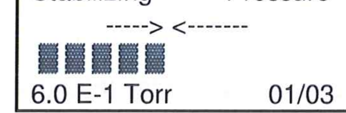
7.3 Turn on the Evactron 25/45 D-C and, if disabled, press the Enable button.

7.4 Cleaning can be enabled by the tool computer or the Enable button on the front panel. The Enable light is on when the Evactron 25/45 D-C is ready to clean. The vent valve should be opened until the pressure measured by the Evactron vacuum gauge is above 2 Torr (2.6 mbar, 260 Pascal). To insure that the cleaning cycle starts properly, make sure the Evactron 25/45 D-C is enabled before venting. Evacuation of the chamber should be restarted with the roughing pump, or the system can be manually vented until it the chamber pressure exceeds 2 Torr, and then allowed to pump down through the roughing pump. Turbo molecular pumps can be used only if the pressure is kept low during the plasma and purge states and the cleaning duration times are minimal. Otherwise, overheating of the turbo molecular pump may occur. When the chamber pressure drops below 2 Torr, the Enable light will alternate on and off, and the Display will show (a), where the pressure, indicated by the bar graph in the third row, is above the set point, indicated by the two arrows in the second row.



(a) Pressure High and Decreasing



(b) Pressure Stabilizing

The leak valve is adjusted so that the desired pressure in the chamber can be stabilized. The Purge gas line is used for this operation in order to minimize contamination. When the chamber pressure has reached the pressure for plasma ignition, the Display will show (b), where the bar graph matches the set point, indicated by the two arrows. In both (a) and (b), the bottom row shows the chamber pressure and the plasma/purge cycle index number (in this example, the first of three cycles is being done).

7.5 Once the ignition pressure is reached, the RF power is turned on to 20 Watts, and the Display will show

Waiting for Ignition	
Fwd Pwr	20.0 Watts
Rev Pwr	1.5 Watts
4.0 E-1 Torr	01/03

When the Evactron 25/45 D-C detects plasma ignition, the plasma on indicator light will turn on. The RF power and chamber pressure adjust to the desired set-points, the plasma timer (top row) will start counting down.

Plasma	00:05:00
Fwd Pwr	12.0 Watts
Rev Pwr	0.3 Watts
4.0 E-1 Torr	01/03

7.6 The chamber pressure is displayed on the bottom left. The cycle index, i.e. how many cleaning cycles have competed or have been started, and the total number of cycles are shown on the bottom right of the display (in this example, the first of three cycles is being done). If desired, the cleaning cycle can be stopped by pushing Enable button in order to disable the Evactron 25/45 D-C.

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7.7 When the preset cleaning time is reached, the RF power and cleaning gas supply will be turned off. If N2 PURGE is ON, post-plasma N_2 purging will commence, the Enable light will alternate on and off, and the Display will show

Purge	00:05:00
4.0 E-1 Torr	01/03

The top row shows the remaining purge time. The bottom row shows the chamber pressure and the cycle index number. If N2 PURGE is OFF, the chamber will pump down normally and the cleaning process will cease. If desired, the cleaning cycle can be cancelled by pressing Enable/Disable button in order to disable the Evactron 25/45 D-C.

When the Purge time is reached and if there are still cycles remaining, the Evactron 25/45 D-C will revert to the Stabilizing Pressure mode (Section 7.4) and reset the chamber pressure to the ignition pressure. Plasma cleaning and purging will then follow.

7.8 When the number of desired cycles has been reached, the chamber will pump down normally and the cleaning process will cease. The Evactron D-C will remain in the Pump Down state until the chamber pumps to or below 50 mTorr (7 Pascal). The Display will show:

When a chamber pressure of 50 mTorr is read by the controller, the Evactron D-C front panel will show the Displays seen in Section 6.2, and will be ready for another clean. The user can bypass the Pump Down state simply by Disabling the Evactron D-C.

7.9 NOTES ON PRESSURE SET-POINTS:

As mentioned in the user interface section, pressure set-points can be changed by the user. We recommend using the factory set-points. For large chambers with fast pumps, pressures lower than the factory set-points while the plasma is running will produce greater cleaning efficiency. However, the user must be aware that lower pressures may not be feasible with all chambers and pumps. Caution must be used to ensure that the pressures chosen can produce stable plasma and steady flow through the ORS. If these criteria are not attained at the pressure selected, the user should increase the pressure set-points until they are attained.

It has been found in small chambers that having the purge set-point at 2 Torr may cause an overshoot above 2.5 Torr as the pressure is adjusted. This overshoot will cause a high pressure fault to occur. Reduce the pressure set-point to prevent this fault from occurring.

Having a pressure set-point below 0.2 Torr in small chambers with small pumps may cause pressure oscillations. Adjust the pressure set-point higher if this behavior occurs.

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7.10 NOTE ON CYCLE PROCESSES:

Cycle processes are a feature which allows the user to clean with remote plasma chemical etch for a period of time, run an N_2 purge to remove the products of the etch, and the repeat the cycle multiple times. These processes should allow the user to obtain the most efficient use of the Evactron D-C while also minimizing contact between oxygen radicals and partially shielded sensitive detectors.

8. External Control

The Evactron 25/45 D-C can be controlled from an external computer using the Evactron Control and Status Graphical User Interface (GUI) found on the CD provided with the instrument. Refer to the Evactron Control and Status GUI Manual for instructions on how to install and use the software.

The Evactron 25/45 D-C also provides for remote control via an RS-232 communications link. A Windows DLL is provided enabling users to write interface software to communicate with the Evactron 25/45 D-C. The CD provided contains the interface software as well as a Programmer's Guide detailing all of the control and status functions.

The RS232 Communications are made through a Male DB9 Connector. A null modem cable is supplied. The Pin assignments are:

Pin 2 Rx
Pin 3 Tx
Pin 5 Common
Pin 7 RTS
Pin 8 CTS

The SEM or Tool Vacuum system should be used to vent the chamber. The Front panel controls cannot vent the chamber.

9. RF Plasma Cleaning with the EVACTRON De-Contaminator

The EVACTRON Controller contains a low power RF generator of compact design. The operating frequency is 13.56 MHz, which is a scientific frequency that requires no license from the FCC. The small box on the feedthrough is an "RF Match" which maximizes to RF power delivered to the plasma by adjusting the phase angles and impedance. See Section 14 for details. The match is preset at the factory. At 40 Watts the peak to peak RF voltage delivered by the system is less than 140 volts and less than 60 Volts at 10 Watts. This low voltage allows the plasma source to be safely operated on the electron microscope. The RF power level can be adjusted between 5 and 20 watts via the configuration screens.

The EVACTRON De-Contaminator is a plasma generation device for oxygen radicals used for chemical etch cleaning. The ORS (Oxygen Radical Source) is a downflow remote plasma device that does not subject the chamber or specimen to direct plasma exposure. The general principle is that the plasma generates active species that flow into the chamber and react with the contaminants to produce volatile compounds that can be removed by the vacuum pumps.

Three cleaning mechanisms can be achieved by plasma processing. The first is Sputter etching. Sputter etching bombards the surfaces with energetic ions that knock off surface molecules and atoms. The second is reactive ion etch which produces reactive ions to remove surface atoms and molecules. The third is to use the plasma to produce active neutral radicals or atoms to react with the surface species. The EVACTRON process was designed to produce neutral oxygen radicals from air to oxidize hydrocarbons.

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The Evactron De-Contaminator is operated as a plasma ashing device to make oxygen radicals when air or other oxygen containing gas is used. Gas is fed into the plasma and the reactive radical species are carried into the instrument by convection flow. The pressure used is between .2 and 1.2 Torr. At these pressures there is viscous flow of the gases, high electrical conductivity, and the mean free path is too short for ion sputtering. Sputtering becomes possible below about 0.15 Torr. Above 1.2 Torr, the recombination of the radicals by three body collisions significantly slows the ashing process.

The Evactron D-C process cleans hydrocarbon, HC, contamination from SEM/FIB chambers and specimens. The reduction of HC contamination improves resolution and measurement accuracy. Oxygen radicals are produced in a localized plasma within the ORS located on a chamber port to ash HC in the chamber. These radicals are transported through the chamber and across the specimens by convection due to the system pumping differential under viscous flow vacuum conditions. The O converts HC contamination into volatile short chain ketones, alcohols, H_2O, CO and CO_2 molecules that are easily pumped away. The low vacuum viscous flow is very efficient at removing these reaction products. At the end of the plasma activated cleaning process, a N2 purge process may be activated to remove the remaining product gases and air. Both the plasma activated cleaning and purging can be done in minutes (5 minutes for plasma, 1 minute for purge) on normal sized SEM and FIB chambers.

Chemistry and Thermodynamics

The Evactron process is successful because the HC oxidation products are volatile in vacuum. Oxygen radicals oxidize hydrocarbons and form volatile oxides. The oxidation generally begins with hydride extraction (hydrogen atom removal) that creates more reactive sites on the hydrocarbon chain. These sites, when ashed by subsequent O radicals, further breakdown the chain.

The most thermodynamic favorable reactions are C double bond oxidation, followed by hydride extraction, followed by C-C single bond oxidation. C-C single bond oxidation is only slightly exothermic which accounts for the very slow degradation of polymers compared to single chain HC compounds. The C-C single bond is usually broken and oxidized after an adjacent bond is oxidized to create a reactive site. In fluorocarbons C-F bond oxidation is very endothermic and these compounds are non-reactive.

The effect of Evactron cleaning on other materials can be predicted by looking at the oxidation chemistry of the target material. If a stabile oxide layer is formed as on most metals, Evactron oxidation will stop.

The **Evactron D-C** has an unique low temperature plasma for making oxygen radicals form air. In air plasma oxygen is ionized and disassociated in a series of reactions leading to the formation of oxygen radicals:

$$O_2 + O^+ \rightarrow O_2^+ + O$$
$$O_2^+ + e^- \rightarrow O + O$$

Compared to the plasma ions, these radicals are long-lived species and may leave the plasma plume for use downstream, but they are reactive with Nitrogen ions within the plasma and are easily destroyed.

The ionization potential of oxygen is 12.1 eV and nitrogen is 15.6 eV. Thus oxygen ionization takes place at a lower temperature or lower energy plasma than nitrogen. The transition from an oxygen-dominated plasma to a nitrogen ion-dominated plasma is a function of the plasma temperature. By lowering the average temperature of the electron-energy distribution, oxygen ionization is favored. When nitrogen ions are produced in air plasma, they react with O radicals by the following fast reactions:

$$N_2^+ + O \rightarrow NO^+ + N$$
$$N + O \rightarrow NO^+ + e^-$$

Two oxygen radicals are destroyed by every nitrogen ion produced. Because nitrogen is the major constituent of air the destruction takes place quickly. In addition, the reaction product NO^+ is a stable ion that is unable to react with neutral diatomic gases and reacts with hydrocarbons to form nitrogen oxide polymers. These are resistant to further oxidation. The Evactron D-C optimizes the operating chamber pressure and plasma temperature so the oxygen radical flux is maximized.

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10. CLEANING WITH AIR

The following conditions are preset in the Evactron 25/45 D-C and are recommended for convenience and economy.

Recommended conditions:

Pressure: 0.4 Torr **RF Power: 14 Watts**

Experiments have shown that plasma cleaning improves with increasing power and decreasing pressure. It has also been shown that cleaning with air may promote the polymerization of hydrocarbons and delay cleaning. If a turbo pump is running during the cleaning process, running the plasma at lower pressures also has the advantage of lessening the possibility of overheating the turbo pump. However, running at too low a pressure may cause too little or no flow through the ORS, affecting the efficiency of the cleaning process. The best plasma pressure and power set-points for cleaning are dependent upon the size of the vacuum chamber and the speed of the pump used.

Cleaning with air under these conditions is very mildly oxidizing. Silicon wafers do not show growth of the SiO_2 layer under these conditions. The disadvantage is that it is slow and does not attack polymerized molecules very well.

11. CLEANING WITH O_2

Pure Oxygen is highly oxidizing. Fire and explosion hazards exist if pure O_2 is used with oil filled vacuum pumps.

If the target vacuum system uses dry roughing pumps, pure Oxygen may be used for a cleaning gas in the plasma. **The Pressure in the Oxygen feed line can be at roughly 1 PSI. DO NOT exceed 60 PSI.**

Recommended conditions:

Pressure: 0.4 Torr **RF Power: 14 Watts**

Cleaning with Oxygen has been shown to greatly increase the cleaning efficiency. It has also been shown reduce the rate of polymerization of hydrocarbons, which in turn reduces the time needed to clean the system. As with air cleaning, the best plasma pressure and power set-points for cleaning are dependent upon the size of the vacuum chamber and the speed of the pump used, and running at too low a pressure may cause too little or no flow through the ORS, affecting the efficiency of the cleaning process.

12. NITROGEN PURGE MODE

The Nitrogen Purge mode purge mode provides an optional alternate cleaning mode to plasma cleaning. Nitrogen purge cleaning cleans by using a physical effect rather than a chemical reaction as with plasma cleaning. Nitrogen purge mode is used to remove CO, CO_2 and water vapor after plasma ashing is completed. By using a N_2 purge after plasma cleaning is completed will result in a faster pump down and a cleaner vacuum.

If clean dry Nitrogen is available, a Nitrogen line may be connected to the Nitrogen inlet fitting on the valve manifold. The supply pressure should be slightly positive up to 2 psi. (>0 -2 PSI)

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Do not use high pressure N_2 (5-90 PSI). On the display edit menu use the encoder to set N2 PURGE "**ON**". This is toggled by highlighting the N2 PURGE **ON/OFF** setting and pressing the encoder (Section 6.5).

There are three useful modes for Nitrogen purge in the Evactron 25/45 D-C.

1. Pre-purge: The Evactron 25/45 D-C will use N2 for during pressure adjustment before the plasma is turned on. When the bar graph is displayed during pressure adjustment N_2 will be used if available to keep air contaminants from entering the chamber. This is automatic if N_2 is set as on.
2. Post Purge: Product gases removal after plasma ashing as needed. 0 -2 minutes of purging is usually sufficient. If an Argon gas mixture or large chamber is present longer purging time are needed: 2-10 minutes
3. SEM-CLEAN™ purging. If there is very heavy oil contamination such as liquid oil deposits in the chamber purging is more effective than plasma cleaning. Purging will remove the oil as it evaporates by the physical effect of convective flow to the vacuum pump. This cleaning rate is only dependant of the vapor pressure of the oil. It is better to purge than to plasma clean in these cases because Evactron 25/45 D-C plasma cleaning will polymerize liquid oil deposits and make a sticky deposit that is slow to disappear. For SEM-CLEAN™ purging the Vacuum system must be left in roughing mode overnight.

Only a few SEM Model vacuum systems can be left in roughing mode for extended periods without special modification or set up. Low vacuum and "Environmental" SEMS can be operated in this mode and Hitachi FE SEMs (S-800 to S-4700 models) with dual roughing pumps also can be. Other SEM models can be purged if the high vacuum pump can be turned off or backed during the purge period. Consult with your Field Service Engineer or XEI to see if your SEM can be purge cleaned.

Purging should not be done with other gases such as Argon. The Pirani gauge is not calibrated for Argon, and Argon may affect the pumping ability of ion pumps on the gun column.

13. TROUBLESHOOTING AND SERVICING

The following describes conditions which will cause the Evactron 25/45 D-C to be in the FAULT State (indicated by FAULT LED ON)

Once the condition causing the fault has been removed, one can Exit the FAULT State by pressing the Encoder Knob or the Enable Button and remove the [ACKNOWLEDGE] message on the display.

In the Evactron Control and Status GUI, an Event Log of the Evactron 25/45 D-C can be generated. The Event Log can greatly aid in troubleshooting. Refer to the Evactron Control and Status GUI Manual for instructions on how to install the software and access the Event Log.

1. **RF Cable Not Connected**
   This also occurs when cover has been removed from RF match box.
   Remove fault by connecting cable or attaching cover to RF match box.
2. **Pressure Gauge Not Connected**
   Remove by securely attaching cable between MicroPirani Gauge and Controller.

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3. **Plasma**

   This will occur when the Evactron 25/45 D-C has determined that the plasma has not ignited or is not lit in a 5 minute time period.
   The 5 minute delay is to allow the user to correct a Plasma fault before this fault is tripped. See Section above. Possible causes of this fault are
   Problem with match, see Section 14.
   Match cable not connected
   Zero bias in match circuitry. Adjust operating pressure.

4. **Plasma Out**

   Evactron 25/45 D-C has determined that the plasma is not lit.
   The Evactron 25/45 D-C will flash **NO PLASMA DETECTED** on the front panel display. Removing conditions which may have caused the fault before the time delay is over will clear the fault without the need to remove the [ACKNOWLEDGE] message. Possible causes of this fault are
   Problem with match, see Section 14.
   Match cable not connected
   Zero bias in match circuitry. Adjust operating pressure.

5. **High Pressure Error**

   This occurs when the chamber pressure exceeds 2.5 Torr during a cleaning cycle. .
   This fault may occur due to
   Leak in the system
   Gas unexpectedly entering the system from another port
   Changes from low pressure to a much higher pressure in systems with very small chambers

6. **Low Pressure Error**

   This occurs when the chamber pressure does not rise to the current setting within 30 seconds. The Low Pressure fault may occur due to
   Pumping too fast (e.g. turbo pump has turned on)
   Insufficient gas supply pressure
   Valves disconnected from Controller

7. **Configuration, Event Log, and Internal Error Faults**

   These faults indicate that the system's non-volatile configuration has become corrupted. The software will reset the system configuration back to factory default conditions. **Please notify XEI Scientific if you encounter this problem.**

The following section describes typical problems, with possible causes and solutions, which may be encountered while running the Evactron. These problems may be related to the fault conditions described above.

The vacuum does not pump down.

1. Leak
2. Valve not closing
3. Pumping is too slow

A cleaning cycle does not start when pressure drops below 2 Torr

Evactron 25/45 D-C is not enabled

The vacuum does not stabilize for plasma ignition

1. Valve not operating or connected to controller
2. Evactron 25/45 D-C is not enabled
3. Pump is too fast

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The vacuum does not stabilize for cleaning and oscillates

1. Pump is too fast
2. Pressure set-point is too low

Message "Waiting for Ignition" stays on.

1. Plasma did not ignite
2. Problem with match, see Section 14.
3. Match cable is not connected between RF Match and Controller

RF light fails to turn ON.

1. Fault light on
2. RF generator is bad

Plasma does not stay on.

1. The pressure set-point is too high
2. Pressure has not stabilized
3. Problem with match, see Section 14.
4. Pressure is too low
5. RF on signal did not stay on

RF power is not stable.

1. The RF power starts at above 20 Watt and then drops to desired power: *This is normal operation of the auto plasma ignition circuit*
2. The fan has failed and the RF generator is overheating
3. Match has failed

RF Power is too high

1. Plasma Detection cable is disconnected
2. Plasma did not ignite

Plasma does not ignite RF light is ON.

1. The pressure set-point is too high
2. The Match cable is disconnected (plasma is on but not indicating)
3. The pressure set-point is too low
4. Problem with match, see Section 14.
5. The match circuit has failed (sometimes accompanied by a burning smell)

At power up, the FAULT LED blinks at ½ Hz and nothing is displayed on the front panel display.

A software upgrade had been terminated prematurely or the application software image has become corrupted. Try to reprogram the application software using the Evactron Control and Status GUI. In all cases, **please notify XEI Scientific.**

Controller stops working and Fault and Enable LEDs blink alternatively at a high rate.

A system failure has occurred. **Please notify XEI Scientific.**

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This table denotes the various operational states of the LEDs. Use this table as an aid for operating the instrument.

LED Name	LED Color	Description
POWER	GREEN	When lit, the Evactron is powered.
RF ON	YELLOW	When lit, the RF circuit is powered.
PLASMA ON	YELLOW	When lit, the plasma detection circuit indicates that the plasma is lit. In some remote cases the plasma may have ignited; however, the detection circuit may not report that it is lit. The software uses a secondary means of detecting plasma ignition by comparing forward and reverse power.
FAULT	RED	The software has detected a system fault. Refer to the front panel display for fault specifics.
ENABLE/DISABLE	GREEN	The unit is enabled and ready to start a cleaning process or, if blinking, is currently running a cleaning process.

This table shows the various operational states of the Enable and Fault LEDs. All table entries assume that the Evactron 25/45 D-C is powered. Use this table as an aid for troubleshooting.

Enable LED	Fault LED	Description
Off (Solid)	Off (Solid)	The Evactron application program is running and it is in disabled state or an operator is viewing or modifying system configuration via the front panel.
Off (Solid)	On (Solid)	A system fault has occurred. The front panel display will detail specifics of the fault condition. If this is not the case, please call XEI Scientific for technical support.
On (Solid)	Off (Solid)	Evactron is ready to start a cleaning process.
On (Solid)	On (Solid)	Please call XEI Scientific for technical assistance.
Blinking at ½Hz	Off	The Evactron is running a cleaning process.
Blinking at ½Hz	On (Solid)	The software has detected that the plasma is no longer lit. A plasma fault condition is pending. The Fault LED will become solid and the ENABLE/DISALBE LED will turn off once the fault condition is asserted (the time-out will have elapsed).
Off	Blinking at ½Hz	The Evactron is ready to upgrade the application software or it is in the process of being upgraded; the operator is upgrading the application software via the Evactron Control and Status application on the PC.
Blinking at 8Hz	Blinking at 8Hz	The LEDs will be blinking alternately (one off, the other on). A system failure has occurred, please contact XEI Scientific for further assistance.

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14. The RF Impedance Match

14.1 MCH-Style RF Impedance Matches

The MCH-style RF impedance matches have Serial Numbers **A0000-MCH-0000**, where A is an alphabetic character from C to H and 0 is any numeric character (0-9). They were manufactured on or before March 2008, and they were preset at the factory to work with maximum efficiency with the Evactron plasma head with which they were shipped. In most cases they do not need further adjustment.

After shipping and other periods of inactivity the plasma often needs extra power applied to ignite. To do this, the Evactron 25/45 Controller supplies maximum RF power until the plasma ignites and a self bias signal is obtained. Maximum power is sustained for one second after ignition and then drops to the programmed cleaning power level. You will see the RF power turn on to 20 Watts and then drop. This is normal and by design. If the pressure is above 1 Torr the plasma may not be sustained. If this is a regular occurrence, adjust the pressure and power settings (see Section 6).

If there is difficulty igniting or sustaining the plasma below 1.0 Torr then the RF matching network may be adjusted. The RF Matching network on the MCH-style match comes with a trimmer capacitor that may be adjusted. Adjusting the Match changes the impedance of the network and allows maximum RF power to be sent to the plasma load. At the ideal match setting the plasma ignites immediately at low forward RF power levels and the reflected RF power from the load and match is minimized.

The standard adjustment for using air for cleaning is done at 0.4 Torr pressure.

An insulated trimmer tool or screwdriver is used to adjust the trimmer cap. The trimmer is located inside the match enclosure behind a small hole on the side. See photo for the location. The full range of the trimmer is achieved in one half turn and then it reverses. DO NOT PRESS DOWN ON TRIMMER. This can damage the capacitor, requiring the unit to be sent back to XEI Scientific for service.

Evactron 25/45 ORS with MCH-style Match

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Enable the Evactron 25/45 D-C, and start a Cleaning cycle. Adjust trimmer to maximize the forward RF power in the ignite mode. In the operating mode (e.g. 15 Watts), observe the plasma and adjust the trimmer so that the plasma is at maximum brightness or maximum plasma sheaf.

14.2 MTC-Style RF Impedance Matches:

The MTC-style RF impedance matches have Serial Numbers **A0000-MTC-0000**, where A is an alphabetic character from H to Z and 0 is any numeric character (0-9). They are manufactured on or after March 2008, and they are preset at the factory to work with maximum efficiency with the Evactron plasma head with which it is shipped. The MTC-style match is designed to have higher efficiency and reliability than the MCH-style match. When operating correctly the MTC-style match exhibits very low RF Reverse (Reflected) Power, and it will never need further adjustment.

After shipping and other periods of inactivity the plasma often needs extra power applied to ignite the plasma. To do this, the Evactron 25/45 Controller supplies maximum RF power until the plasma ignites and a self bias signal is obtained. Maximum power is sustained for one second after ignition and then drops to the programmed cleaning power level. You will see the RF power turn on to 20 Watts and then drop. This is normal and by design. If the pressure is above 1 Torr the plasma may not be sustained. If this is a regular occurrence, adjust the pressure and power settings (see Section 6).

Evactron 25/45 ORS with MTC-style Match (Horizontal Configuration)

If the Reverse Power Reading when the unit is in the Plasma State exceeds 20% of Forward Power Reading, immediately turn off the Evactron D-C and contact XEI Scientific. A high Reverse Power Reading indicates a problem with the operation of the Evactron D-C. When the unit is in the Waiting for Ignition State, the Reverse Power Reading is high (>20% of Forward Power). This is normal operation and the Reading should become low (~10% of Forward Power) when the plasma has ignited.

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15. Five Year Warranty and Repair Policy

The Evactron D-C is designed to operate for extended periods without failures or repairs. The unit contains no consumables.

This EVACTRON plasma cleaning system carries a limited factory service warranty on parts and workmanship for a period of 5 years from date of delivery. Such defects will be repaired at no charge at the factory. All units will be reviewed and evaluated at XEI Scientific, Inc. prior to credit being issued or repairs being made. Most repairs are completed within one day after receipt and all units are operated overnight before return. Shipping of units is done at Customer's expense. However, if repair due to part defects or workmanship is needed within 1 year of date of delivery, XEI Scientific, Inc. will pay for shipping. A purchase order is not required but an RMA must be requested. This policy does not apply to misuse, malicious or destructive damage to the unit.

Prior to returning the unit for repair, you must contact XEI to obtain an RMA (Return Materials Authorization) Code. You may reach us at +1-650-369-0133 or 1-800-500-0133 (within USA only). Also, you may send an email to service@evactron.com to obtain your RMA Code and shipping instructions. When contacting us, you will need to provide the following information:

1) Unit serial numbers (located on rear of unit and on Match box). Any request for warranty repair requires reference to the Item's serial number(s).
2) Model number (Evactron C, 25, 40, or 45 D-C)
3) Reason for return

Clearly mark the RMA number on the packaging so that it is highly visible and easily identified. Shipping must be pre-paid. We will refuse all CODs. Unauthorized returns will not be accepted. Once you obtain your RMA, please return the unit freight pre-paid to:

XEI Scientific, Inc.
1755 East Bayshore Rd. Suite 17
Redwood City, CA 94063

All warranty repairs are to be carried out exclusively at the factory at XEI Scientific, Inc. Any repairs attempted without the explicit authorization of XEI Scientific, Inc. will void the warranty.

XEI Scientific, Inc. assumes no liability, and the warranty becomes null and void if the end user or third parties:

- Disregard the information in this document
- Use the product in a non-conforming manner
- Abuse or damage the product by misuse or mishandling
- Make any of modifications, alterations, unauthorized repairs, or changes to the product
- Use the product in a manner not listed in this document or otherwise approved by XEI Scientific, Inc.
- Allow the product to become contaminated by hazardous or radioactive materials
- Cause shipping damage due to improper packing for return shipment

XEI Warrants Moxtek UTW Windows Against Evactron Cleaning Damage
Evactron Cleaning causes no significant damage to Moxtek UTW EDS windows based on our extended in-house exposure tests and field experience. XEI makes the following warranty: "*XEI Scientific, Inc. will pay for Moxtek UTW replacement on SEM and FIB systems that are equipped with an Evactron D-C if Moxtek shows that damage was due to corrosion by the Evactron Cleaning process. This warranty is limited to the window replacement cost and repair of the EDS system, and does not cover the cost for loss of use of the systems. Windows judged by Moxtek to have failed from other causes or that reached the limit of their normal expected lifetime are not covered.*"

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16. Compatibility of the Evactron Process with Materials

The Evactron process has been tested to see if damage occurs on various materials and components used in the semiconductor industry and in electron microscopes. XEI Scientific, Inc. has found no damage to any of these materials and components with **two exceptions**.

Materials containing **silver**, including silver braiding and silver plating, will become **damaged**; they will tarnish and flake during the Evactron process, especially for long plasma cleaning times. Damage will also occur to samples containing silver which are left in a chamber being cleaned by the Evactron process. It is recommended that whenever possible silver components are either removed, protected or placed away from the line of flow between the ORS and the vacuum port in vacuum systems to be cleaned by the Evactron D-C, and that samples containing silver not be cleaned by the Evactron D-C.

Hydrocarbon lubricants may be etched or polymerized during extended Evactron cleaning runs. This will reduce the lubrication effectiveness. It is recommended that fluorocarbon lubricants such as Braycote or Fomblin be used instead of hydrocarbon lubricants. This matter should be discussed with the manufacturer of the tool on which the Evactron DC is installed.

17. Decommissioning and Recycling the Evactron D-C

All components in the Evactron D-C Models 25/40/45 are Reduction of Hazardous Substances (RoHS) compliant. They may be disposed either by returning to XEI Scientific or with your local recycling entity.

XEI Scientific, Inc. will receive at no cost, other than shipping and handling, any Evactron D-C for recycling and disposal. Please contact XEI Scientific, Inc. (phone: 1-650-369-0133, fax: 1-650-363-1659, email service@evactron.com) for a Return Materials Authorization (RMA). When you contact XEI Scientific, please provide the serial numbers of your unit.

Upgrades and trade-ins of older Evactron D-C models to new models are also available. Please contact XEI Scientific, Inc. for a trade-in quotation. Reusable components from recycled Evactron units may be used in the upgraded model.

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Evactron® RF Plasma Cleaning Systems for Electron Microscopes

CE Declaration of Conformity

Manufacturer: XEI Scientific, Inc.
1755 East Bayshore Rd. Ste. 17, Redwood City, CA 94063
(650) 369-0133, FAX (650) 363-1659
www.Evactron.com, Rvane@Evactron.com

Model: Evactron® Models 25, 40, 45 De-Contaminator

Type of Equipment: RF Plasma Cleaning System for vacuum systems

Application of Council Directives(s): 73/23/EEC as last amended by EC Directive 93/68/EEC (Low Voltage Directive) 98/37/EC (Machinery Directive)

2004/108/EC EMC directive

Testing Provider Notified Body, and Certification body: TUV Rheinland of North America, San Francisco Office
1279 Quarry Lane
Pleasanton, CA 94586

Tests: Confirmation of conformity to the Low Voltage and Machinery Directive:
IEC 61010-1:2001 & Annex I of 98/37/EC (Machinery Directive)
TUV: file number 30372945.004 and .005

Certificate of Conformity to Electromagnetic Compatibility
EC Directive 89/336/EC as amended by EC Directive 93/68/EEC as last amended by 2004/108/EC
Tested acc. to: EN 61326: 1997+A1+A2
TUV Report Nos. 30372945.005 & 30372945.006
Registration No. AE 72032483 0001

I, the Undersigned, hereby declare that the equipment above conforms to the above Directives and Standards, when installed in accordance with the manufacturer's specifications.

Place of Issue: Redwood City, CA

Date of Issue: July 10, 2008

Ronald Vane

Ronald Vane - President

© XEI Scientific, Inc., 2007

XEI SCIENTIFIC, INC.

1755 East Bayshore Road, Suite 17, Redwood City, CA 94063
Main 1.650.369.0133, Fax 1.650.363.1659, www.Evactron.com

January 1, 2009

Declaration of RoHS Compliance

All current XEI Scientific products meet RoHS compliance standards with the levels of Pb, Cd, Hg, Hexavalent Cr, PBB and PBDE below the stated limits for all parts. XEI Scientific products are not in categories that are RoHS required.

XEI Scientific has used only lead free solder since February 2007.

If available, only the RoHS compliant version of parts has been purchased since October 2005. Full compliance was reached on July 1, 2007 when all non-RoHS parts were purged from inventory.

All parts and assemblies used by XEI Scientific have statements of Conformity or RoHS specifications on file from our qualified suppliers. These files are available for inspection on request.

Ronald Vane

Ronald Vane
President

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CERTIFICATE

of Conformity
EC Council Directive 98/37/EC
Machinery

Registration No.: AM 72072828 0001

Report No.: 30372945 006

Holder:
XEI Scientific
1755 East Bayshore Road Suite 17
Redwood City CA 94063
USA

Product:
Laboratory Equipment
RF Plasma Cleaning System

Identification:
Model Numbers: Evactron 45, Evactron 40
Serail Number: Prototype

This certificate of conformity is based on an evaluation of a sample of the above mentioned product. This is to certify that the tested sample is in conformity with all provisions of Annex I of Council Directive 98/37/EC, referred to as the Machinery Directive. This certificate does not imply assessment of the production of the product and does not permit the use of a TÜV Rheinland mark of conformity. The holder of the certificate is authorized to use this certificate in connection with the EC declaration of conformity according to Annex II of the Directive.

Certification Body

Cologne, 04.12.2007

Dipl.-Ing. M. Heinze

TÜV Rheinland Product Safety GmbH - Am Grauen Stein - D-51105 Köln

CE The CE marking may be used if all relevant and effective EC Directives are complied with. CE

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Ref. Certif. No.

US-TUVR-4689-A1

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

SYSTEME CEI D'ACCEPTATION MUTUELLE DE CERTIFICATS D'ESSAIS DES EQUIPEMENTS ELECTRIQUES (IECEE) METHODE OC

CB TEST CERTIFICATE

Product Produit	RF Plasma Cleaning System
Name and address of the applicant Nom et adresse du demandeur	XEI Scientific 1755 East Bayshore Road Suite 17 Redwood City, CA 94063 US
Name and address of the manufacturer Nom et adresse du fabricant	same as applicant
Name and address of the factory Nom et adresse de l'usine Note: *When more than one factory, please report on page 2* Note: *Lorsque il y plus d'une usine, veuillez utiliser la 2ème page*	same as applicant
Ratings and principal characteristics Valeurs nominales et caractéristiques principales	AC 100-240V, 50/60Hz; 150W Class I
Trademark (if any) Marque de fabrique (si elle existe)	Evactron
Model / Type Ref. Ref. De type	Evactron C, 25, 40, 45
Additional information (if necessary, may also be reported on page 2) Les informations complémentaires (si nécessaire, peuvent être indiqués sur la 2ème page)	Re-issue of Certificate US-TUVR-4689 due to 1st modification (editorial change only: correction of trademark, Interlock description added). See associated test report for details. (TMP)
A sample of the product was tested and found to be in conformity with Un échantillon de ce produit a été essayé et a été considéré conforme à la	**PUBLICATION** IEC 61010-1 — **EDITION** 2nd Edition (2001)
As shown in the Test Report Ref. No. which forms part of this Certificate Comme indiqué dans le Rapport d'essais numéro de référence qui constitue partie de ce Certificat	30372945.011

This CB Test Certificate is issued by the National Certification Body
Ce Certificat d'essai OC est établi par l'Organisme **Natioinal de Certification**

TÜVRheinland®
Precisely Right.

Date: April 23, 2009 Page 1 of 1 Signature: Martin Glagla

ISSUED 2003-05

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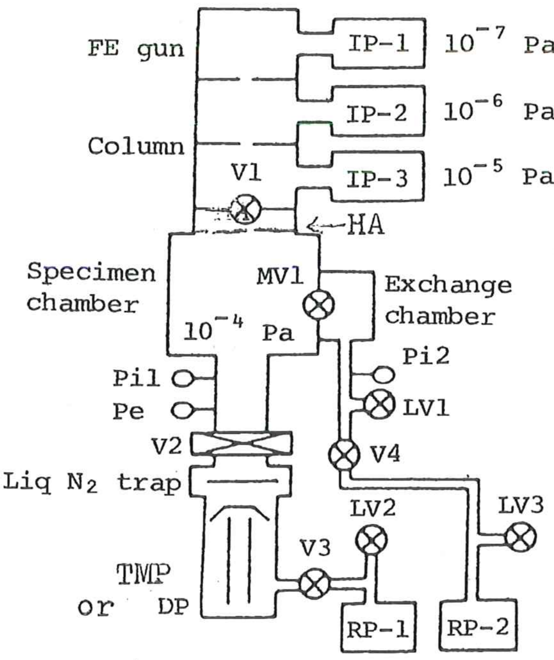
Appendix A - Hitachi FE SEMs Vacuum Operation Notes

These notes apply to Hitachi S4000, S4100, S4160, S4200, S4300, S4500, S4600, S4700, S4800, S5000, S5100, and S5200 FE SEMs with some variations between models. Models S800 and S900 are similar but do not have heated apertures. The more recent the model, the more safeguards and automation are built into the evacuation control circuits.

Hitachi FE SEMs basic vacuum system configuration:



Important Features:

1. On turbo-pumped systems, the DP and Liquid N_2 Trap are replaced with a TMP.

2. All rough pumping is done with RP-2. Rough pumping of the Specimen Chamber (S.C.) is done with MV1 and V4 open and V1 and V2 closed.

3. There is a heated aperture (HA) below V1 that must be cooled before S.C. is vented. And, HA is reheated before stable imaging can be done. The heated aperture prevents the formation of electron beam deposits on the aperture and produces better images.

4. The exchange chamber (S.E.C.) is normally evacuated continuously by the RP-2 and is subject to molecular flow oil backstreaming from RP-2, if RP-2 is a rotary vane pump. This is the main source of contamination in most Hitachi FE SEMs.

5. To vent the Specimen Chamber, the operator must do the following:
   Turn off the heated aperture, HA – wait 20 minutes to cool
   Close the gun valve V1
   Set the vacuum mode to S.C. from S.E.C.
   Open MV-1. (The instrument will close V4 and when this is done a clunk will be heard.)
   Press the Vent switch. This will close V2 and open LV1.

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6. To restart Evacuation of S.C.:

Press EVAC. LV1 will close, and V4 will open.

Crossover: When the pressure read by Pi-1 reaches Low Vacuum state (about 100 mTorr or less), V4 will close, and V2 will open. The high vacuum pump will begin to evacuate both the S.E.C. and S.C.

After crossover, MV-1 may be closed. V4 will open, and the SEC will be pumped by the roughing pump.

After crossover, the SEC/SC switch may be returned to the normal SEC position.

After the switch is back in the SEC position, the heated aperture may be turned back on.

When Pi-1 reaches high vacuum, the Pe (penning gauge) will be turned on. If the gauge immediately reads high vacuum, this is not accurate. This reading is a result of no conduction current, because the internal plasma needed for measurement is not ignited.

Evactron D-C Model 25/45 Installation and operation instruction on Hitachi FE SEMS:
Take a picture of a standard sample prior to cleaning.

Procedure:
1) Turn off the heated aperture, and wait 20 minutes for cool down.
2) Vent the chamber to the atmosphere. Do not touch hardware. Pump chamber down. Record the pump-down time to crossover (high vacuum pump open), crossover pressure, and time to high vacuum.
3) If the crossover pressure is above 300 mTorr or 60 Pa, **STOP**! Consult with Hitachi Field Engineering to lower crossover pressure point by adjustment on EVAC control board.
4) If the crossover pressure is below 300 mTorr, proceed.
5) Vent the chamber again and install adaptor flange. Reuse O-ring. Handle vacuum parts with gloves.
6) Install KF 40 blank flange and centering ring on end of adaptor. Clamp and make vacuum tight.
7) Pump down, and make sure the pump-down time is correct. (No leaks)
8) Vent and remove blanking flange. Install ORS on Adaptor flange.
9) Set up controller and connect cables. Turn on power to controller. Digital display meter will light up.
10) Turn off Clean Enable switch on Controller. Set the time to 300 seconds.
11) Evacuate SEM, and make sure pump-down time is correct. (No leaks)
12) Turn on Clean Enable switch or Gas flow switch.
13) Vent chamber until pressure is above 10^3 Pascal
14) Restart evacuation.
15) When Vacuum ready light is on, the Gas flow will turn on and after a delay the RF may be turned on.
16) Cleaning will begin:
    a) Pressure will go to between 10^{-7} and 10^{-6} Torr
    b) After a delay for pressure stabilization RF power will go to 25-30 until plasma ignites, at which point it will drop to 10.
    c) Plasma on indicator will come on.
    d) There may be a slow drop in pressure during the cleaning. This is normal.
17) At the end of 300 seconds, the FE SEM will pump down normally.
18) Turn on Heated Aperture
19) Take a comparison picture after cleaning.

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Appendix B – Using the Evactron 45 with Cable Lengths of 22 feet (6.7 m)

No adjustments can be made to the **MTC-style** RF impedance match (manufactured on or after March 2008), as discussed in Section 14. Due to the change in cable length, the reverse power readings on the controller may be higher than the actual reverse power, as read by a Bird meter. The reverse power readings on the controller should still be <20% of forward power, as mentioned in Section 14.

If the **MCH-style** RF Match (manufactured on or before March 2008) is being used, it may need to be adjusted in order to minimize the reflected RF power. For users with cable lengths of 22 feet (6.7 m), a special adjustment procedure may be necessary in order to minimize reverse power and maximize forward power to the RF plasma. If you have an MCH-style match, review Section 14 of this manual and contact XEI Scientific for a detailed procedure on the match adjustment.

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XEI SCIENTIFIC EVACTRON 25 Traveler 1100-0003-03

Customer CALIFORNIA INST. OF TECH		Ship Date 06/15/11
Controller S/N K0201-E25-2272		ORS S/N K0110-MTC-2294
S.O. E25K0609CIT	Inv Number	Index Number 2272
Firmware Rev. V1.01	K0615CIT E25	Software Rev. V1.65

Step	Description	Batch/ SN	Date
1	Control Board Test Procedure 1000-0001-00 Completed	K0201CP45MC	6-10-11 MV XEI TC3
2	RF Gen Alignment Procedure 1000-0004-00 Completed	K0304RFGMC	6-9-11 MV XEI TC3
3	RF Filter Set-Up Procedure 1000-0005-00 Completed	K0304 RF MC	6-9-11 MV XEI TC3
4	Match Passed Testing and Burn-in	K0110MTCME	6/10/11 XEI TC4
5	ORS Passed High Vacuum Testing Micro-Pirani	1030134630	6/8/11 XEI TC4
6	Control Valve	EPCA284SUXNW 1211	
7	Display Programmed for TTL.		6-10-11 MV XEI TC3
8	HiPot and Ground Bonding Tests		6-10-11 MV XEI TC3
9	Load S/N and App Software. Check sales order if alternate software required.		6/11/11 XEI TC4
10	Functional Testing. Test Procedure 1000-0002-04 Completed.		6/11/11 XEI TC4
11	Burn-in Test Completed.		6/12/11 XEI TC4
12	Final Assembly Completed		6/13/11 XEI TC4
13	Final Test Completed.		6/13/11 XEI TC4
14	Set to Factory Defaults		6/13/11 XEI TC4
15	Final Quality Check. Ready for Shipping.		

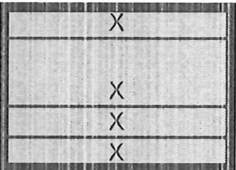
Final QA Check

1	Final Inspection Performed. All Fasteners Secured on controller and ORS.	6/13/11 XEI TC4
2	Shake Test for loose hardware Passed	6/13/11 XEI TC4
3	The instrument packed in the shipping container with: AC Power Cord, (See Sales Sheet for required AC Power Cord), Cable Set, Null Modem Cable,Owner's Manual, Software CD, Blank Flange, Centering Ring and Clamp attached to ORS .Required adapter flanges. (See sales sheet for details)	6/15/2011 Ren XEI TC5

Evactron 25 & 45 Controller Test Procedure

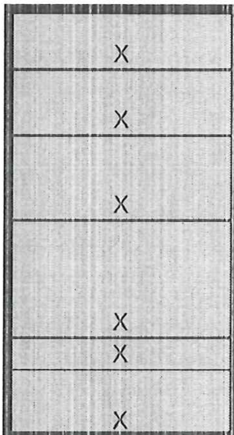
Field	Value
	1000-0002-04
	CAL-TECH
	K0201-E25-2272
ORS S/N:	K0110-MTC-2294
Date:	06/11/11
Tested by:	GS
Board S/N:	K0610-CP45-A001
Firmware:	v. 1.01
Application Installed:	v. 1.65
Chamber used for Test	Cylinder
Bird Meter used for Calibration	7
Remote Vent Enable Installed?	N
Custom Front Panel Start?	N
Custom Display Loaded?	N
Cable Bundle Length:	12.5
Notes:	ORS-U

1. Setup



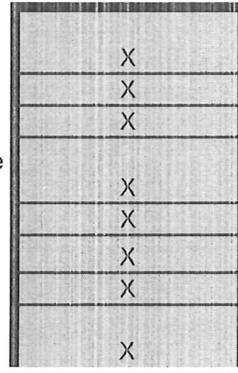
Step	Check
1.1 If Remote Vent option is ordered, install jumper onto board.	X
1.2 Connect unit to ORS via Bird Power meter using customer and RF test cables	X
1.3 Connect computer interface using null modem cable.	X
1.4 Power unit on.	X

2. Download Software, Setup Serial Numbers



Step	Check
2.1 In the Controller preparation tab of the GUI, select the proper Model Number.	X
2.2 Enter the Controller Serial Number and click on the Program Product ID button.	X
2.3 Using the Software Update tab on the GUI download the appropriate application software. The software should be located in C:\XEI\Controller\Application\	X
2.4 Read the software version and serial number from the GUI. Verify that they are correct. If they are incorrect, return the board to the board test station, re-program the bootloader, and return to the application download step in this procedure.	X
2.5 Write the software version and serial number on page 1 of this procedure.	X
2.6 In the Controller preparation tab of the GUI click on the Program LCD Startup button	X

3. Initial Controller Tests

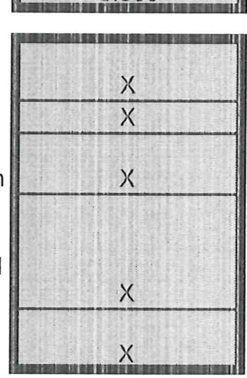


Step	Check
3.1 Cycle the power and verify that the display shows "XEI Scientific" and the correct model and software version.	X
3.2 Verify that the line power lamp is lit.	X
3.3 Verify correct time and date on GUI.	X
3.4 Press enable button and verify that unit changes state at the pressing of the button and not upon release.	X
3.5 Verify operation of enable lamp.	X
3.6 Disconnect the RF cable and verify operation of Fault lamp	X
3.7 Reconnect RF cable, clear fault.	X
3.8 Use the front panel encoder to change the clean time both up and down to verify encoder operation.	X

4. Cleaning Cycle Tests

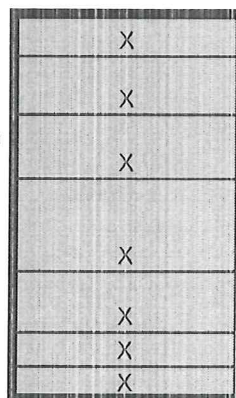
Step	Parameter	Setting	Check	Unit
4.1 Set following clean conditions from the front panel or GUI:	a) Plasma Time	2 minutes (or as required)	X	
	b) Purge Time	30 seconds (or as required)	X	
	c) Power	10 Watts	X	
	d) Ignition pressure	500 mTorr	X	
	e) Plasma pressure	600 mTorr	X	
	f) Purge pressure	1 Torr	X	
	g) Cycles	Any value OK	X	
	h) Purge	ON	X	
4.2 Vent and pump down chamber to initiate clean cycle.			X	
4.3 Verify that the unit undershoots pressure once and then settles to 500mTorr			X	
4.4 Verify that the RF ON lamp is lit.			X	
4.5 Verify that the fan is operating properly.			X	
4.6 Upon achieving ignition, verify Plasma lamp lit & Plasma sheath visible			X	
4.7 While cleaning, verify pressure reading within 10% of reference gauge.	a) Pressure Reading		0.6	Torr
	b) Reference reading		0.63	Torr
	c) % Error		4.76	%
4.8 In Purge mode verify N2 valve open by placing finger over inlet and noting suction.			X	
4.9 Allow the cleaning cycle to complete.			X	
4.10 Verify correct Last Clean Date and Time on front panel display.			X	
4.11 Allow to pump down to chamber base pressure, verify that the ORS does not leak.	a) Base pressure achieved		0.035	Torr

5. Check Remote Vent Enable



Step	Check
5.1 Disconnect Pressure Gauge cable from Controller, install MicroPirani 0.25 mTorr simulator	X
5.2 Clear fault, Enable cleaning	X
5.3 On the Controller Preparation tab of the GUI, click on the Start Now button	X
5.4 If the unit is configured to enable venting (jumper installed in step 1), verify that the unit jumps to the Stabilizing Pressure state. If the unit is not configured to enable venting, verify error message displayed on the GUI	X
5.5 Disconnect MicroPirani 0.25 mTorr simulator, reconnect Pressure Gauge cable to ORS, clear fault	X

6. Power Calibration



Step	Check
6.1 Vent and Pumpdown to initiate a cleaning at 10 watts and 600mTorr	X
6.2 Calibrate forward power by adjusting detector for 10 watts forward power on Bird meter.	X
6.3 Initiate a cleaning at 14 watts and 600mTorr on the Evactron. Adjust match to the lowest reflected power shown on the Bird meter.	X
6.4 Initiate a cleaning at 6 watts and 600mTorr on the Evactron. Verify that the tip of plasma sheath is visible within about ¼ of an inch at the mark on the calibration Tee.	X
6.5 Measure and record the forward and reverse power readings on the Bird meter in Table 1 below.	X
6.6 Repeat for the remaining powers listed in the table.	X
6.7 Verify that the values measured are within the limits shown in the table.	X

Table 1:

Power Readings Summary

Parentheses Contain Acceptable Limits of Readings

W	Bird Forward Power Readings (4-7W)	6.2	W
10 W	Bird Forward Power Readings (6-12W)	10.0	W
15 W	Bird Forward Power Readings (10-17W)	14.7	W
20 W	Bird Forward Power Readings (14-22W)	19.1	W

Evactron Reverse Power Readings with Forward Power set at 5 W (<1W)	0.5	W
Evactron Reverse Power Readings with Forward Power set at 10 W (<2W)	0.7	W
Evactron Reverse Power Readings with Forward Power set at 15 W (<3W)	1.2	W
Evactron Reverse Power Readings with Forward Power set at 20 W (<4W)	1.9	W

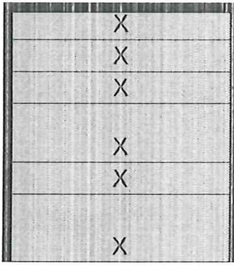
Bird Meter Reverse Power Readings with Forward Power set at 5 W (<1W)	0.1	W
Bird Meter Reverse Power Readings with Forward Power set at 10 W (<2W)	0.1	W
Bird Meter Reverse Power Readings with Forward Power set at 15 W (<3W)	0.8	W
Bird Meter Reverse Power Readings with Forward Power set at 20 W (<4W)	1.9	W

7. Burn-in Test

7.1 Set following clean conditions from the front panel or GUI:			
a) Plasma Time	20-24 hours (as required for an overnight run)	X	
b) Purge Time	N/A	X	
c) Power	20 Watts	X	
d) Ignition pressure	500 mTorr	X	
e) Plasma pressure	400 mTorr	X	
f) Purge pressure	N/A	X	
g) Cycles	1	X	
h) Purge	OFF	X	
7.2 Vent and pump down chamber to initiate clean cycle.		X	
7.3 Upon achieving ignition, verify PLASMA ON lamp lit, FAULT lamp not lit, and plasma sheath visible		X	
7.4 Record Evactron Reverse Power Reading (Must be <4W)		1.8	W
7.5 Record Bird Meter Forward Power Reading (Must be between 11-18W)		19.0	W
7.6 Record Bird Meter Reverse Power Reading (Must be <3W)		1.8	W
7.7 Allow Evactron to run overnight (minimum 12 hours)		X	
7.8 After overnight run, verify PLASMA ON lamp lit, FAULT lamp not lit, and plasma sheath visible		X	
7.9 Record Evactron Reverse Power Reading (Must be <4W)		2.0	W
7.10 Record Bird Meter Forward Power Reading (Must be between 11-19W)		19.1	W
7.11 Verify that change in Bird Meter Forward Power is <15%		0.5	%
7.12 Record Bird Meter Reverse Power Reading (Must be <3W)		2.1	W

8. Cold Calibration

8.1 Let Evactron cool down after Burn-in process	X
8.2 Set Final Test clean conditions from the GUI (See Final Test)	X
8.3 Initiate clean cycle	X
8.4 Calibrate forward power by adjusting detector for 10 watts forward power on Bird meter.	X
8.5 Disable Evactron and Initiate new cleaning cycle	X
8.6 Verify Evactron 10 watts power readout matches 10 watts forward power reading on Bird meter	X

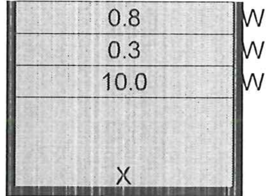


8.7 Record Evactron Reverse Power Reading

8.8 Record Bird Meter Reverse Power Reading

8.9 Record Bird Meter Forward Power Reading

8.10 Initiate a cleaning at 6 watts and 600mTorr on the Evactron. Verify that the tip of plasma sheath is visible within about ¼ of an inch at the mark on the calibration Tee.



W
W
W

9. Final Assembly

9.1 Disable Evactron, Turn off power, vent vacuum, disconnect both ORS and null modem cables

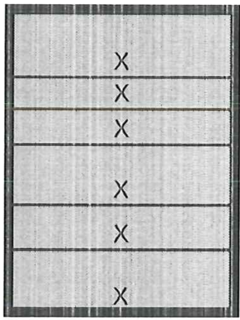
9.2 Attach top cover to Controller

9.3 Place two High Voltage stickers on top cover.

9.4 Place Fuse sticker on back panel, covering fuse information currently on panel

9.5 Place adjustment hole covering dome plugs on match.

9.6 Disconnect ORS from vacuum chamber, place ORS, Controller, and Traveller in stock



10. Final Test

10.1 Connect unit to ORS using customer cables

10.2 Connect computer interface using null modem cable.

10.3 Power unit on.

10.4 Set following clean conditions from the front panel or GUI:

a) Plasma Time	2 minutes (or as required)
b) Purge Time	30 seconds (or as required)
c) Power	10 Watts
d) Ignition pressure	500 mTorr
e) Plasma pressure	600 mTorr
f) Purge pressure	1 Torr
g) Cycles	Any value OK
h) Purge	ON

10.5 Enable unit, vent and pump down chamber to initiate clean cycle.

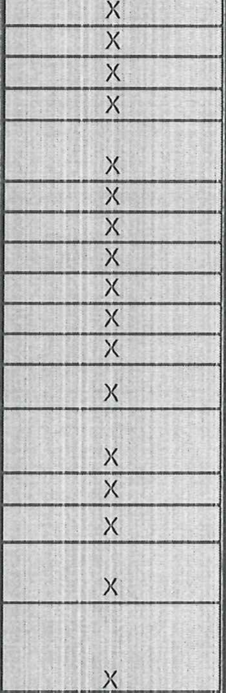
10.6 Verify that the unit undershoots pressure once and then settles to 500mTorr

10.7 Verify that the RF ON lamp is lit.

10.8 Verify that the fan is operating properly.

10.9 Upon achieving ignition, verify Plasma lamp lit & Plasma sheath present.

10.1 Initiate a cleaning at 6 watts and 600mTorr on the Evactron. Verify that the tip of plasma sheath is visible within about ¼ of an inch at the mark on the calibration Tee.



11. Set to Factory Defaults

11.1 Disable unit. Go to the Controller Preparation tab of the GUI and click on the Set Config to Default button

11.2 Verify on the display that the Last Clean Time is --/--/-- --:--:--

11.3 Go to the Events tab and click Reset to clear the event log

11.4 On the Process Configuration tab of the GUI open Factory Settings. Download Configuration to the Controller

11.5 Click on the Upload Configuration button and verify that the parameters match the factory default conditions

11.6 Refresh and reset event log again before shipping