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AV Etcher 2 - Standard Operating Procedure

Badger name:	**AV-2 Plasmatherm (k3)**	**Revision number:**	**1**
Model:	**Vision 320**	**Revisionist:**	**Wanjohi Kimani**
Location:	**Keller – Bay 3**	**Date:**	**March 30, 2020**

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1. **Scope**
   1.1. This document provides detailed instructions on how to properly operate the AV Etcher 2.

2. **Tool Description**
   2.1 The AV-2 Etcher is an RIE system with five (5) etchant gases available. These are: Argon (Ar), Trifluoromethane (CHF_3), Tetrafluoromethane (CF_4), Oxygen (O_2) and Sulphur Hexafluoride (SF_6). The system is designed to etch silicon, silicon nitride, silicon oxide, photoresists, other allowed organics and semiconductor materials. It is run via Cortex (for Vision) software in Microsoft Windows 7.

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3 Safety

3.1 While chamber is closing, ensure there are no items including limb in the path where the lid rests after closing.

4 Restrictions/Requirements

4.1 Must be a qualified user on the AV-KH Etcher

5 Required facilities

5.1 Compressed air
5.2 Chilled water
5.3 Vacuum
5.4 N_2
5.5 CHF_3
5.6 CF_4
5.7 O_2
5.8 SF_6
5.9 Ar

6 Notes

6.1 The AV-2 Etcher has different etch recipes from those in AV-1 etcher or the STS etcher. Standard recipes from the older etchers were determined not to work well in the new etcher. A table with the recipe parameters and the etch rates has been included at the end of this SOP. Note that the AV Etchers utilize a graphite chuck, while the STS Etcher has an anodized aluminum chuck.

7 Operating instructions

7.1 Logging on

7.1.1 Enable the "**AV-2 Plasmatherm (K3)**" using the MNC Badger system

7.1.2 If login is required, select **OPERATOR** and click the **User Login** button. Enter **1234** for password.

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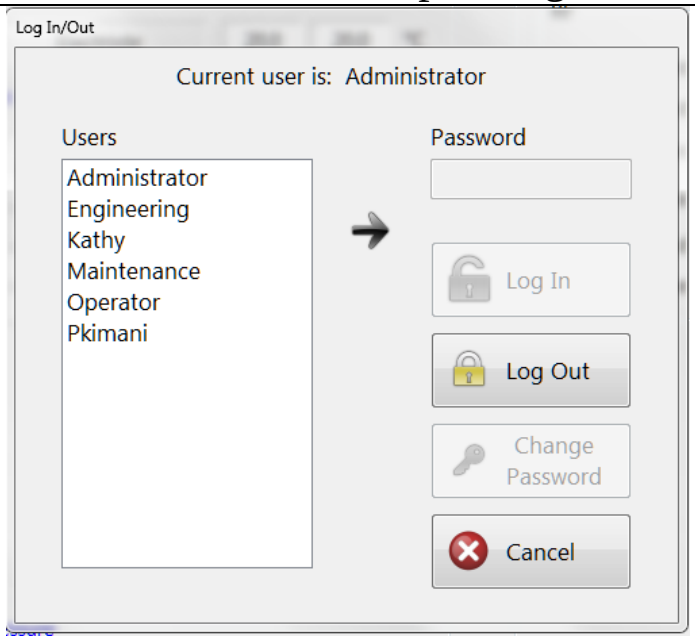
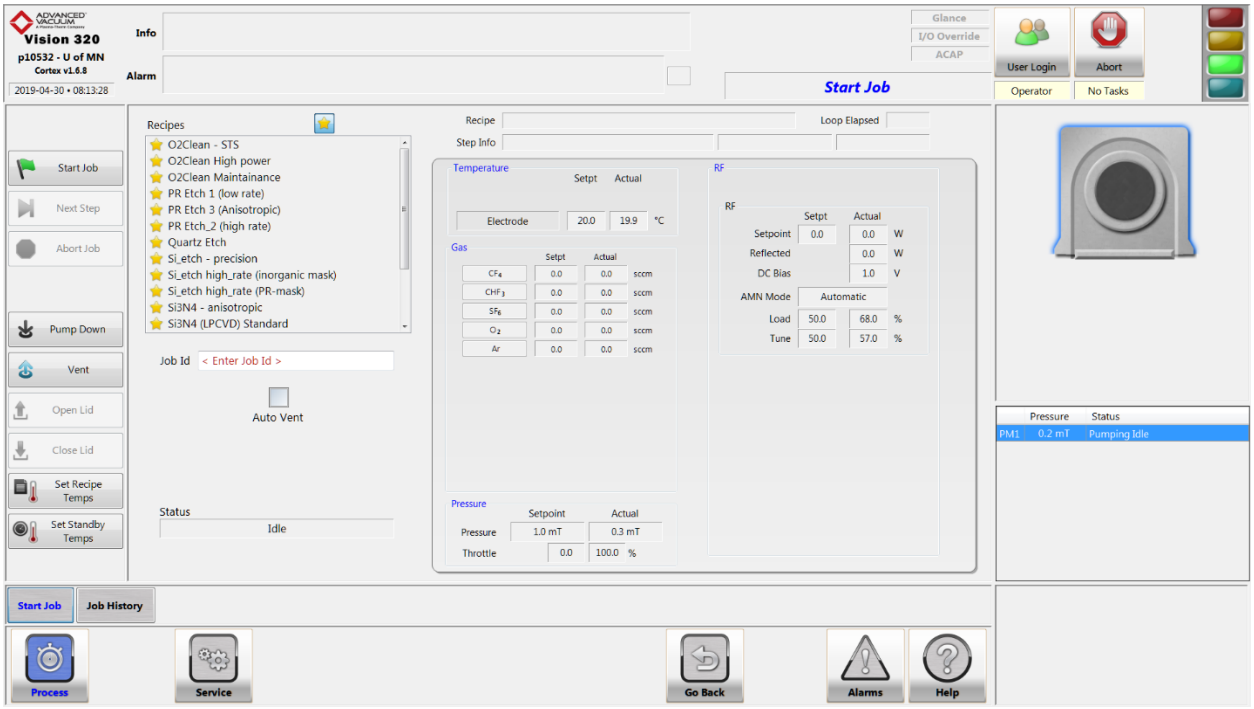


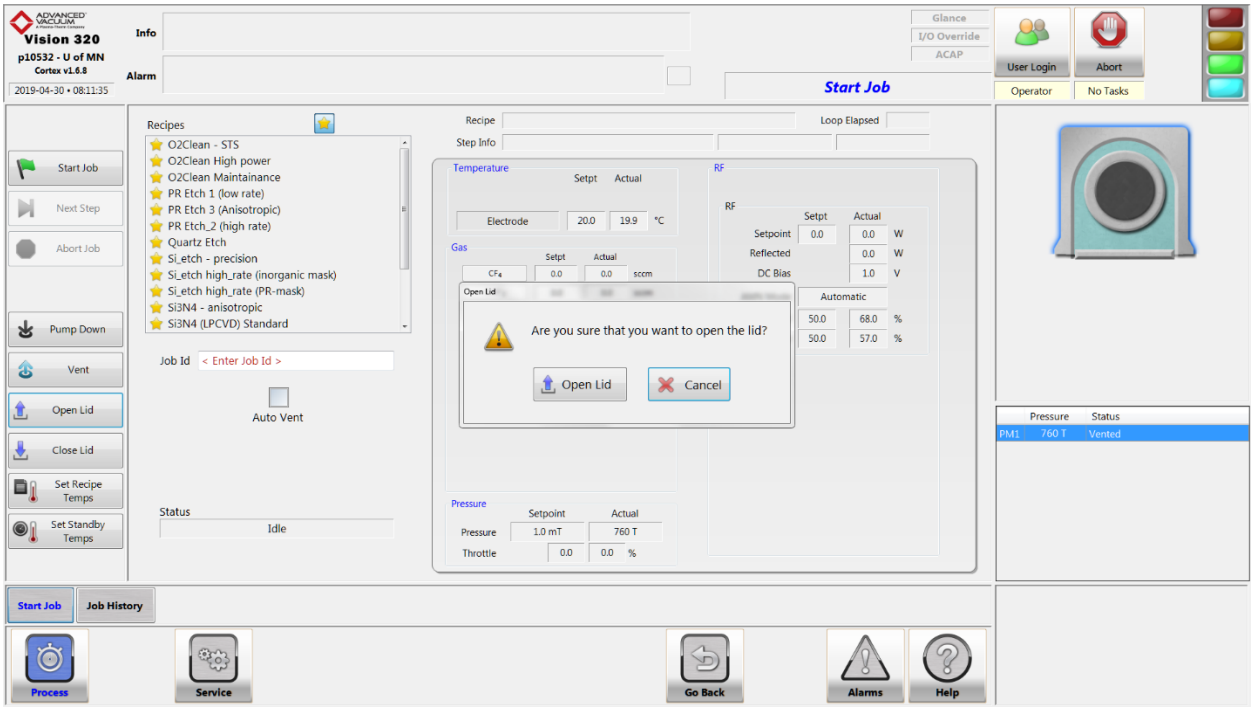
The screen image below is what you see when logged in



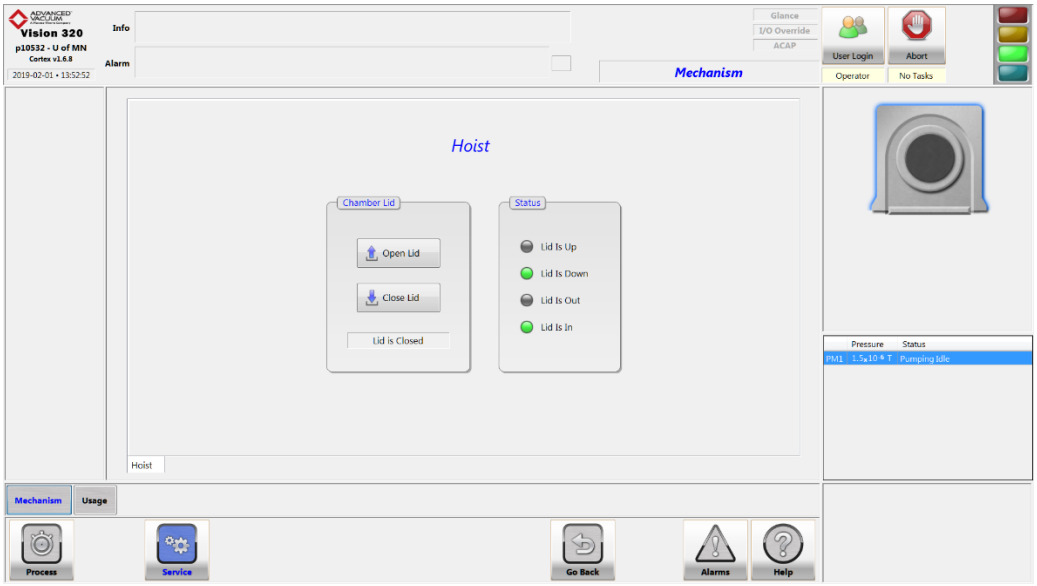
7.2 Vent and Loading samples

7.2.1 Click on "**VENT**" button on the left side of the screen

7.2.2 Wait until the system is vented as indicated by the info section at the top of the screen. When vent is complete, click on **OPEN LID** and acknowledge. You can also select "**SERVICE**" at the bottom of the screen, then click **OPEN LID** to open the lid without needing to acknowledge.



If you are on the service menu, it should like this (below)

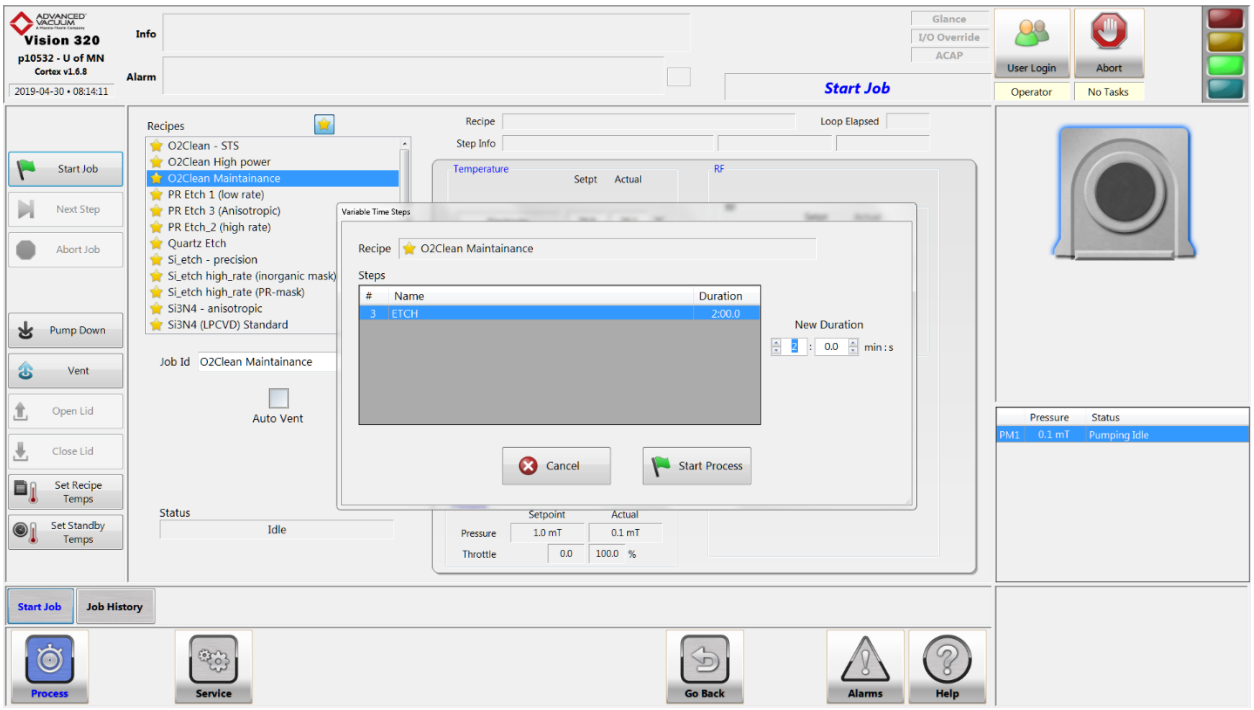


7.2.3 After the chamber lid lifts up, it will swing to the right and then come to a stop.

7.2.4 Load your samples directly on the graphite chuck. Place glass slides along the sides of your sample(s) if you don't want your samples to shift extensively during pump down. The glass slides can be adhered to the chuck with Kapton tape.

7.2.5 Click on the "**CLOSE LID**" on the left side of the screen or in the **SERVICE** menu. The chamber lid should now close automatically.

7.3 Running a process



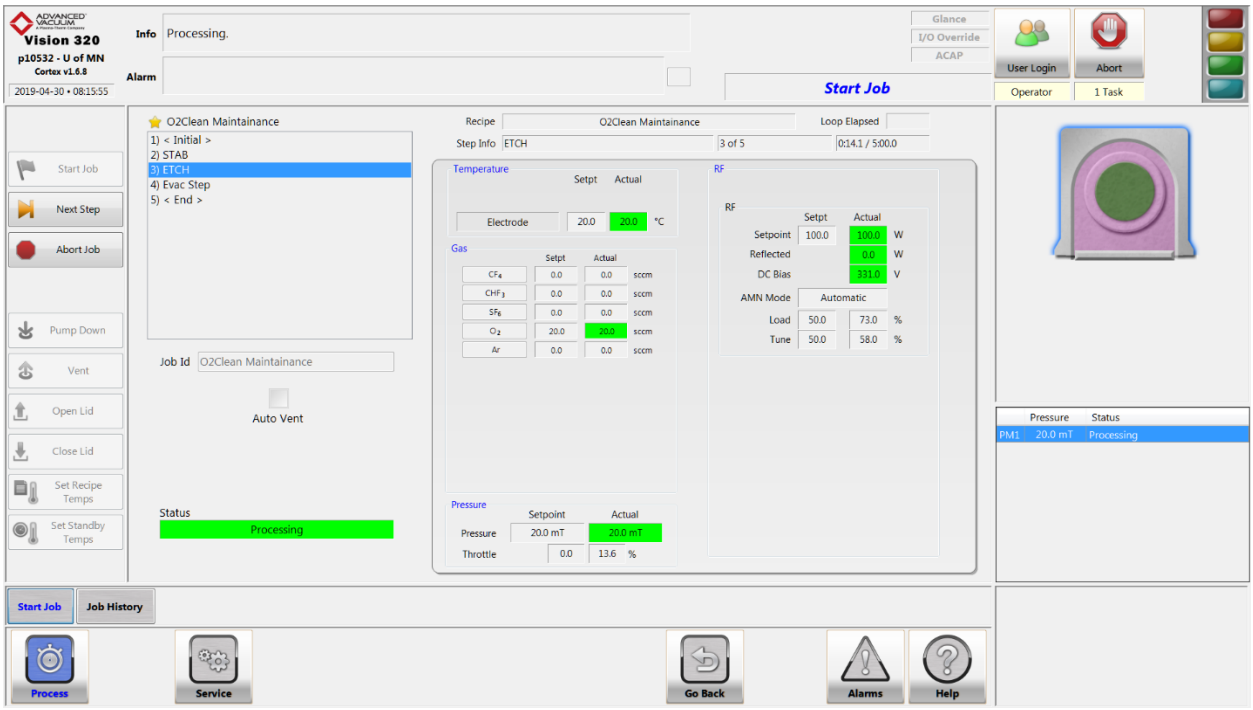
7.3.1 After closing the lid, click on the **AUTO VENT** box if you want the system to vent automatically upon completion of the job.

7.3.2 Click on "**START JOB**" to run a process.

7.3.3 Enter the duration of etch in min and seconds (see diagram above)

7.3.4 Click **START PROCESS**

7.3.5 The process will begin automatically. Gas flow and chamber pressure will stabilize, and then RF will turn on and ignite plasma. A process countdown timer is displayed on the top right side of the screen (as well as the feedback for the gas flow, pressure, power, etc). When the programmed step is complete, plasma will extinguish, process will end automatically and place the system in standby mode (if **AUTO VENT** is not checked) or vent to atmosphere (If **AUTO VENT** is checked)



Note that if you want to abort the process before the timer goes to "0", you can press the "**NEXT STEP**" button on the left side of the screen.

7.4 Unloading samples

7.4.1 Click on "**VENT**" button on the left side of the screen (assuming system did not vent automatically)

7.4.2 Once the system is vented, click "**OPEN LID**' and acknowledge or open the "**SERVICE**" menu at the bottom of the screen and then click on "**OPEN LID**"

7.4.3 After the chamber lid lifts up, it will swing to the right and then come to a stop.

7.4.4 Unload your samples

7.4.5 Click on the "**CLOSE LID**" button. The chamber lid should now close automatically.

7.4.6 Click on the "**PUMPDOWN**" button situated on the left side of the screen

7.5 Logging off

7.5.1 On the upper-right side of the screen, click on "**USER LOGIN**", then click on "**LOG OUT**".

7.5.2 Disable the "**AV-2 Plasmatherm (K3)**" using the MNC Badger system.

8 Trouble shooting

8.1 If you try to start a job while the lid is open, the tool will go into alarm. Simply click on "**ALARM**" at the bottom of the screen, and look for the "**SILENCE**" button. Then close the lid and start the job.

8.2 Should the system not function as intended, report problem on Badger and/or contact MNC staff responsible for the tool.

9 Process parameter table

Etch Recipes	Gases							
	CHF3	CF4	SF6	O2	Ar	Pressure	Power	Platen Temp
	Gas flow (sccm)					mT	watts	°C
FastPoly			25	4		80	100	20
O_2Clean Maintenance				99		100	150	20
O_2Clean STS				99		100	100	20
O_2Clean high power							300	20
Photoresist etch - 1 (low rate)				99		50	150	25
Photoresist etch - 2 (High rate)				99		100	300	25
Photoresist etch - 3 (anisotropic)				10		13	200	20
PJSOxide	25	12.5			25			
Si_3N_4 (LPCVD) etch - Selectivity to oxide			20			40	50	25
Si_3N_4 (LPCVD) etch - standard	10	42				80	150	25
Si_3N_4 etch - anisotropic (TYB type)	25	10				50	150	25
Si etch - high rate (PR mask)	7.5		19.5			30	55	20
Si etch - precision (NIT1 type)		32		8		80	100	20
SiO_2 etch - PJSOxide type	25	6			25	50	175	25
SiO_2 trench etch			20			40	200	30
NB Etch - (72 CF_4:8 O_2)		72		8		150	100	20

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10 Process etch rates

Etch Recipes	Target material	Target's etch rate	Typical masking materials												Silicon Etch with PR mask	
		measured (MNC)	AZ 1512 (+ve PR)		NR 71 1500P (-ve PR)		SiO_2 (Thermal)		Si3N4 (LPCVD) LSN		Oxide (PECVD)		ALD Al2O3			
		(Å/min)	(Å/min)	Unif(±)	(Å/min)	Unif(±)	(Å/min)	Unif(±)	(Å/min)	Unif(±)	(Å/min)	Unif(±)	(Å/min)	Unif(±)	(Å/min)	Unif(±)
FastPoly	Si														22,600	
O_2Clean Maintenance	NA		1359	4.6%			15.6	66.5%			1.5		2.6			
O_2Clean STS	PR (AZ 1512)	1,625	1110	1.5%			(0.4)				10		0			
O_2Clean high power	Chamber		4716	7.2%			0.2				3.5		0.4			
Photoresist etch - 1 (low rate)	PR (AZ 1512)	2,370	2370	3.9%	2042	23.1%	(0.8)				1.5		0.7			
Photoresist etch - 2 (High rate)	PR (AZ 1512)	5,057	5057	6.1%	4269	4.0%	(0.1)				0.1		0.5			
Photoresist etch - 3 (anisotropic)	PR (AZ 1512)		1529	3.6%			4.0				5.4		4.9			
PJSOxide	SiO2		49.1	20.2%												
Si_3N_4 (LPCVD) etch - Selectivity to oxide	Si_3N_4	260	206	4.6%			78	13.3%	260	19%	79	10.6%	0.4			
Si_3N_4 (LPCVD) etch - standard	Si_3N_4	360*	194	9.7%	259	23.1%	310	4.6%	388	26%	320	11.3%	3.1			
Si_3N_4 etch - anisotropic (TYB type)	Si_3N_4	38					221	17.6%	38	90%	215	7.2%	3			
Si etch - high rate (PR mask)	Si	3,233	267	6.6%	323	19.2%	134	12.4%			117	19.6%	(1.4)			
Si etch - precision (NIT1 type)	Si	3,899	709	5.6%			322.0	9.4%			1143	8.3%	0.5			
SiO_2 etch - PJSOxide type	SiO_2		19		74	88.4%	284.0	6.4%			271	19.80%	2.9			
SiO_2 trench etch	SiO_2		1907	3.9			779	4.7%	847	16.8						
NB Etch - (72 CF_4:8 O_2)	Niobium						245	33.7%	579	17.5%	267	15.10%				