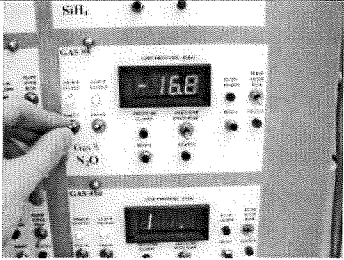


YES PLASMA CLEANER Standard Operation Procedure	
Instrument	YES-R1
Manufacturer	Yield Engineering Systems, Inc
	Secondhand Semi
Property Number	ISU xxxxxxxx
Location	2055A Gilman Hall (Clean Room)
Supervisor/Trainer	
In case of emergency	Push the emergency power off switch. Turn off emergency key on the gas panel.
Objectives	<ol style="list-style-type: none"> 1. The user will become aware of all potential hazards involved in the procedure. 2. The user will learn the correct procedure for standard cleaning and PDMS-glass or PDMS-PDMS bonding.
Related SOP	<ul style="list-style-type: none"> • Process gas handling procedure • Vacuum pump maintenance • Clean room
Required Safety Training	<ul style="list-style-type: none"> • AL-001 (General employee) • AL-133 (PPE) • AL-137 (Chemical hazard communication) • (AL-022) (recommended)
MSDS	<ul style="list-style-type: none"> • MSDS for process gases is located in 2831A Gilman Hall.
Authorization Process	<ol style="list-style-type: none"> 1. Read this document. 2. Have an orientation from ST. 3. Take safety training listed above.
Personal Protection (PPE)	Powderless gloves, clean room suite, safety glasses.
Potential Hazards	High Voltage:
	Chemical Hazard: The user must protect themselves from the chemical hazards associated with the chemicals used in conjunction with the equipment for plasma cleaner.

<p>1. Vacuum pump</p>	<ul style="list-style-type: none"> • Make sure vacuum pump is on. • If not, plug in the power line. • For the maintenance, see "<i>vacuum pump maintenance SOP</i>". ST will perform maintenance. • Contact ST if users find something unusual.
<p>2. Gas Handling</p>	<ul style="list-style-type: none"> • Open high-pressure valves by switches on the panel in the clean room. Green light indicates valves being open and red light indicates valves being closed. • When sudden change in gas flow occurs, low-pressure valve is closed and error indicator blinks. Push the reset button until it stops blinking. • After the experiments, users will close the high-pressure valves by the switches on the panel in the clean room. • If above procedure does not work, contact ST. • ST will perform maintenance of gas lines. 
<p>3. Plasma Cleaner</p>	<p>System Overview</p> <ul style="list-style-type: none"> • User can program up to 9 sequences. The default is the sequences #1. Sequences #2 ~ #9 are currently empty. • In the sequence #1, user can run 4 different recipes. User will choose the recipe by turning the thumbwheel. <ul style="list-style-type: none"> ○ Thumb wheel #1 → Process with gas #1 ○ Thumb wheel #2 → Process with gas #2 ○ Thumb wheel #3 → Process with gas #3 ○ Thumb wheel #4 → Venting with N₂. <p>Check Operational Parameters (Run the program without samples).</p> <ol style="list-style-type: none"> 1. Make sure power switch is on. The power switch is located on the backside of the controller. Also, turn on the power of the plasma generator located under the rack.

2. Make sure the sequence #1 is selected.

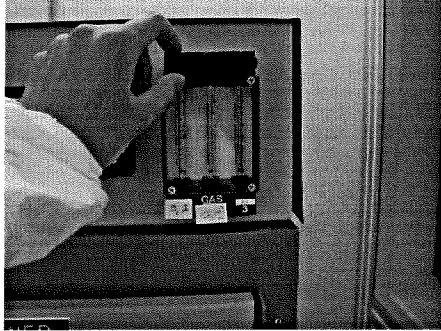
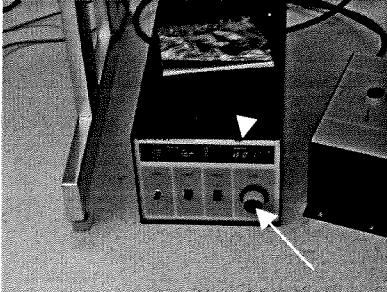


3. Select thumbwheel #1~#3. #1 for Oxygen, #2 for CF₄, #3 for air.
4. Make sure chamber is closed. Without samples, run the program by pressing either "run" on the program panel or red button on the chassis.



5. Program will run following sequences. Check and adjust setups as listed below.

1. Vacuum	Check the pressure gage. The pressure gets lower.
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		<p>PDMS-glass bonding) Occasionally fine adjustment is needed: turn the manual pin-valve.</p> 
	<p>3. Vacuum, Gas, Plasma</p>	<p>During this process, check the plasma power shown on the plasma generator panel. (0.035kW for Oxygen Plasma for PDMS-glass bonding). Adjust the set point if needed.</p>  <p>Measure plasma time. Default is 1 min for gas #1.</p> <p>If longer or shorter time is needed, user may change the duration time by changing the program steps. Follow the instruction below*.</p> <p>If duration time is longer than a</p>

desired plasma time, user may stop the process by pushing “stop” on the program panel or black button on the chassis. Then set thumbwheel to #4. Push "run" on the program panel or red button.

4. Vent

Load Samples and Run Program.

1. After completion of venting, open the chamber and place samples on the sample rack.
2. Close the chamber and select thumbwheel #1~#3 and run the program.
3. Watch the pressure, plasma power, and plasma duration time.
4. If plasma duration time is longer than a desired plasma time, user may stop the process by pushing “stop” on the program panel or black button on the chassis. Then set thumbwheel to #4. Push "run" on the program panel or red button.
5. Otherwise, wait until the whole process is completed. In either case, after the venting, orange color light will be blinking.
6. Open the chamber and take the samples out.
7. Close the chamber.
8. Write down log note.

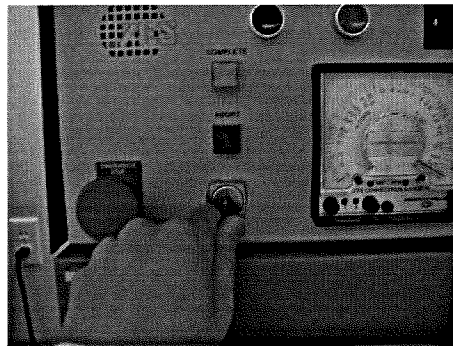
Process Recipe Example

- Oxygen Plasma for PDMS-glass & PDMS-PDMS bonding.

Thumbwheel	#1 (Oxygen)
Oxygen pressure	1 Torr
Plasma Power	0.035kW.
Plasma Time	1 min

***Changing Plasma Time in the Program.
Shown here is the procedure to change plasma time
in the Sequence #1, process with gas #1.**

1. Check step 014.
014 LOOPC =0005 1,2,8
2. If =0005, plasma time is ~5min. If =0001, it is 1 min.
3. Unlock the key.



4. Change the number using $\uparrow\downarrow$ key.
5. Press "start" on the program panel. The program may start running.
6. Lock the key.
7. Stop or abort the process.
8. Check step 014. It must be new number written.

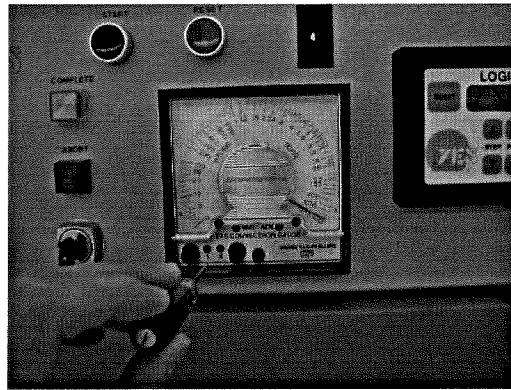
Similarly, steps 033 and 048 are for processes with gases #2 (CF₄) and #3 (Air), respectively.

Other parameters.

- For example, user could change step 011 to change time (default 4 min) to fill chamber with process gas #1 before applying plasma. [NOT RECOMMENDED. KEEP THE DEFAULT].

Vacuum Setpoints

- Vacuum setpoints appeared in the program were set up from the vacuum gage hardware. Push left button to see Setpoint 1 on the gage. Push right button to see Setpoint 2 on the gage. These setpoints can be changed by turning the small screws.



Currently Setpoint 1 is 2 Torr, Setpoint 2 is 200mTorr.

Trouble Shooting

- Vacuum does not reach to Setpoint 1.
Ask ST to check if house N₂ gas has enough pressure (=80psi). If N₂ gas does not have enough pressure, the vacuum valve cannot be operated and remains closed.
- See YES manual for details.
- Consult with YES.
- Secondhand Semi
James L Corbin, 408-956-1262

Document written by Hajime Takano (7/24/02)

Output Designation

Input Designation

| Input/Output Designation

1	Vacuum	A	Vacuum Setpoint 1
2	Gas #1	B	Thumbwheel 1,3,5,7,9
3	Gas #2	C	Thumbwheel 1,2,3,6,7
4	Gas #3	D	Vacuum Setpoint 2
5	Vent	E	Thumbwheel 4,5,6,7
6	Complete	F	ARC Detect Input
7	Abort/Alarm	G	Not Used
8	RF Power	H	Thumbwheel 8,9

— Ag 02

The suggested program examines the status of interlocks in order to continue the process or abort. These interlocks are the Granville-Phillips vacuum gauge setpoints and the two proximity switches to ensure closure of the door. In the steps where the interlocks are examined, we are looking to see if the unit has reached a sufficient vacuum level or if the door is closed.

If these interlocks are not satisfied, the process will abort to pre-programmed subroutines where the **ABORT** light flashes rapidly and the system is backfilled until the **RESET** button is pushed.

Note

The **ABORT** cycles should be allowed to continue until the system has reached atmospheric pressure, as indicated by the ability to open the door before pressing **RESET**. Noting the step #'s of the abort condition will indicate the problem with reference to the abort table at the end of this section.

The proper setpoints are in the control of the process engineer. Y.E.S. suggests **2 Torr** for Setpoint 1 and **800 mTorr** for Setpoint 2. Setpoint 1 is used as a vacuum check after 2:15 minutes of the process. Setpoint 2 is near the process pressure level. For different process gases this pressure may be different. For heavier gases lower pressures may be required.

The following procedure demonstrates how to program or alter a program in the Lark Sequencer.

| Programming

Programming is done at the front of the unit by pressing buttons on the keypad. There are nine different sequence program areas, each capable of 999 steps. Only one of the nine programs can be programmed or run at any one time.

| Method

The active sequence is selected during the **RESET** mode by using the **STEP** buttons. The upper right portion of the window shows the active sequence and the number of steps that have been entered into that sequence. Each of the sequence program areas use the same inputs and outputs.

Nine functions are available in the program mode. **Count 0000** will be displayed if nothing has been entered at that step.

The **FUNC** buttons will advance or recede through a list of selectable functions.

When changing the plasma process time, be careful not to press any buttons other than those specified below, and follow these steps exactly. Pressing the wrong buttons will change **STEP** functions and cause improper operation.

| Changing Plasma Process Time

The unit, as shipped, was preprogrammed with the suggested program in the microprocessor's memory. Recheck the system in the following manner.

Thumbwheel

Description

0	60 min. vacuum pump down
1	5 min. Gas #1 process
2	5 min. Gas #2 process
3	5 min. Gas #3 process
4	1 min. Vent to atmosphere
5	30 min. Gas #1 flow adjust
6	30 min. Gas #2 flow adjust
7	30 min. Gas #3 flow adjust
8	Backfill adjust
9	2 min. Gas # 2 process followed by 5 min. Gas # 1 process

| Thumbwheel Setting

YES-R1 Program Plasma Clean Program

Step	Func	Data	Output	Comments
001	GO TO	>003		Go to step 003
002	GO TO	>000		Not Used
003	IF	H>083		Check thumbwheel 8 and 9
004	IF	E>060		Check thumbwheel 4,5,6, and 7
005	MINS	=2:15	1	Vacuum valve open for 2:15 minutes
006	IF	A>074	1	ABORT if above 2 Torr
007	IF	C>029	1	If 2 or 3 dialed on Thumbwheel, go to step 029
008	IF	B>011	1	If 1 dialed on Thumbwheel, go to step 011
009	MINS	=57:45	1	Program 0. 1 hour total vacuum
010	GO TO	>025		Go to step 025. Complete cycle
011	MINS	=04:00	1,2	Program 1. Fill chamber with process gas# 1
012	IF	A>074	1,2	ABORT if above 2 Torr
013	SECS	=05.00	1,2,8	RF power ON. Activate plasma
014	LOOPC	=0005	1,2,8	Load 5 in memory loop. Change this number to equal the desired minutes of plasma
015	LOOPC	=0500	1,2,8	Load 500 in nested loop memory to equal 1 minute of plasma while checking every 1/10th of a second to confirm stable plasma
016	IF	A>074	1,2,8	ABORT if above 2 Torr
017	IF	D>019	1,2,8	If above 800 mTorr, go to step 019
018	GO TO	>077	1,2,8	Vacuum below 800 mTorr, ABORT to step 077
019	IF	F>021	1,2,8	Power supply signal ON. Go to step 021
020	GO TO	>080	1,2,8	Power supply Signal OFF. ABORT to step 080
021	SECS	=00.10	1,2,8	1/10th of a second of plasma
022	LOOPJ	>016	1,2,8	Subtract 1 from number in step 015 memory loop. Repeat sequence beginning at step 016.
023	LOOPJ	>015	1,2,8	If memory equals zero, go to next step Subtract 1 from number in step 014 memory loop. Repeat sequence beginning at step 015. If memory equals zero, go to next step
024	SECS	=05.00	1,2	5 seconds to extinguish plasma
025	MINS	=01:30	5	Vent/Backfill for 1:30 minutes to atmosphere
026	SECS	01.00	5,6	Vent/Complete light
027	SECS	01.00	5	flashing until RESET
028	GO TO	>026	5	is pushed
029	IF	B>045	1	If 3 is dialed on the Thumbwheel, go to step 045
030	MINS	=04:00	1,3	Program 2. Flush chamber with process gas #2
031	IF	A>074	1,3	ABORT if above 2 Torr
032	SECS	05.00	1,3,8	RF power ON. Activate plasma
033	LOOPC	0005	1,3,8	Load 5 in memory loop. Change this number to equal the desired minutes of plasma
034	LOOPC	0500	1,3,8	Load 500 in nested loop memory to equal 1 minute of plasma while checking every 1/10th of a second to confirm stable plasma
035	IF	A>074	1,3,8	ABORT if above 2 Torr
036	IF	D>038	1,3,8	If above 800 mTorr, go to 038
037	GO TO	>077	1,3,8	Vacuum below 800 mTorr, ABORT to step 077
038	IF	F>040	1,3,8	Power supply signal ON. Go to step 040
039	GO TO	>080	1,3,8	Power supply Signal OFF. ABORT to step 080
040	SECS	00.10	1,3,8	1/10th of a second of plasma

YES-R1 Program (Cont.)

Step	Func	Data	Output	Comments
041	LOOPJ	>035	1,3,8	Subtract 1 from number in step 034 memory loop. Repeat sequence beginning at step 035. If memory equals zero, go to next step
042	LOOPJ	>034	1,3,8	Subtract 1 from number in step 033 memory loop. Repeat sequence beginning at step 034. If memory equals zero, go to next step
043	SECS	05.00	1,3	5 seconds to extinguish plasma
044	GO TO	>025		Go to step 025 for vent and Complete cycle
045	MINS	4:00	1,4	Program 3. Flush chamber with process gas #3
046	IF	A>074	1,4	ABORT if above 2 Torr
047	SECS	=05.00	1,4,8	RF power ON. Activate plasma
048	LOOPC	0005	1,4,8	Load 5 in memory loop. Change this number to equal the desired minutes of plasma
049	LOOPC	0500	1,4,8	Load 500 in nested loop memory to equal 1 minute of plasma while checking every 1/10th of a second to confirm stable plasma
050	IF	A>074	1,4,8	ABORT if above 2 Torr
051	IF	D>053	1,4,8	If above 800 mTorr, go to step 053
052	GO TO	>077	1,4,8	Vacuum below 800 mTorr, ABORT to step 077
053	IF	F>055	1,4,8	Power supply signal ON. Go to step 055
054	GO TO	>080	1,4,8	Power supply Signal OFF. ABORT to step 080
055	SECS	00.10	1,4,8	1/10th of a second of plasma
056	LOOPJ	>050	1,4,8	Subtract 1 from number in step 049 memory loop. Repeat sequence beginning at step 050. If memory equals zero, go to next step
057	LOOPJ	>049	1,4,8	Subtract 1 from number in step 048 memory loop. Repeat sequence beginning at step 049. If memory equals zero, go to next step
058	SECS	05.00	1,4	5 seconds to extinguish plasma
059	GO TO	>025		Go to step 025 for Vent and Complete cycle
060	IF	C>066		If 6 or 7 dialed on the Thumbwheel, go to step 066
061	IF	B>064		If 5 dialed on the Thumbwheel, go to step 064
062	MINS	=01:00	5	Program 4. Vent valve open for 1 minute
063	GO TO	>025		Go to step 025
064	MINS	=30:00	1,2	Program 5. 30 minutes to set gas flow for gas #1
065	GO TO	>025		Go to step 025 for Vent and Complete cycle
066	IF	B>069		If 7 dialed on the Thumbwheel, go to step 069
067	MINS	=30:00	1,3	Program 6. 30 minutes to set gas flow for gas #2
068	GO TO	>025		Go to step 025 for Vent and Complete cycle
069	MINS	=30:00	1,4	Program 7. 30 minutes to set gas flow for gas #3
070	GO TO	>025		Go to step 025 for Vent and Complete cycle
071	GO TO	>000		Not Used
072	GO TO	>000		Not Used
073	GO TO	>000		Not Used
074	SECS	00.50	5,7	ABORT from steps 006,012,
075	SECS	00.50	5	016, 031, 035, 046, 050, 093, 095, 099, 110

YES-R1 Program (Cont.)

Step	Func	Data	Output	Comments
076	GO TO	>074	5	Vacuum above 2 Torr
077	SECS	00.50	5,7	ABORT from steps 018,
078	SECS	00.50	5	037, 052
079	GO TO	>077	5	Vacuum below 800 mTorr
080	SECS	= 00.50	5,7	ABORT from steps 020,
081	SECS	00.50	5	039, 054
082	GO TO	>080	5	Power supply is OFF
083	IF	B>092		If 9 dialed on the Thumbwheel, go to step 092
084	MINS	00:45	1	Program 8. Adjust N ₂ flow
085	MINS	01:30	5	
086	LOOPC	0004		Load 4 into memory loop
087	SECS	01.00	6	Sound sonalert for 1 second
088	SECS	01.00		
089	LOOPJ	>087		Repeat from step 087 until memory equals zero
090	GO TO	>084		Repeat from step 084
091	GO TO	>000		
092	MINS	= 02:15	1	Program 9. Vacuum valve open for 2:15 minutes
093	IF	A>074	1	ABORT if above 2 Torr
094	MINS	= 04:00	1,3	Flush chamber with process gas #2
095	IF	A>074	1,3	ABORT if above 2 Torr
096	SECS	05.00	1,3,8	RF power supply ON. Activate plasma
097	LOOPC	0002	1,3,8	Load 2 in memory loop. Change this number to equal desired minutes of plasma clean. DO NOT EXCEED 10 MINUTES AT 1000 WATTS ENERGY OR DAMAGE WILL RESULT
098	LOOPC	0500	1,3,8	Load 500 in nested loop memory to equal 1 minute of plasma while checking every 1/10th of a second to confirm stable plasma
099	IF	A>074	1,3,8	ABORT if above 2 Torr
100	IF	D>102	1,3,8	If above 800 mTorr, go to step 102
101	GO TO	>077	1,3,8	Vacuum below 800 mTorr, ABORT to step 077
102	IF	F>104	1,3,8	Power supply signal ON. Go to step 104
103	GO TO	>080	1,3,8	Power supply Signal OFF. ABORT to step 080
104	SECS	00.10	1,3,8	1/10th of a second of plasma
105	LOOPJ	>099	1,3,8	Subtract 1 from number in step 098 memory loop. Repeat sequence beginning at step 099.
106	LOOPJ	>098	1,3,8	If memory equals zero, go to next step Subtract 1 from number in step 097 memory loop. Repeat sequence beginning at step 098. If memory equals zero, go to next step
107	SECS	05.00	1,3	5 seconds to extinguish plasma
108	MINS	= 01:30	5	Vent/Backfill for 1:30 minutes to atmosphere
109	MINS	= 02:15	1	Vacuum valve open for 2:15 minutes
110	IF	A>074	1	ABORT if above 2 Torr
111	GO TO	>011	1	
112	GO TO	>000		