THE UNIVERSITY OF ARIZONA

NanoFabrication Core Facility

Center for Semiconductor Manufacturing · Office of Research & Partnerships

STANDARD OPERATING PROCEDURE

YES-R1 Plasma Cleaner

Setup, Operation, Programming & Safety

Document Number	SOP-PC-R1
Facility	UA NanoFabrication Core Facility (NFC) — Micro/Nano Fabrication Center, Tucson, AZ
Equipment	Yield Engineering Systems (Y.E.S.) Model YES-R1 Bench-Top Plasma Cleaner
Nameplate	120 V, 60 Hz, 1.4 A, 175 W — Model YES-R1, Serial 87710
Asset / Tag	Plasma Cleaner — Tag 73 (AEI surveyed 8/19/25)
Controller	Y.E.S. “Lark” Logical Sequencer (Manual Rev. 08-93)
Vacuum Pump	Fisher Scientific Maxima C Plus, Model M2C (KF-16 inlet)
Plasma Power	Plasma-Therm PE-1000 AC source (~1 kW, ~50 kHz, 115 VAC)
Matching Network	Advanced Energy LM-5K manual transformer matching unit
Prepared By	Aleco Dominguez — Undergraduate Student
Revision	C (UA NFC release; incorporates commissioning field notes)
Status	DRAFT — verify open items in §14 before production use

Prepared By	Aleco Dominguez (Undergraduate Student) Date: _____
Reviewed By	_____ Date: _____
Approved By	_____ Date: _____

Prepared from Y.E.S.-R1 Manual Section 4 pages 11-15 (Aug 1993), Iowa State SOP (July 2002), and field notes. Items marked “verify” are recommended to be checked against the actual hardware before relying on them.

Facility Information

This procedure is maintained for use at the University of Arizona NanoFabrication Core Facility (NFC). The NFC is part of the Center for Semiconductor Manufacturing (CSM) and is an Office of Research and Partnerships (ORP) core. It is an open, user-friendly facility serving academic, government, and private researchers at the micro and nano scale.

Facility Detail	Information
Facility	NanoFabrication Core Facility (NFC)
Parent center	Center for Semiconductor Manufacturing (CSM); Office of Research & Partnerships core
Location	Micro/Nano Fabrication Center, 1230 E. Speedway Blvd., Rm 230F, Tucson, AZ 85721-0104
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Scheduling & training	Equipment scheduling and training are handled through iLab (ua.ilab.agilent.com). Create an iLab account, then request training or reserve tool time.
Access & keys	Tool access requires completion of NFC safety training and issuance of facility keys/codes per NFC Safety Requirements.
Website	nfc.arizona.edu

RESEARCH ACKNOWLEDGEMENT

Work performed using this tool should acknowledge the facility. Suggested wording for papers, presentations, and posters:

"This work was performed in part at the Nano Fabrication Core Facility at the University of Arizona."

EMERGENCY & SAFETY

For any life-safety emergency, call 911. Follow the NFC Emergency Response Guide and Safety Requirements for tool-specific incidents. Locate the nearest E-STOP, gas shut-off, and exit before operating. Chemical safety data (SDS/MSDS) is available through the RLSS user dashboard.

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1. Purpose & Scope

This Standard Operating Procedure (SOP) describes the setup, startup, operation, programming, and shutdown of the Y.E.S.-R1 bench-top plasma cleaner. The tool uses a low-pressure gas plasma to remove organic contamination and to surface-activate parts and substrates (e.g. oxygen plasma for PDMS/glass bonding, argon for cleaning/etching).

The scope covers physical installation and utility connection, the vacuum and gas/pneumatic subsystems, the PE-1000 / LM-5K power and matching equipment, the Lark Logical Sequencer and its recipes, and the safety interlocks. It applies to all trained personnel authorized to operate the tool.

THREE THINGS THAT WILL SAVE YOU TIME

1. The key switch enables programming. If the panel won't let you edit sequences, turn the front-panel key to the Program/enable position first.

2. The VENT port wants LOW pressure (5–15 psi). Feeding 60–80 psi into VENT makes the Mini-Myte pilot valve hiss continuously — that is over-pressure, not a normal purge.

3. The controller DOES NOT run the pump. Start the Maxima pump manually before every run and vent before stopping it.

2. Safety

Read this section in full before operating the tool. Plasma processing combines RF/AC high-voltage energy, vacuum, compressed gas, and a mechanical pump.

2.1 Hazards & Controls

Hazard	Control
RF / AC plasma energy	Keep covers and the chamber door closed during a run. Never defeat the door interlock. The RF output is enabled only via the controller (Output 7) when interlocks are satisfied.
Vacuum / implosion	Inspect chamber, viewport, and seals before each use. Do not run with cracked glassware.
Compressed gas (N_2, 80 psi)	Regulate each port correctly (High-Pressure Air 60–80 psi; VENT 5–15 psi). Secure cylinders. Investigate any continuous hissing.
Pump oil / backstreaming	Vent the line before stopping the pump to prevent oil being pulled toward the chamber.
Hot surfaces	Chamber and parts may be warm after a run — allow to cool before handling.
Electrical loading	Keep the PE-1000 (draws up to ~13 A at full power) on its own 15–20 A circuit so it does not trip the breaker shared with the pump.

EMERGENCY STOP

The red EMERGENCY STOP mushroom button removes power from the process. Press it for any abnormal condition — arcing, unexpected venting, gas odor, smoke, or a loud sustained hiss.

After an E-STOP, find and correct the cause before releasing it and restarting.

2.2 General Rules

- Only trained, authorized personnel may operate the tool. The programming key is held by authorized operators only.
- Never run plasma without the roughing pump confirmed ON and pumping.
- Never bypass the door, vacuum, or pneumatic interlocks.
- RF electronics (PE-1000 / LM-5K) are the last to turn ON and the first to turn OFF.
- Let an ABORT or vent cycle finish (chamber at atmosphere) before pressing RESET or opening the door.
- Never energize Vacuum (Output 1) and Vent (Output 5) at the same time.

3. System Overview & Components

The plasma cleaner is an integrated bench-top system built around five subsystems: the YES-R1 control cabinet, the vacuum pump, the gas/pneumatic supply, and the PE-1000 + LM-5K power chain. Required components are listed below; open items are tracked in Section 14.

3.1 Equipment Summary

Item	Model / Rating	Role
YES-R1 cabinet	120 V, 1.4 A, 175 W; Ser. 87710	Control, chamber, gauge, valves, gas metering.
Lark Logical Sequencer	Y.E.S. controller	Selects, programs, and runs recipes; reads interlocks.
Maxima C Plus M2C	Dual-stage rotary-vane; KF-16 inlet	Pumps chamber to the mTorr range.
PE-1000	Plasma-Therm AC source; ~1 kW, ~50 kHz, 115 VAC	Provides power to strike/sustain plasma.
LM-5K	Advanced Energy manual transformer	Impedance/voltage-ratio matching to the chamber.
MDC angle valve	Pneumatic KF-16 angle valve	Automated isolation valve at the pump inlet.
Humphrey Mini-Myte 41E1	4-way pilot solenoid valve	Routes compressed air to actuate the angle/vent valves.

POWER-SOURCE DECISION

Use the PE-1000 as the plasma power source; use the LM-5K only as the manual matching transformer. Field guidance flagged that a 5 kW industrial supply would be wrong to drive this small chamber directly, and that the LM-5K's heavy industrial 3-phase input is not available on a 120 V bench. In this configuration the PE-1000 supplies the AC power and the LM-5K's transformer matches it to the chamber. Confirm the exact input requirements on each unit's nameplate before powering up.

3.2 Front Panel Controls & Indicators

Control / Indicator	Function
START	Begins the selected sequence (after RESET / pump running).
RESET	Returns to RESET mode; selects the active sequence; clears an ABORT once at atmosphere.
Power switch	Main power to the YES-R1 control electronics.
Key switch	Enables Program mode. Must be turned to unlock sequence editing.
COMPLETE (amber)	Lights when a cycle finishes; flashes until RESET.
ABORT (red)	Flashes rapidly during an abort while the chamber backfills.
EMERGENCY STOP (red)	Immediately removes power from the process.
Convectron gauge	Granville-Phillips / YTS analog gauge, calibrated for N_2; reads chamber pressure.
Logical Sequencer	Lark keypad + display; selects, programs, runs recipes.
Gas flowmeters 1/2/3	Three rotameters meter Gas #1/#2/#3 into the chamber.

3.3 Rear-Panel Connections

The rear panel carries the vacuum, gas, pneumatic, and RF connections. Identify each before plumbing:

- **Vacuum exhaust port** — the largest flange on the rear panel, a smooth-faced KF-25 (40 mm / 1.57 in OD) fitting. Connects to the pump. Do not confuse it with the small ¼-in gas fittings higher up.
- **HIGH PRESSURE AIR** — brass compression fitting (center). Feeds the pneumatic valves and satisfies the safety pressure switch. Regulate N_2/CDA to 60–80 psi (≈75 psi).
- **VENT** — far-right fitting. Backfills the chamber to atmosphere. Regulate to 5–15 psi — never feed it 60–80 psi.
- **GAS 1 / 2 / 3** — ¼-in Swagelok/compression inlets for process gases (e.g. O_2, Ar).
- **RF / electrode input** — heavy coaxial bulkhead (HN/large-N type) for the shielded cable from the LM-5K RF output.

3.4 Logical Sequencer (Lark Controller)

The two-line display reads MODE – SEQUENCE # – TOTAL STEPS on top, and STEP # – FUNCTION – CONDITIONAL – OUTPUTS on the bottom. The unit observed at commissioning showed:

```
-PROGRAM-        SEQ 1      112
006  IF      A>074     00000000
```

That is Sequence 1, 112 steps, displaying step 006 (an IF interlock test on input A). Keypad groups: STEP (▲/▼) move through steps; FUNC (▲/▼) scroll the nine functions; DATA (four ▲/▼ pairs) set the value; OUTPUT (◄/►, ON/OFF) set the eight output bits; RESET and PRG/RUN/HALT select the mode.

3.5 Input / Output Bit Designation (from the manual)

Out	Output	In	Input
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

.

3.6 Flange & Tubing Reference

Flange	Bore	Mating Tubing
KF-16 (pump inlet)	1.18 in / 30 mm	5/8– 3/4 in tubing
KF-25 (YES-R1 outlet)	1.57 in / 40 mm	1 in tubing (inner)

Every KF joint needs a centering ring (with Viton O-ring) and a hinged wing-nut clamp. Hand-tighten only — never use pliers on a KF clamp. The pump inlet (KF-16) and the YES-R1 outlet (KF-25) differ, so a KF-25→KF-16 reducer is required (see §5).

4. Mechanical & Electrical Installation

4.1 Mechanical

1. Place the YES-R1 on a stable, level bench with rear clearance for vacuum, gas, and RF lines.
2. Place the Maxima pump on the floor or a low shelf to reduce vibration; keep the oil sight glass visible.
3. Install/secure the double-deck trays (replace missing screws); replace any missing top-panel screw.
4. Inspect the chamber door, seal, and viewport — clean and undamaged.
5. Obtain and fit the front-panel programming key.

4.2 Electrical Loading (Tucson 120 V)

Three independent loads must be powered without tripping the breaker:

Load	Supply	Controlled by
Maxima M2C vacuum pump	120 V wall outlet	**Manual switch**
YES-R1 control cabinet	120 V wall outlet	Power switch
PE-1000 AC source	115 VAC, dedicated 15–20 A circuit	PE-1000 / Output 7

Put the PE-1000 on a separate circuit from the pump — it can draw ~13 A at full power, so sharing a single 15 A outlet with the pump's startup surge will trip the breaker.

> **DO NOT**
> **Never power the vacuum pump from the PE-1000 or LM-5K.** Those are RF/AC plasma generators; their output would destroy the pump motor. The pump runs from a wall outlet only. (This unit also lacks a switched "vacuum pump" outlet on the back, so the pump is always manually controlled.)

5. Vacuum Line Plumbing

5.1 Pump Oil Check (before connecting)

With the pump off and level, inspect the sight glass. Healthy oil is clear to pale yellow. Change the oil before use if it is:

- **Dark yellow / amber / brown** — oxidized; lost lubrication, will sludge.
- **Milky / cloudy** — water contamination.
- **Particulates / black flecks** — mechanical wear; actively damaging the vanes.

Optional blank-off test (only if oil looks clear but you suspect it is spent): cap the pump inlet with a solid KF blank + centering ring + clamp, run 15–20 min to warm up, and read the gauge. Fresh oil pulls below ~10 mTorr isolated; stalling near 100 mTorr means the oil is saturated and should be replaced. If the oil already passes the visual check, you may skip this and proceed.

5.2 Recommended Plumbing Stack

Place the MDC pneumatic angle valve directly on the pump inlet for the best oil-backstream protection and fastest isolation. Stack, from pump to cabinet:

Maxima M2C pump inlet	KF-16
↓ KF clamp + centering ring	
MDC pneumatic angle valve	KF-16
↓ KF clamp + centering ring	
KF-25 → KF-16 conical reducer	transition
↓ KF clamp + centering ring	
KF-25 stainless bellows hose (with a slight bend for vibration isolation)	KF-25
↓ KF clamp + centering ring	
YES-R1 vacuum exhaust port	KF-25

Use a stainless-steel flexible bellows hose, not rubber/PVC (which outgas under vacuum). Keep a slight slack/bend so pump vibration is not transmitted to the chamber. A KF-25→KF-16 conical reducer (Kurt J. Lesker, McMaster-Carr, Grainger, or local UA surplus) is the cleanest adapter; place it at the pump so the wide KF-25 line runs most of the distance for better conductance.

5.3 Angle-Valve Orientation

Orient the MDC valve so the bottom port (straight under the sealing poppet) faces the YES-R1 chamber, and the side port faces the pump. Verify by looking into the ports: the side port shows the

internal shaft/bellows; the bottom port looks straight up at the flat sealing disk. This lets atmospheric pressure help seat the valve closed during venting and keeps the delicate bellows on the pump side.

5.4 Exhaust & Backstreaming

1. Fit an oil-mist eliminator on the pump exhaust; route its outlet to a fume hood / local exhaust.
2. Always vent the line before stopping the pump. Stopping under deep vacuum pulls oil up the hose toward the chamber.
3. Shutdown order for the vacuum line: isolate the chamber (close the angle valve / Vent command) → vent the pump line to atmosphere → switch off the pump.

6. Gas, Nitrogen & Pneumatic Setup

6.1 Port Assignments

Port	Pressure	Use
HIGH PRESSURE AIR	60–80 psi	Actuates pneumatic valves; satisfies the safety pressure switch (stops beeping / unlocks valves). N_2 or clean dry air.
VENT	5–15 psi	Backfills chamber to atmosphere with N_2. Low pressure only.
GAS 1 / 2 / 3	per regulator (≈10–15 psi)	Process gases (e.g. O_2 on GAS 1; Ar on GAS 1/2). ¼-in fittings.

6.2 Feeding Both Pneumatic Ports from One N_2 Tank

You can split a single N_2 supply to both HIGH PRESSURE AIR and VENT, but the two ports need very different pressures. Do not feed 80 psi straight into VENT.

> **THE VENT OVER-PRESSURE TRAP**
>
> **Symptom:** a loud, continuous hiss from the Humphrey Mini-Myte pilot valve. **Cause:** 60–80 psi on the VENT line overwhelms the Mini-Myte's low-pressure seals, so it dumps the excess out its exhaust continuously. This is not a normal purge (which is a single sharp "pfft").
>
> **Fix: drop the VENT branch to ≤15 psi with an inline step-down regulator.** The hissing stops once the Mini-Myte sees a gentle 5–15 psi.

Preferred plumbing: keep the tank regulator at ~75–80 psi feeding HIGH PRESSURE AIR directly, and run a second branch through an inline regulator stepped down to ~10 psi into VENT.

Distinguish leak vs. purge: a normal purge is a brief sharp burst that goes silent; a constant sustained hiss is a leak or over-pressure. Soap-test the Mini-Myte push-fittings and body — bubbles at the orange collars mean a tube isn't seated (re-cut and reseat the tubing); bubbles from the body seam mean a failed internal seal (replace the valve).

6.3 Connect Sequence

1. Connect all three process-gas lines to GAS 1/2/3 and set each regulator to spec (~10–15 psi).
2. Connect N_2 to HIGH PRESSURE AIR at 60–80 psi.
3. Connect N_2 to VENT through an inline regulator at 5–15 psi.
4. Connect the angle-valve pilot air (Mini-Myte) and verify no continuous hiss at the actuator.

7. RF Power & Matching (PE-1000 + LM-5K)

7.1 Cabling

1. Connect a thick shielded RF coax (e.g. RG-213/RG-393) from the LM-5K RF OUTPUT to the chamber's coaxial electrode bulkhead. Hand-tighten firmly — a loose RF joint causes arcing and reflected-power damage.
2. Connect the analog control cable (DB-25 / DB-50) from the YES-R1 logic port to the PE-1000 "User I/O" / Remote port, so loss of vacuum or an open door instantly kills the plasma.
3. Power the PE-1000 from its dedicated 115 VAC circuit.

7.2 Baseline Settings (verify on your hardware)

Control	Setting
LM-5K voltage-ratio knob	Start near position 3 (0.75) or 4 (0.57). If ignition fails or reflected power is high, turn RF off, step the knob down one position, retry. Never move it while firing.
PE-1000 OUTPUT switch	Leave OFF manually — the recipe's RF-power output bit flips it on at the plasma step.
PE-1000 LEVEL knob	Unlock the lock ring (CCW). During the plasma step, turn CW until the display reads the target (e.g. 0.035 kW / 35 W), then re-lock.
PE-1000 DISPLAY toggle	Voltage for a clear view of generator stability; Current to watch transformer draw.

POWER LIMIT

Do not exceed 10 minutes at 1000 W. The manual's plasma-clean routine (Program 9) explicitly warns that exceeding this energy will cause damage. A typical clean runs far lower (e.g. ~35 W). Watch for the PLASMA indicator steady and a pink/purple (O_2) or blue (Ar) glow; if ARC or INTERLOCK trips, stop and check the RF coax.

8. Startup Sequence

Always follow this order. The pump runs before plasma is struck; the RF electronics come on last.

1. **Turn on Nitrogen first** — open the N_2 cylinder; set High-Pressure Air to ~75 psi and VENT to ~10 psi. This satisfies the pneumatic safety switch and holds the isolation valves in their default positions.
2. **Turn on the Main YES-R1 unit** — main power switch. Confirm the panel beep stops now that N_2 pressure is present.
3. **Turn on the Vacuum Pump** — manually start the Maxima M2C and confirm it is pumping.
4. **Power up the PE-1000 and LM-5K** — last. (First to turn off at shutdown.)

> **EXPECTED VACUUM**
> **Healthy pump-down: ~1 mTorr in 1–2 min.** The Maxima C Plus, isolated with fresh oil, should reach <10 mTorr. If the system stalls (e.g. plateaus ~3.8 mTorr at ~2:00, or above 1 Torr), suspect a closed isolation valve, a KF/door-seal leak, or a pump/line issue — do not strike plasma.

9. Programming & Recipes

9.1 Unlock & Structure

- Turn the key switch to Program/enable — the panel will not let you edit sequences otherwise (this is the most common “lockout” cause).
- The Lark holds 9 sequences, each up to 999 steps; only one runs at a time. Sequence #1 is the default; #2–9 are custom.
- Within a sequence, the thumbwheel digit (0–9) selects which recipe/sub-program runs — it sets the hardware logic and the gas used.
- Nine functions are available (GO TO, IF, MINS, SECS, LOOPC, LOOPj, …); “Count 0000” shows on an empty step.

9.2 Reading the Bottom Line (the OOOOOOOO field)

The eight characters are the Output Designation, bits 1–8 left to right. An “O” means that output (relay) is OFF; a “–” means it is energized ON for that step. Per the manual’s output table:

Bit	Output	Typical use
1	**Vacuum (isolation)**	ON in pump-down/process steps to open the line to the pump.
2	**Gas #1**	ON to flow the gas on GAS 1 (e.g. O_2).
3	**Gas #2**	ON to flow the gas on GAS 2 (e.g. Ar).
4	**Gas #3**	ON to flow the gas on GAS 3.
5	**Vent**	ON to backfill via the Mini-Myte / VENT line.
6	**Complete**	ON on the final step (buzzer / done light).
7	**Abort / Alarm**	Abort subroutine signalling.

Bit	Output	Typical use
8	**RF Power**	ON to trigger the PE-1000 to strike plasma.

> **CONFIRM YOUR MAPPING FIRST**
> Field notes circulated an alternative decoder that placed Vent and RF on different bits than the manual's table. Before running a real recipe, verify each bit on your own unit: in a safe state (no gas, RF off), toggle one output bit at a time and observe which relay/valve actuates. Trust what the hardware does over any printed map.

Two safeguards when building steps:

- Never energize Vacuum and Vent on the same step — you would route gas straight to the pump and bypass the chamber.
- Let gas stabilize before RF: program a gas-on / RF-off step first, then a following step that adds RF.

9.3 Thumbwheel Recipe Map for Default Sequence (SEQ 1)

Digit	Routine
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

9.4 How a Recipe Runs

Each recipe follows the same skeleton from the manual's program listing:

1. Read the thumbwheel and branch to the matching program (steps 003–009 test thumbwheel/gauge inputs and GO-TO the routine).
2. Pump down and verify vacuum (vacuum valve open ~2:15; ABORT if above ~2 Torr).
3. Fill with the selected gas; recheck pressure (ABORT if above ~2 Torr).
4. Turn on RF and strike plasma; confirm power-supply signal ON (ABORT on arc / no-strike).
5. Hold plasma using nested loops (LOOPC sets minutes; an inner loop checks stability every 1/10 s).
6. Extinguish (~5 s), vent/backfill (~1:30), light COMPLETE until RESET.

CHANGING PLASMA TIME (carefully)

Edit only the loop-count value (the LOOPC step: “Load N in memory loop — change this number to equal the desired minutes of plasma”). STEP to that step, set the DATA value, return to RUN.

Pressing other buttons can change STEP functions and cause improper operation. Never exceed 10 minutes at 1000 W.

10. Routine Operation

1. Complete startup (§8) and confirm the pump is running.
2. Load the sample(s); close and confirm the chamber door is fully seated (interlock satisfied). If the door won’t seal at first, press firmly on its center for 5–10 s to let the initial vacuum pull it tight.
3. At RESET, select the active sequence with STEP; set the thumbwheel to the desired recipe digit.
4. Set the gas flowmeter(s) to the recipe flow.
5. Press START. The controller checks interlocks (vacuum setpoints + door), pumps down, strikes/holds plasma, then vents.
6. During the plasma step, set PE-1000 LEVEL to the target power (e.g. 35 W) and confirm a steady PLASMA light and the expected glow.
7. Wait for COMPLETE; the vent/backfill returns the chamber to atmosphere.
8. Press RESET, confirm atmosphere (door opens freely), open and unload.

11. Abort Recovery & Shutdown

11.1 Abort Recovery

1. On abort, the ABORT light flashes and the chamber backfills automatically.
2. Let backfill finish completely (door opens freely = atmosphere).
3. Note the step number and compare to the abort table at the end of the program listing (e.g. >2 Torr, power-supply off/arc, <800 mTorr).
4. Correct the cause, then press RESET to clear and reselect the sequence.

11.2 Normal Shutdown

1. Confirm the cycle is COMPLETE and the chamber is at atmosphere; unload.
2. Turn OFF the PE-1000 / LM-5K first (confirm 0 W output).
3. Isolate / vent the vacuum line (close the angle valve or run Vent) so the chamber is at atmosphere.
4. Turn OFF the vacuum pump only after the line is vented (oil-backstream defense).
5. Turn OFF the YES-R1 main power.
6. Close the nitrogen and process-gas supplies; leave the chamber closed and the area clean.

12. Quick Reference — Recipe Programs using Default Sequence (SEQ 1)

Prog.	Action	Notes
0	1 hour total vacuum	Pump-down / vacuum hold.
1	Fill & plasma — Gas #1	ABORT if > 2 Torr.
2	Flush & plasma — Gas #2	ABORT if > 2 Torr.
3	Flush & plasma — Gas #3	ABORT if > 2 Torr.
4	Vent valve open ~1 min	Vent to atmosphere.
5	30 min set gas flow — Gas #1	Flow-adjust mode.
6	30 min set gas flow — Gas #2	Flow-adjust mode.
7	30 min set gas flow — Gas #3	Flow-adjust mode.
8	Adjust N_2 flow	Sonalert pulses during adjust.
9	Vacuum 2:15 + Gas #2 plasma clean	Alert ≤ 10 min @ 1000 W max.

13. Troubleshooting

Symptom	Likely cause / fix
Panel beeps / won't let you edit sequences	Turn the key switch to Program/enable (most common). Also confirm door closed and N_2 High-Pressure Air at 60–80 psi. If N_2 was applied after power-on, cycle power with N_2 already pressurized.
Continuous hiss at the Mini-Myte	VENT line over-pressured — drop it to 5–15 psi via an inline regulator. If it persists at low pressure, soap-test for a failed seal/loose tube.
Pump runs but pressure won't drop	Isolation valve closed (raise High-Pressure Air to ~75 psi); gas-ballast knob open (close it); inline manual valve closed (open it); door O-ring not sealed (press the door center 5–10 s, clean the O-ring).
Pump-down stalls above 1 Torr	KF-joint or door-seal leak. Re-seat centering rings; clean the door O-ring. To isolate, thumb-test pump suction at the disconnected hose.
Plasma won't strike / high reflected power	RF coax loose — retighten. Step the LM-5K voltage-ratio knob down one position (RF off first). Confirm pressure is in range for the gas.
ARC / INTERLOCK light on PE-1000	Stop RF. Verify the chamber RF coax is screwed down tight; confirm door and vacuum interlocks are satisfied.

14. Pre-Operation Checklist & Open Items

14.1 Pre-Operation Checklist

✓	Item
☐	Pump oil clear/healthy; mist eliminator fitted and exhausted to ventilation.

✓	Item
☐	Vacuum stack assembled (angle valve at pump, KF-25→KF-16 reducer, bellows) and leak-checked.
☐	N_2 to HIGH PRESSURE AIR at 60–80 psi; N_2 to VENT at 5–15 psi (no Mini-Myte hiss).
☐	Process gases connected to GAS 1/2/3; flowmeters set.
☐	PE-1000 on its own 15–20 A circuit; RF coax and DB-25 interlock cable connected and tight.
☐	Programming key turned; door closed and latched.
☐	Startup order followed: N_2 → YES unit → pump → PE-1000/LM-5K.
☐	Pump-down reaches ~1 mTorr in 1–2 min (no stall).
☐	Correct sequence selected; thumbwheel set to the desired recipe; output bits verified.
☐	PE-1000 OUTPUT left OFF (recipe will enable it); LEVEL lock ring released.

14.2 Open Commissioning Items

Item	Priority	Owner / Status
Source KF-25 → KF-16 conical reducer + rings/clamps	**High**	_____
Install inline step-down regulator on the VENT line (≤15 psi)	**High**	_____
Confirm Mini-Myte hiss resolved after VENT regulated	**High**	_____
Verify output-bit map on the actual unit (Vent vs RF bits)	**High**	_____
Confirm PE-1000 / LM-5K nameplate inputs & on dedicated circuit	**High**	_____
Connect all three process-gas systems	**Med**	_____
Front-panel programming key located/secured	**Med**	_____
Double-deck trays / missing screws; replace top-panel screw	**Med**	_____
Set/verify pneumatic thresholds for vacuum valves	**Med**	_____
Verify angle-valve orientation (bottom→chamber, side→pump)	**Med**	_____
Fit pump oil-mist eliminator + exhaust to ventilation	**Med**	_____
Test default program; validate other sequences	**Low**	_____
Obtain larger process tube if required for parts	**Low**	_____

— End of Procedure —