

PECVD Operation

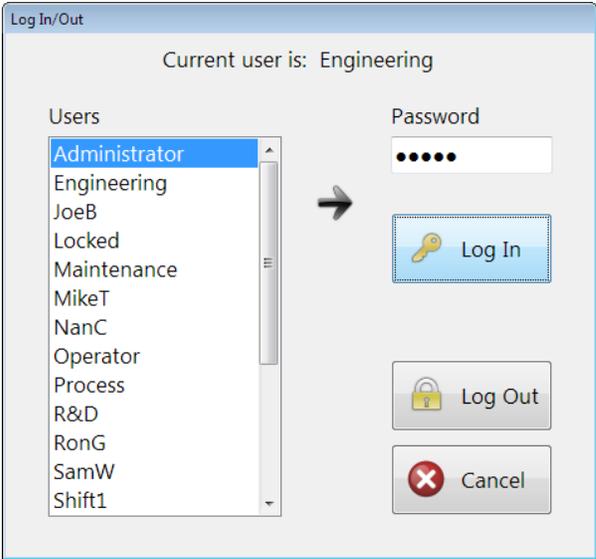
Logging in to Cortex



To log in to the system

Use this procedure to log in.

1. Click the **User Login** button at the top of the screen. The Log In/Out dialog box appears. To select an account, click the name “**operator**” in the Users box.
2. In the Password box, type the password “**op**”, and then click **Log In**.



Command buttons

Command buttons are rectangular buttons that appear in the panel on the left side of the screen. You click a command button to take an action, such as Save, Vent, Start Job, New Recipe, and Delete User. Most but not all screens have command buttons.

The commands that are available depend on several factors, such as whether processing is active. Available command buttons appear three-dimensional; most are highlighted in color when the mouse pointer is on them. A command button that is not available appears flat and gray, with no color, and is not highlighted when the pointer is on it.

For example, the **Start Job** button on the Start Job screen is available when a recipe is selected and the system is ready to start processing. It is not available if a job is already running or when no recipe is selected.



The Start Job command button shown with the three types of shading: command available, button highlighted, command not available.

Running process jobs

This section describes how to run process jobs using saved recipes.



The **Process** menu's **Start Job** screen displays available recipes, system parameters, and command buttons for controlling processing. This screen also provides for initialization of system temperature control. When the system is actively processing, information about the current recipe, step, elapsed time and other processing data can be monitored without leaving the Start Job screen.

Material is loaded manually in the Load Lock (AL module). Processing is typically preceded by automatic transfer of the material to the process chamber (PM), and transfer back to the Load Lock at the end of processing, with automatic venting of the Load Lock for material removal.

Running jobs

Once recipes have been saved and material is loaded in the system, use the following procedure to start processing.

To start a job

1. Click **Process** and **Start Job**, if necessary, to display the Start Job screen. The system focus can be on AL or PM.
2. In the Recipes list, click to select a recipe. The selected recipe name appears highlighted.

3. Click the **Start Job** button. A confirmation message appears; click **Start Job** in the message box to begin processing.

Interrupting processing

While a recipe job is running, the **Abort Job** and **Next Step** command buttons are available, unless the user's account settings prevent access to them.

Stopping a job: To stop processing immediately, click **Abort Job**. It interrupts the recipe, stops gas flow and RF power. The chamber is pumped down. Temperature setpoints remain at the recipe values. Unless the No Transfer option is selected, material is returned to the Load Lock.

The Job History screen indicates when Abort was requested during recipe processing, and shows the time of material transfer and job termination.

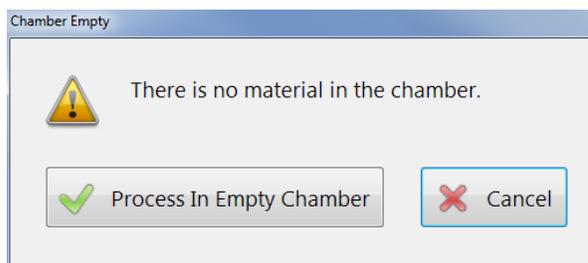
Ending a recipe step: To skip immediately from the current recipe step to the following step, click **Next Step**. The system implements the parameters specified in the next step. It updates the step information shown on the Start Job screen.

Processing options

No Transfer

In some cases, typically when running a **clean** or chamber **predep** recipe, processing can be initiated without material transfer and with no material in the process chamber.

If no material is present in the selected process chamber when you click Start Job, a message asks if you want to proceed without material. Click **Process in Empty Chamber** to begin processing without material.



Note: To run a recipe without transferring material, select the **No Transfer** checkbox before starting the recipe. A checkmark appears in the box when the No Transfer option is active. The setting of the No Transfer option is not saved with

recipes. When No Transfer is selected, the Auto Vent option is not available.

If the process chamber does not contain material, and No Transfer is selected, when you click Start Job, a message asks whether to process without material or cancel processing. Click **Process in Empty Chamber** to run the recipe, or click **Cancel** to return to the Start Job screen without running the recipe.

Auto Vent

Typically on Load Lock systems, the AL module is vented to atmosphere so material can be removed immediately after processing. When the Auto Vent option is selected, Cortex vents the Load Lock after the material has been transferred. The Info box displays status messages during venting, and the system graphic displays blue background shading when venting is complete and the Load Lock is at atmosphere.

Temperature control

Before starting a recipe job, the system can be brought to a specified standby temperature or recipe temperature setpoints:

- Select the recipe in the Recipes box, then click **Set Recipe Temps** to implement the temperature setpoints specified in the recipe's Initial step.
- Click **Set Standby Temps** to use the standby temperature setpoints, which are specified on the Temperature Configuration screen.

Note: The temperature setpoints in “clean recipe” is varied.

Creating recipes



Creating a recipe involves specifying processing parameters for a series of steps. The Recipe Editor shows the steps and settings for the current recipe. It contains several tabs, which provide various views and options for setting up recipes.

When it opens, the Recipe Editor contains a blank recipe framework, or displays the last recipe that was loaded for editing.

To create a process recipe

1. Select the process module and then click **Recipes** and **Edit Recipe**.
2. Click **New Recipe** to start with default recipe steps. Type a Recipe Name

and Description in the text boxes. Set the recipe category as "production" by selecting from the Category drop-down list.

3. The < Initial > step is selected in the Steps box. Specify the initial process parameters (described below). Then, select the < End > step and configure the parameters to apply at the end of processing.
4. Insert additional steps as necessary. Clicking the "Insert Step..." button inserts a process step. Press the arrow and choose from the menu to insert a different type of step. Multiple steps can be inserted, and special options (described below) can be specified in the Recipe Editor.
5. Click **Save** to save the current steps and settings. The Status Panel displays a confirmation message when the recipe is saved.

After a recipe is saved, it remains loaded into the Recipe Editor. Steps can be inserted, deleted, and parameters can continue to be modified.

When changes are made after a recipe is saved, "< Modified >" appears next to the Category box. Click **Save** to store the changes, or click **Revert** to discard all changes made since the last time the recipe was saved.

To copy a recipe

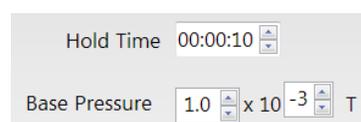
After saving a recipe, type a different name in the Recipe Name box, and then click **Save** to store the recipe on disk with the new name.

Recipe settings and step options

The following options and parameters are available on the Recipe Editor screen. Some of the items apply to all recipes; others apply only to specific step types or system configurations.

Recipe Name: Recipes are identified in the system by name. A recipe name can contain letters, numbers, spaces, and punctuation characters, and be 100 or more characters long. Recipes names are displayed in the Recipes box on the **Start Job** screen, where recipes are selected to run. Recipes are listed by name when a user clicks **Load** to select recipes for editing.

Description: The recipe description is additional text that can help distinguish and identify recipes. The description can contain letters, spaces, numbers and punctuation characters.



Hold Time 00:00:10

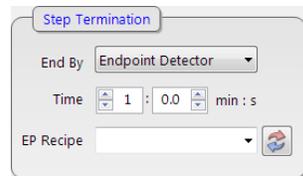
Base Pressure 1.0 x 10⁻³ T

Hold Time: This value specifies how long the Base Pressure is held. There is a Hold Time parameter for the < Initial > step, and one for the < End > step.

Base Pressure: Set the pressure to be maintained in the process chamber for the specified Hold Time at the start and end of processing. Base Pressure is a parameter of the < Initial > and < End > steps.

Temperature: Several temperature parameters may be available, depending on the system's temperature control configuration. For example, Upper and Lower Electrode temperature settings are configured. Temperature parameters are specified in Initial recipe steps only.

Step Termination



The screenshot shows a dialog box titled "Step Termination". It contains three main fields: "End By" is a dropdown menu currently set to "Endpoint Detector"; "Time" is a numeric input field with a spinner, showing "1" for minutes and "0.0" for seconds, followed by "min : s"; and "EP Recipe" is a dropdown menu with a refresh button to its right.

The duration of process steps can be based on elapsed time or controlled by endpoint detection. Select the setting from the End By drop-down menu:

Fixed Time sets the step duration to the Time value, which is entered as minutes and seconds.

Endpoint Detector specifies that the step duration will be based on an endpoint signal from Plasma-Therm's EndpointWorks program. Select the Endpoint Recipe from the EP Recipe list; click the refresh button if necessary to update the list. This option is not available if the system is not configured for endpoint detection.

Step Details view

The Details tab on the Recipe Editor screen allows editing of tolerance values for process steps, and for morphing factors for looped process steps.

When a step is selected in the Steps box, the Details tab shows each parameter's Setpoint and Tolerance. If the step is part of a loop sequence, the Details tab also shows the Start Setpoint, End Setpoint, and Morph Curve factor.

Using tabular view

To view the settings for all the steps in a recipe at once, click the **Tabular View** tab on the Edit Recipes screen. Tabular view can be used when creating recipes initially and when editing recipes.

	1. < Initial >	2. < Chuck >	3. Process Step	4. Process Step	5. Loop 3 times	6. < Dechuck >	7. < End >
Time	0:10.0	0:30.0	1:00.0	1:30.0		0:30.0	1:30.0
Pressure	10	10	5	5		10	10
SF6		0	30	0		0	
C4F8		0	0	25		0	
O2		0	0	0		0	
N2		0	0	0		0	
He		3	0	0		3	
NH3		0	0	0		0	
Ar		0	0	0		25	
Bias		50	50	50		0	
ICP		100	150	150		0	

A recipe in Tabular View. The first cell is selected.

In Tabular View all the steps and parameters in the recipe are arranged in a table. The parameters for each step are listed in a column, starting with the Initial step at the left and the End step in the last column on the right. The values in each step for a single parameter, such as Time or Channel 1 gas flow, are listed across in a row. The column headings show the step number and type. The first column lists the parameter names. Cells that are shaded dark gray indicate values that are not available, such as gas flow in the Initial and End steps.

If all the steps or parameters do not fit in the window, scroll bars appear so the table can be scrolled up and down and left and right.

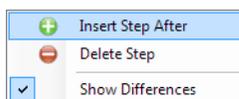
Highlighting parameter changes: Colored shading of cells indicates when parameter values change from one step to the next. Adjacent values in a row that are not identical are shaded. To turn shading on or off, right-click at the top of the table and choose Show Differences. A check mark indicates that shading is enabled.

Pressure	10	10.0	5.0	5.0
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Shading highlights a change (10.0 to 5.0) in the Pressure parameter.

Editing in tabular view

To change parameters in the table, click to select a value and type a new value. The selected table cell is highlighted. You can press TAB or the keyboard arrow keys to move the selection. When you finish changing values, click **Save** to store the edited recipe.



Right-click a column heading at the top of the table to insert or delete a step.

- Choose **Insert Step After** to add a new step to the right of the column heading where you clicked.
- Choose **Delete Step** to delete the column that you clicked. You cannot delete Initial, or End steps.

While recipe steps can be inserted and deleted in tabular view, step names and descriptions can be changed only on the Process Parameters tab of the Edit Recipe screen.

Recipe step types and options

Recipes can contain various types of steps. When you create or edit a recipe, press the **Insert Step Before/After** button to select a Process Step, Evacuation Step, Loop Step, or Purge Step. Simply clicking the button inserts a new Process step after the selected step, unless the End step is selected, in which case the step is inserted before the selected step.

Step types

Process Step

The settings that can be applied in a process step are Gas, RF (power), and pressure. The Step Termination settings control the length of time that the settings remain in effect, either a fixed time saved in the recipe or a time specified when the recipe is run.

Evacuation Step

An Evacuation Step initiates pumping of the process chamber. On the Evacuation Parameters tab, enter values in the Base Pressure and Hold Time boxes. When it executes the step, the system pumps down the chamber to the specified Base Pressure and maintains it for the Hold Time before proceeding to the next step.

Loop Step

A Loop step allows a group of steps to be designated as a "loop cycle" that are run as a unit one or more times, for a set number of iterations, a specified amount of time, or until endpoint is detected. You can insert a Loop step when any step except is selected in the Steps list. Process steps within a loop sequence can also have Parameter Morphing applied to gradually adjust process parameters over multiple iterations of the loop sequence.

Purge Step

This step type is available only in Cortex on retrofit 790 and SLR systems. During the step, purge gas flows and RF power is applied to initiate a plasma.

Designating restart steps

A "restart step" is a process step that has been designated as a step to be repeated if the operator restarts a recipe process that was interrupted by an alarm. Steps that are not designated as restart steps are skipped when processing is restarted.

On the Edit Recipe screen, when the **Restart Step** button is selected, any process step you select or insert is designated as a "restart" step. Once you click the Restart Step button, it remains selected until you click it again, or a non-process step is inserted into the recipe.

Looping options

After inserting a Loop step, select a step in the "Loop To Step" box to designate the start of the loop cycle. An arrow in the Steps list points from the Loop Step to the first step in the loop cycle. The Loop step label indicates the number of times or amount of time that the loop executes, or that it executes until an endpoint signal is received.

Loop termination

Choose one of the following options in the Loop Termination box for ending the loop cycle, and enter the required values.

Iterations: Enter an integer for the number of times the loop cycle should run. An value of 1 means each step will run only once; the process will not "loop" back to repeat the steps in the loop cycle. When the Iterations value changes, the Time value is updated to reflect the total time of the loop cycle, based on the duration of each step.

Time: Enter the amount of time for the loop cycle to continue. A value of zero is the same as 1 iteration of the loop steps. If the specified time has not elapsed, processing returns to the first step in the loop cycle. When the specified time has elapsed, the system runs any remaining steps in the loop cycle before continuing. When the Time value changes, the Iterations value is updated to reflect the number of times the loop cycle will execute, based on the time specified for each step in the loop cycle.

Endpoint Detector: Select the endpoint recipe from the Recipe menu; click the double-arrow button to refresh the list if necessary. Cortex displays the list of available endpoint recipes that it receives from Plasma-Therm's EndpointWorks program. The Endpoint Detector option is not available if EndpointWorks is not configured and running on the system.

Over-Loop™: With any of the Loop Termination options, the Over-Loop option can be selected to extend the loop cycle execution. Enter a percentage value in the adjacent text box. For example, if Endpoint Detector is used, and Over-Loop is set to 25%, and the loop cycle executes for 10 minutes before endpoint, the loop execution would be extended an additional 150 seconds. Loop sequences always finish if time elapses during a loop cycle, with all steps in the sequence being executed.

RF matching network modes

The Automatic Matching Network adjusts impedance to present a uniform 50-ohm load to the RF generator to produce the most efficient power application (the lowest amount of reflected power) to the process chamber during plasma processing.

Systems can be configured to enable automatic and manual control of RF matching network(s) during processing. The following settings for matching network control are available in Process steps from the AMN Mode drop-down menu:

Automatic is the normal operating mode. The matching network automatically adjusts throughout the Process step to apply power most efficiently to the plasma. When Automatic is selected, the Load and Tune values are not available.

Manual fixes the positions of the matching network capacitors during a Process step according to the Load and Tune values. This setting may be useful if testing indicates that a particular Process step requires fixed Load and Tune values to establish a plasma.

Man -> Auto positions matching network capacitors according to the Load and Tune values at the beginning of the Process step, and after a delay, the matching network automatically adjusts the capacitors to apply power most efficiently during the remainder of the Process Step. Using the "Man -> Auto" setting to pre-position the capacitors is similar to having a brief Process step with AMN Mode set to Manual, followed by a Process step with AMN Mode set to Automatic. The time (in seconds) that manual control is in effect before automatic matching begins is specified by the "RF Match Box Switch Delay" value on the Tool Settings screen.

Processing sequence

While parameters in recipe steps often differ significantly depending on the plasma process, many recipes involve similar operations performed in the same general sequence. The following is an outline of a typical process sequence.

1. **Initial conditions:** The chamber vacuum and temperature to be established at the start of the recipe are specified in the <Initial> step. The Hold Time period, which begins once pressure and temperature are within tolerance for their setpoints, allows time for process chamber conditions to stabilize.
2. **Gas stabilization:** In regular Process steps, one or more gas flows are initiated and maintained at a specified rate.
3. **Plasma initiation:** Once pressure, temperature, and gas flow are stabilized, RF power is applied in a separate Process step to light the plasma.
4. **Processing:** Additional regular Process steps may implement power level, pressure, and gas flow changes for specified times or until endpoint conditions are reached. Looping may be used to repeat a series of

parameter changes.

5. **Flush and evacuation:** After main processing is complete, process gasses are flushed. Venting to atmosphere allows removal of material from the Load Lock after processing. Material transfer and venting is enabled by default on Load Lock systems.

Contact Paul Horng (x4827, horng@udel.edu) for assistance