University of Minnesota Nano Fabrication Center

Standard Operating Procedure

Equipment name: Spray/Puddle Developer
Badger name: *develop spinner CEE-4* **Model:** 200X
Location: Bay 2 **Revisionist:** Paul Kimani
**Revision #:** 1 **Date:** April 26, 2013

Description

The *develop spinner CEE-4* spinner is a PC-controlled automated dispense tool. Instructions are fed on a PC-based touch screen interface running on windows XP. It is capable of spin speeds from 0 to12, 000 rpm and spin speed accelerations of 0 to 30,000 rpm/s (23,000 rpm/s if using a 200 mm substrate). Substrate size capability is from < 1cm to 200 mm round.

Safety

a. For all chucks, ensure that the notch on the chuck is aligned to the drive pin on the spindle and push the chuck all the way down
b. Chucks (except the piece chuck) need to be secured with the vented screw (screw with hole in center) that has been tightened with the provided torque hex wrench.
c. Developer and deionized water-filled canisters are pressurized. Their **respective pressure must be relieved** before opening canister. Do not attempt to refill the canisters. Report empty canisters on Badger or to any NFC staff.
d. If the waste container (orange drain bottle) is full, a sensor will lock the ability to use the spinner and a yellow light will go ON, on the drain bottle. Waste bottle can be unscrewed and drained into an appropriate waste container.
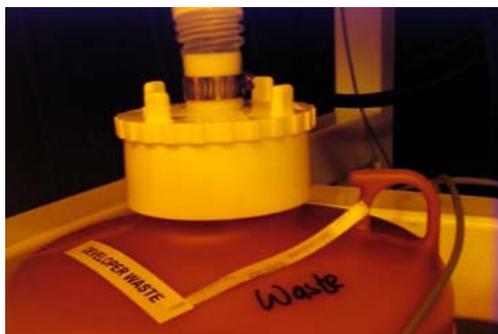
e. When draining the waste bottle, do so over the provided collection tray to avoid spills on the floor and use appropriate containers for the waste. The same applies when refilling developer and rinse canisters

Restrictions/requirements
a. Must be a qualified user on the *develop spinner CEE-4*. Use only material approved for use in *develop spinner CEE-4*. These are CD 26, deionized water and any other materials approved by NFC staff.
b. Regularly used or **standard recipes are saved with 0_xxxx or 1_xxxx naming system.** These recipes will appear at the top of the list and no other recipe should precede them. Recipes that do not adhere to the above requirements will be deleted.
c. Maximum spin speed (12,000 rpm) or maximum acceleration (30,000 rpm per sec) should not be exceeded

Required facilities
a. Nitrogen supply (45psi – 55psi)
b. Voltage range: single phase 100 – 120V AC, 10 amps
c. Vacuum source: 25" Hg
d. Exhaust: 50 cfm at 0.2 water

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Definitions
1. **Recipe Name:** The name of the currently loaded recipe
2. Live update: Not applicable to this spinner
3. **Load:** Brings up the TODO Recipe Select Screen to select for processing
4. **Edit Recipe**: This button will navigate to the Spin process Editor if a recipe is loaded. If a recipe is not loaded, it will go to the TODO Recipe Select Screen
5. **Lid Closed:** A lamp showing the state of the Lid Closed sensor
6. **Substrate Present/missing Indicator**: A lamp showing the state of the Spin Chuck Vacuum sensor
7. **Step Indicator:** shows the current step of the process
8. **Time Indicator:** Shows time remaining on the current step
9. **Speed Indicator:** Shows the current speed of the spindle
10. **Exhaust:** Not applicable to this spinner
11. **Dispense:** Illuminated buttons show which dispenses are currently activated
12. **Iterations:** Not applicable
13. **Start Centering:** See below under **Process Button**
14. **Vacuum hold/release:** this button allows the user to actuate the vacuum of the spin chuck as they center the substrate.
15. **Center:** Repeatable centering. Use this button to check centering at any time.

Process Button: This has four modes:
   a. **Start Centering:** Starts the wafer spinning very slowly to check for centering on the spin chuck
   b. **Start Process:** Starts the selected process
   c. **Abort:** Aborts a currently running process
   d. **OK:** Turns off the process complete buzzer
   e. **Vacuum Hold/Release button:** Allow users to actuate the vacuum of the spin-chuck as they center the substrate.

Dispense setup
Dispensers are set up as follows:
   a. **Disp 1** – CD 26 developer
   b. **Disp 2** – Top side rinse with deionized water
   c. **Disp 3** – Backside rinse with deionized water
   d. **Disp 4** - None

If a recipe has a dispense step included, fluid will flow through the dispense nozzles during the dispense step and dispense buttons will be highlighted in green. The **Developer** and **Top Rinse** dispense nozzles can be manually moved to adjust aim on the wafer so that fluid is directed at the wafer center. The **Backside Rinse** dispense nozzles can be moved manually to ensure that the rinse is directed under the wafer. Pressure at the dispense nozzles is managed from the dispense control box, and has been adjusted to minimize flow volumes.

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Operating instructions

1. Log into Badger and enable the *develop spinner CEE-4*.
2. On the main screen, tap the **Login** button (assuming previous user logged out). This will bring up the keyboard to enter your password. User password is **<u>1234</u>**
3. Use appropriate size chuck. Available chucks are ” for small samples, 4” for 100 mm wafers and an additional chuck for 150mm or 200mm wafers.
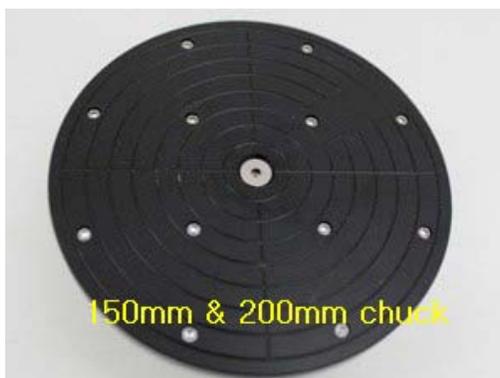
4. Press the **Run Spin Process** button, to bring up the spin process window
5. To run a spin process, load your substrate on an appropriate size chuck (substrate should fully cover all chuck surface), then load a recipe by pressing the **Load** button. *NB: If the waste drain bottle is full, you will not be able to run any process until the waste bottle has been emptied.*
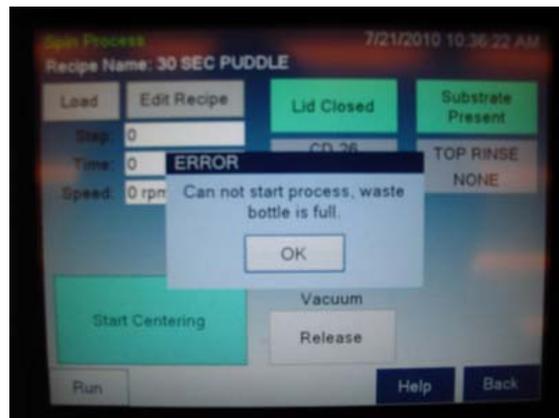
6. A recipe **Selection Screen** will be brought up. Select a recipe by double clicking or pressing enter after your selection
7. Load wafer using provided centering tools (4" substrate loading depicted in the images below). Press **Vacuum Hold** to actuate vacuum on the substrate.

8. Press **Start Centering**: The spin chuck spins for the 5 seconds to test for centering. Centering can be restarted by pressing the Center button. *NB: Centering happens whether the lid is open or closed.*
9. Press **Start Process** to begin the spin-develop process. For the duration of the process the lid must remain closed. Once the process is started, the **Abort** button can be used at any time to halt the process.
10. **Process Complete:** Once the process is completed, an audible alarm may sound. Pressing the **OK** button will silence the alarm

Problems/troubleshooting
   a. **Substrate present light not on**: Ensure that developer CEE-1 is enabled on badger
   b. **Spin vacuum error**: potential problems include vacuum lost during spin or spindle vacuum seal is worn out. Notify maintenance personnel.

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Editing/Writing a Recipe (Applies to CEE-1 and CEE-3 as well)
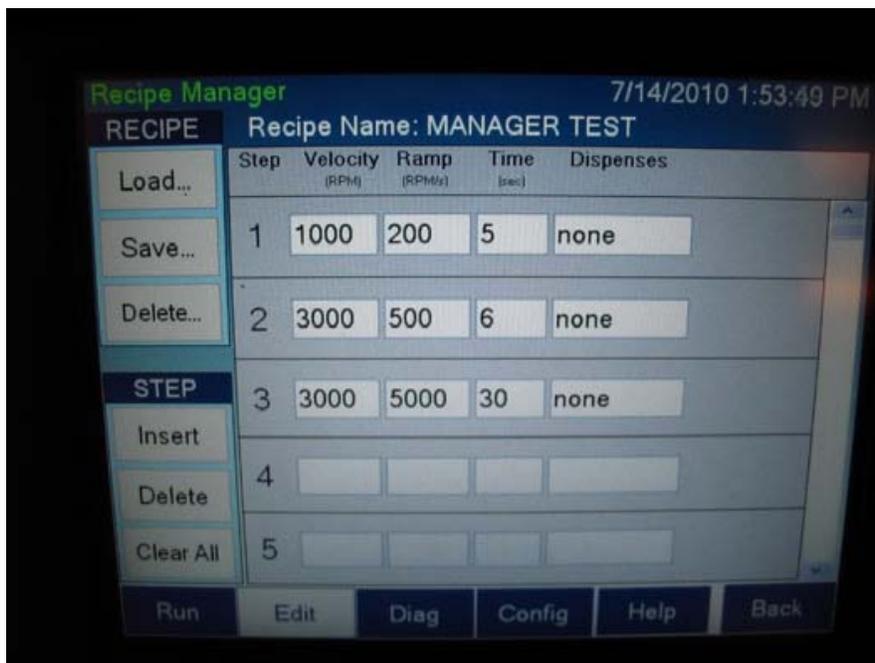
Definitions:

a. **Recipe Name**: The name of the currently loaded recipe

b. **Load button**: This button opens the dialog to load recipe into the editor

c. **Save button**: Opens the save dialog for saving the current recipe

d. **Delete button (under recipe heading)**: Opens the delete dialog for deleting the recipe

e. **Velocity column**: Where the velocity data is entered for each step in rpm's

f. **Ramp Column**: Where ramp data is entered for each step in rpm's/sec

g. **Time Column**: Where length of each step is entered in seconds

h. **Dispenses column**: Opens the dialog which allows you to select which dispenses are active for each step

i. **Insert button**: Inserts a blank step in front of the currently highlighted step

j. **Delete button (under step heading)**: Deletes currently selected step

k. **Clear All button**: Clears all data loaded in the editor

A currently loaded recipe can be edited then saved by overwriting the original file name or saved as a new recipe name. **Clear All** button clears all current data on the editor allowing user to enter all new recipe data. User can also simply tap on the relevant box to make changes to a single item on the recipe editor.

Recipes can have up to 100 steps (in most cases you may not need more than two). The maximum spin speed is 12,000 rpm with a maximum acceleration of 30,000 rpm per second

when spinning a 4" (100mm) wafer. Maximum acceleration is 23,000 rpm when using a 6" (200 mm) wafer.

To enter velocity data, click on **Velocity** box. A numeric pad will appear. Enter the parameter for the velocity step. The numeric pad indicates the valid range at the top of the window. Press enter. The same can be done for **Ramp**, and **Time**.

Click on **Dispense** to open the dispense select screen. The screen shows all installed dispenses on the tool. Click on the dispense name to select it. Clicking again will deselect the dispense.
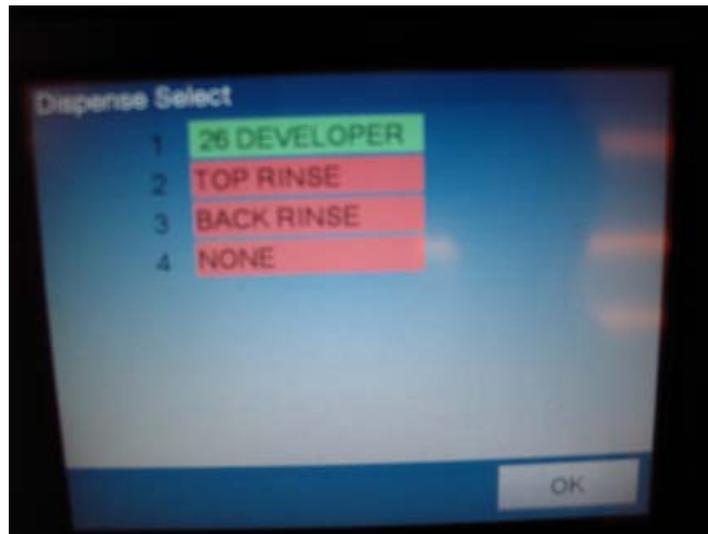
NB:
Dispenses that will be turned on during the step will be highlighted in green; those that remain off will be highlighted in red

- There is no limit to the number of dispenses enabled per step
- Dispense 1 tank is filled with CD 26 developer
- Dispense 2 tank is filled with Deionized water and feeds the top side rinse
- Dispense 3 tank is filled with Deionized water and feeds the backside rinse

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Refilling Canisters! (Applies to spinner CEE-3 also)

The canisters are pressurized. **Before opening the canisters, pressure has to be relieved**. This is done by turning the pressure relief knob one quarter turn to the right. One should hear an accompanying hissing sound upon turning this knob.

Pressure relief knob   Canisters
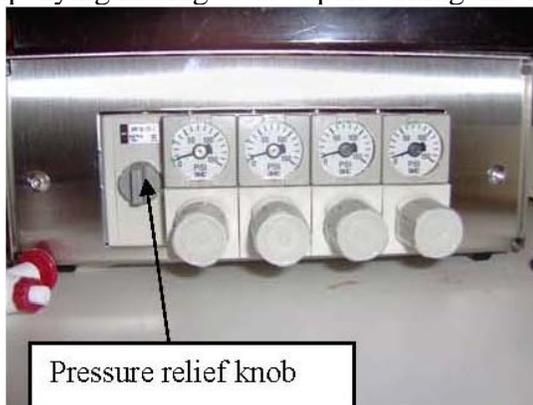
a. Open the canister by unscrewing (counterclockwise) the large black knob on top of the canister. Turn this knob until you are able to slide out the entire top lid and gain access to the canister's opening.
b. Fill canister to three-quarter (¾) depth with the required fluid (developer or DI-water).
c. Insert lid, ensuring that it is properly oriented on the canister opening and tighten by screwing the knob in the clockwise direction. Ensure the lid is firmly sealed; the rubber edge ensures a tight seal with the canister.
d. Pressurize the canister by turning the pressure relief knob one quarter turn to the left.

Sample Recipes

Sample spray develop recipe (30 sec develop)

Spin speed (rpm)	Acceleration (rpm/s)	Time (sec)	Dispense nozzle***
500	500	30	1
500	500	30**	1,2
3000	500	45	0

Sample puddle develop recipe (30 Sec develop)

Spin speed (rpm)	Acceleration (rpm/s)	Time (sec)	Dispense nozzle***
1500	2000	1	1
200	2000	3	1
0	2000	30**	0
500	2000	15	2
2000	2000	60	0

** Indicates the desired development time, *** 1 is developer, 2 is rinse water