Denton E-beam Evaporator

1. Purpose

Standard operating procedure for the Denton E-beam Evaporator. E-beam evaporation is a thermal evaporation process, where the desired material is placed in a crucible and heated by a focused electron beam. The heat from the e-beam vaporizes the material, which then deposits on the substrate to form the required thin film.

2. Scope

This SOP is intended for general purpose use of the Denton E-beam Evaporator, and do not take the place of thorough training on the system. If you are not sure of your ability to operate it, do not hesitate to contact a staff member.

3. Prerequisites

Users must have cleanroom access.

4. Responsibilities

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5. Safety

This system uses high voltage, >5KV, operators should **NEVER** attempt to work on the internal parts of this system or remove protective panels. **Lethal voltages may exist, even with the power supply off.**

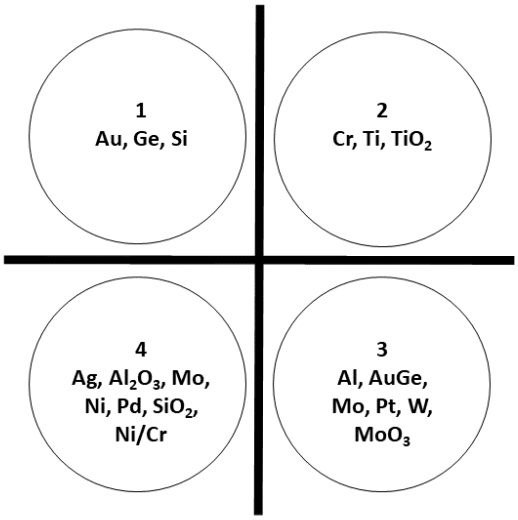
In the event of an **emergency** which requires you to evacuate the cleanroom before your run is completed, press the **e-stop button** before immediately leaving the cleanroom.

CAUTION – use care when touching inside surfaces after opening, some areas in chamber and especially near the e-gun may be **HOT**.

NEVER operate the tool in service mode. **DO NOT override any interlocks**. If the tools has been left in service mode, please see a staff manager.

6. Procedure

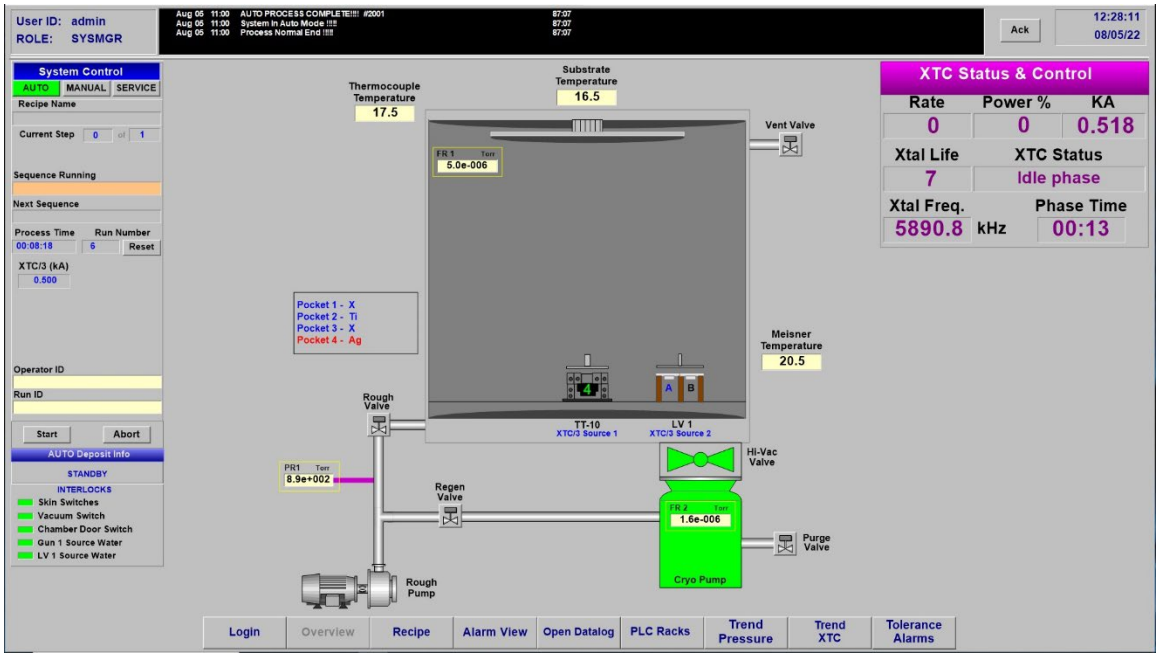
Allowed Materials: The following is a schematic of the allowed materials and their corresponding pocket locations. Please see a staff member to discuss additional materials.



Log In: In the top left corner of the deposition program, confirm that the UserID reads 'Engineer'. If not, navigate to the **Log In** screen and sign in as UserID: Engineer / Password: Engineer.

You must login to the tool through FOM to enable the system. If not, the Skin Switches interlock will remain enabled and prevent you from using the system.

Overview: Navigate to the **Overview** screen. Double check the system status: the system control is in **Auto**, all the interlocks are **Green**, the pressures are in the 10^{-6} torr range or lower, the cryopump temperature is below 16 K, and there are no unusual alarms. If anything looks wrong, please contact a staff member.



Auto Vent: In the **System Control** Panel on the left side of the overview screen select **Start**. A recipe selection window will pop up. In the drop-down menu find the **01Auto Vent.dat** recipe. Hit **Select**. The recipe should now be displayed in the **Current Master Recipe** box. Hit **OK**. The system will now prompt you to enter **Operator ID** (input your name) and **Run ID** (write a brief description of the program).

The Auto Vent program will now vent the chamber.

Sample Loading: Load your sample(s) onto the stage using the appropriate holder. Load your desired material crucibles into the appropriate pocket number. You may reference the **Allowed Materials** section of this SOP to ensure the correct pocket.

To move to your desired pocket location for loading a crucible select **Manual** mode in the **System Control** panel. Hover the curser over the schematic of the pocket control until you see the 'up' arrow and then click and enter the pocket you want to go to.

When you are done loading, wipe the door o-ring with an iso wipe. Close the door and latch it.

Return the system to **Auto** mode in the **System Control** panel.

Pump Down:

In the System Control Panel on the left side of the overview screen select Start. In the recipe window drop-down menu find the 00Auto Pump.dat recipe. Hit Select. The recipe should now be displayed in the Current Master Recipe box. Hit OK. Enter your Operator ID (your name) and Run ID (write a brief description of the program).

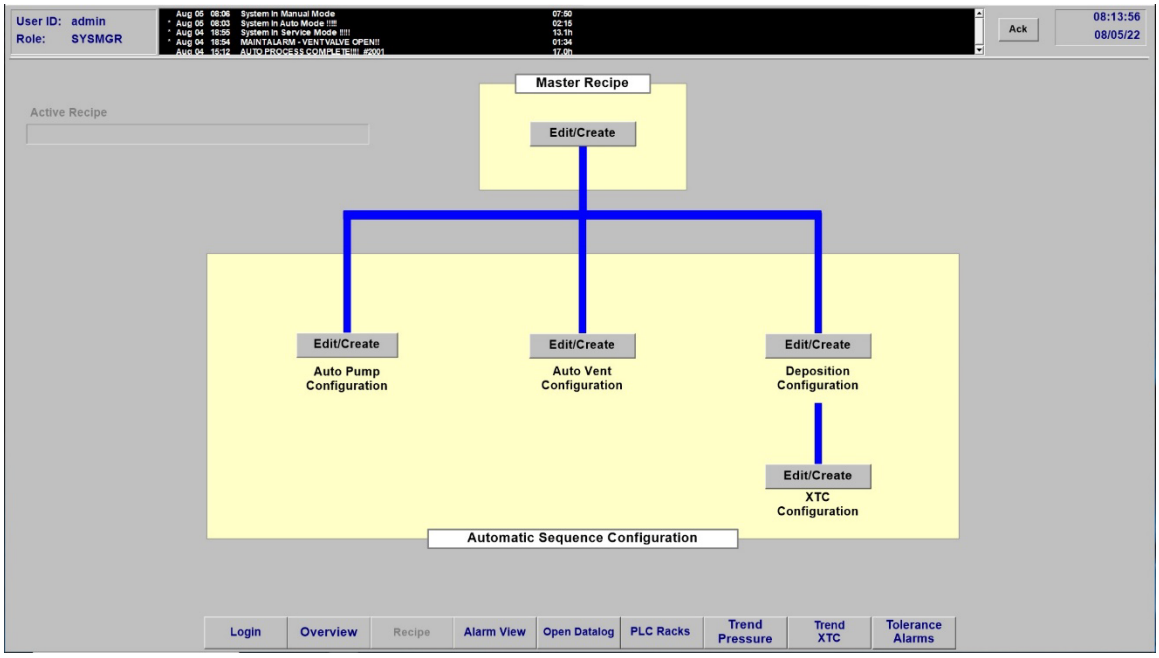
The system will now automatically pump down. Allow 1 to 2 hours to reach a chamber pressure in the low to mid 10^{-6} torr range for deposition.

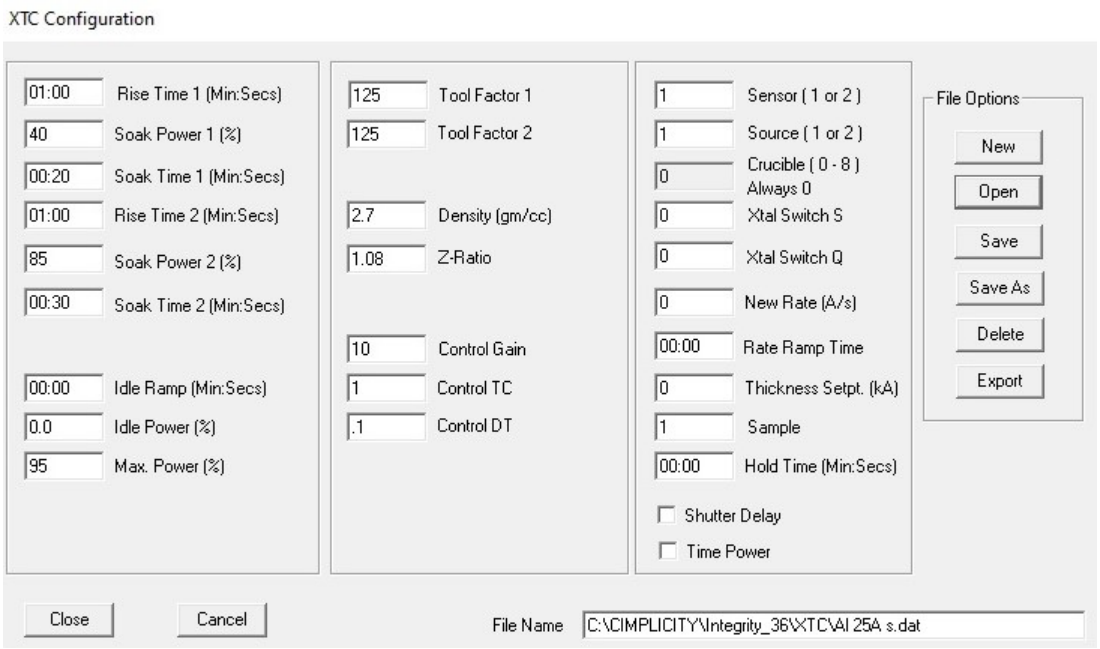
Recipe Creation:

Navigate to the Recipe screen. On this screen, recipes for automatic deposition (as well as venting and pumping) are created.

The Auto Pump recipe is set by Staff and should not be edited by users. If you feel you need a specialized pumping recipe, please contact the staff.

The Auto Vent recipe screen gives the option to choose a time delay before venting. There are various premade programs with time delays up to 30 minutes, feel free to make your own vent recipe for longer times. Please use at least a 15-minute time delay after deposition to allow the system to cool down before venting.





The XTC configuration is for creating the material file. Set your desired rise times and soak power. Use a rise time of between 1 ~ 3%/min depending on the material. Set the idle ramp time and power for cool down after deposition. Set the max power to a slightly larger value than Soak Power 2. The Density and Z-Ratio are material specific and can be found in the materials chart of the XTC3 handbook, open on the desktop. The Control Gain, TC, and DT suggested starting values are 10, 1, and 0.1, respectively. They are the PID values for controlling the automatic deposition rate. Please contact the staff for help adjusting these values.

Select Deposition Configuration on the recipe screen to specify your film parameters. If you are running an auto pump down directly into deposition, set your desired vacuum set point and soak (delay) time before your deposition will automatically start. Input the crucible number for the material and select a sweep pattern (1 is the default sweep). In the drop-down list select your material file and hit Select. Ensure the correct material file is listed in the Current XTC File box. Input your desired final thickness and deposition rate. Save As your file if this is a new file.

Go to the Master Recipe Builder on the recipe screen. Select your sequence type (Auto Pump, Vent, or Deposition) and then select your recipe from the drop-down menu. Hit Add on the right side of the screen. In the Master Sequence list on the left-side of the screen, your desired recipe will be added to the program. For example, you can select 00Auto Pump.dat to pump down the system, select your deposition recipe(s), and then 01Auto Vent.dat. to run a completely automated sequence to pump down the system, deposit your film, and then vent the system.

Even if you are running an entirely automated process, you must be physically present for the deposition to monitor the process.

For recipes incorporating multiple material films, there are 'WAIT' deposition recipe steps to be used in between layers. This is to allow time for cooling before rotating the pocket to the next material. The recipe runs at 0% Idle for 2 minutes after ramping down the ebeam power following deposition. There are four separate wait recipes labeled WAIT1, WAIT2, WAIT3, and WAIT4, which specifies the pocket # to remain idle on. Please ensure that you select the correct wait recipe corresponding to the preceding layer.

Save As your program. Navigate to the Overview Screen. Hit Start on the left-side panel, enter your operator and run ID information and start your program.

Session End:

Remove your sample(s) and personal crucible(s) from the Denton. Run the 00Auto Pump.dat program to pump the system back down. Do not leave the system at atmosphere when you are finished.

Log off of FOM.