The LPCVD system is a stack or cabinet that holds four horizontal tubes that each runs a separate process. Four tubes each is a large quartz tube that is sealed at the front with a door while the back of the tube is connected to a vacuum pump. Around each quartz tube is heating elements that heat the tube and it contents up to the correct temperature. With a vacuum in the tube and at the correct temperature, the gases are entered into the tube. The heat causes the gases to react and a film is deposited. The amount of film is determined by the amount of time the gas step is ran into the tube.

2 Safety
   a The main item here is there is several gases used here that are dangerous.
   b Electrical hazard since this system uses high voltage/current to power the elements.
   c High temperature is a concern, as the tubes open at temperatures over 600 degrees.
   d The danger of vacuum and the quartz ware if the quartz was to break.

3 Restrictions/Requirements
   a Must be a qualified user for this system.
      To prevent wafers from contaminating the tubes and other user’s wafers and large cost:

4 Required Facilities
   a Compressed air  60psi
   b Process chilled water
   c Nitrogen gas
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Standard Operating Procedure

5 Definitions
   a ESW Sun computer: The computer that is the operator interface.
   b Mypro: This is the tube computer that controls only one tube.
   c Boat: This is the quartz container that holds the wafers
   d SiC paddle: This is the long support that holds the boat as it goes into the tube.

6 Setup
   a Make sure that you have your wafer ready to go which is clean and ready to load. If you need a
test wafer to run during the poly deposition contact a staff person.
   b Reserve you time for the system if needed.
   c Enable the system by using CORAL
   d The system can only be used Monday – Friday from 7:00 AM to 5:00 PM

7 Operating Instructions

   a First Enable the tube to be used in CORAL. Start to enter data in log book for the tube.

   b The first item is to go to the ESW terminal and make sure it is ready to run.
If the ESW is not ready, as in the screen is locked, contact a NFC staff person. If the screen does not
display the Sentinel box you may need to start it running by clicking on Icon at the bottom task bar. If
the Sentinel palette is on the screen, you need to log in by clicking the upper left FILE.
Enter the user name and password which is: nfc and nfc1234 in lower case. (Fig. 1.)
Click on the Icon labeled MYPRO this will bring up a new box with three icons. (Fig. 3.)

![Login screen that starts the Sentinel software.](image-url)
c Find the icon labeled **Tube Status** on the screen and click on it. (Fig 2.)

![Fig. 2 Check the status of the tube you want to use.](image)


d Check to see if the box on the far left is colored **GREEN** and it says **Idle** under the label **Process State** for the tube you want to run. If it is not idle but says step 59 under Process state this is being worked on by maintenance.

e Click on the icon called **Run Tool** on the screen and click on it. This is used to select a recipe. A new box will open where all the recipes are that can be ran. (Fig 4.)

![Fig. 3. Run Tool and Tool Status icons.](image)
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Standard Operating Procedure

Make sure the small box in the upper left is the Production button if it is not displayed.

Select the minispec from the list which is planned to be ran. The recipe name you want.

This will cause a recipe to appear on the right, click the diamond under tool, it turns RED.

Now click on the Run Minispec button at the top to start loading this recipe.

---

Fig. 4. The recipe and tube has been selected and the next thing is to select “Run Minispec”.

A new window will open labeled: **Run Tool Login**  (Fig. 5.)

Complete the information for the page:  **User Id** nfc    **Password** nfc1234

Fig. 5. The run tool login info with user and password info being entered.
After completing the info the next item is to click on the **Operator** Step box. This will have another box appear. This is the delay time (Deposit Time) that you will need to enter. There is a limit of 6 hours of total time that can be entered, if you need more time contact NFC staff for more information. (Fig. 6.)

![Run Tool Operator Step](image1)

Fig. 6. The operator step, which is the delay time will determine the resulting film thickness.

- Clicking **OK** on the operator step, this will display a small box that gives a brief review of the data you entered, check this to make sure you have the correct recipe and operator step time. Then click **OK** again. (Fig. 7.)

![Information](image2)

Fig 7. A review of the data entered for the minispec to be ran.
n The data and recipe will be downloaded to the tube computer at which time you can then exit from the Run Tool screen, just click on the File and select exit. Next look at the Tool Status and you should see the tube will now have a new recipe listed for the tube selected. Click on the Control Icon for that tube and a small box will appear. Press the START button and the control screen should now display the word running for the selected tube. In a few seconds the tube will go in HOLD. Press HOLD to have it continue. Press the Cancel bar at the bottom to remove the box, to avoid having the Abort button being pressed by mistake. You must have the box closed before being able to select other tubes. (Fig. 8)

Fig. 8. Control panel listing the four items that can be controlled for each tube.

\[ \text{The other button that can be selected on the left side of Tool Display screen is Detail, this displays the actual analog and digital values for the tube. Click this to watch the actual values. The Detail screen and the Tool Display screen is all the information needed to process a run.} \]

Fig. 9 The detail screen displays many useful items about the tube.
The program will run and the first thing is that the tube will check on things and if it is okay it will go to the next step which is a HOLD step. This is waiting on you to say “that it is okay to open”, all recipes wait for you to say it is okay to open. No recipe will open a tube by itself. Notice the Tool Status will display the word HOLD for the tube. Open the Control Panel for the tube and press the HOLD button and the Buzzer button too. Close the Control Panel when you are done.

The tube will vent and open and will stop with the loader open waiting for you to load your wafers. Again Do NOT place the boats any where except the allowed placements areas! Load your wafers in a safe and orderly manner. Take care to not allow your gloves or cleanroom gown to touch the boats nor the paddle, as they will be hot. Fill log book, with Process time! In case there is an error and NFC staff can fix the problem we will need to know the process parameters.

Once the wafers are loaded, click on the HOLD for the tube again, the loader will close the tube, watch for the loader to make sure the IN LED is lit when the tube is closed.

You can watch the detail screen to see the pressure of the tube go down and the temperature go to the correct value and gases turn on for the needed time and later the once the time is completed the gas will be purged from the tube and temperature will go down and the tube will be ready to unload and waiting at a HOLD step again.

Press the HOLD button again, unload your wafers. Press HOLD again to close the tube. Once the tube is closed watch to make sure the IN LED is lit and it is pumping down correctly.

Once the tube has pumped down correctly, and process state is IDLE, load and run IDLE-xx recipe for the tube. Now you can log out of the tube on Coral.

8 Problems/Troubleshooting

- Tube closed but the IN LED is not lit.

Click the loader switch to the LOAD position for ~ 2 seconds and then move it back to the AUTO position. If this did not help contact NFC staff immediately.

-Red alarm is display.

Check the alarm, if the process gas and temperature values are normal, and the process did not abort continue running, if the values are wrong or the system aborted, contact NFC staff. Record dep time too.

- The screen saver is on and it asks for a password.

Ask for a NFC staff person to get the system running.
9 Process recipe list

There are four process LPCVD tubes:

Tube 32 Poly silicon
Tube 33 Regular and low stress Nitride

<table>
<thead>
<tr>
<th>Recipe</th>
<th>Dep rate</th>
<th>Uniformity within wafer</th>
<th>Across boat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube 32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POLY-SIL</td>
<td>92 to 96 Ang/min</td>
<td>0.9% in wafer</td>
<td>3% boat</td>
</tr>
<tr>
<td>PHOSPOLY</td>
<td>25 to 16 Ang/min</td>
<td>~ 10% in wafer</td>
<td></td>
</tr>
<tr>
<td>ASIL-550</td>
<td>~ 10 Ang min</td>
<td>~ 1 in wafer</td>
<td></td>
</tr>
<tr>
<td>Tube 33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSN-33</td>
<td>~ 28 to 36 Ang/min</td>
<td>~ 22% in wafer</td>
<td>~12% boat</td>
</tr>
<tr>
<td>NIT-33</td>
<td>~ 41 Ang /min</td>
<td>~ 4% in wafer</td>
<td>~9% boat</td>
</tr>
</tbody>
</table>

Tube 33 LSN-33 stress values are in the range of 100 MPa +/- 50

APPENDIX:

**Allowed and prohibited processing and materials**

Only these materials are allowed into the LPCVD tubes:
- New silicon wafers
- Wafers that have been previously processed in one of the top three Tylan tubes
- Wafers after ion implantation
- Other LPCVD films
- Wafers after cleaning RCA or piranha (H₂SO₄ + H₂O₂) cleaning in Bay 1 wet benches
  Wafers after lithography steps or dry etching in STS or Deep trench etcher (These wafers must have a piranha clean on the wafers first)

**NOT allowed in the LPCVD tubes:**
If wafers were ran in Alloy tube, RTA, metal deposition systems, PECVD, or was contaminated with any film, or was even handled with bare hands. Any of these things will contaminate the tube and cause many parts to be replaced. Not to mention the chance of contaminating someone else wafers, or other process equipment.