Standard Operating Procedure

Apogee spin coater, bake plate and vapor primer bake plate

Scope

This manual provides detailed instructions for the proper operation, handling, and maintenance of the Apogee Spin Coater, Bake Plate, and Vapor Primer Bake Plate, installed in Bay 4, AggieFab (**Figure 1**). These tools are used for photolithography and surface preparation processes, including spin-coating of photoresists, soft/hard baking, and HMDS vapor priming of substrates, such as silicon wafers or glass slides.

Figure 1. Apogee spin coater, bake plate, vapor HMDS bake plate system in Bay 4, Aggiefab.

Safety

General Precautions

- Read this manual in full before operating any of the systems.
- Only trained personnel should operate the Apogee Spin Coater, Bake Plate, or HMDS Primer.
- Always wear appropriate Personal Protective Equipment (PPE), including cleanroom gloves, goggles, and a coveralls.
- Ensure proper ventilation and fume exhaust are functioning before operating any equipment.

Spin Coater Safety

- Do not operate the spin coater unless the lid is fully closed. A safety interlock will stop the motor if the lid is opened above 60 rpm.
- Never reach into the bowl area while the chuck is spinning.
- Secure the substrate properly on the chuck to prevent it from flying off at high speed.
- Ensure the vacuum is functioning correctly before starting any recipe.
- Handle solvents (e.g., acetone, photoresist) with care; avoid inhalation and skin contact.
- Keep flammable materials away from electrical components.

Bake Plate Safety

- Bake plate surfaces may exceed 115°C. Do not contact the surface directly. Use wafer tweezers or transfer tools.
- Use tweezers or wafer lifters to place or remove substrates, never touch the hotplate directly.
- Ensure lid covers are used properly to maintain temperature uniformity and protect users from burns.

Vapor Primer (HMDS) Safety

- HMDS is flammable and slightly to moderately toxic following acute oral, dermal, and inhalation exposure. Use only in well-ventilated environments with fume extraction.
- Do not expose HMDS to sparks or an open flame. Store in a cool, dry, and ventilated location.
- Use only containers and valves rated for HMDS and maintain tight sealing to prevent leaks.
- In case of exposure or spill, follow MSDS and institutional EHS guidelines.

Instrument Operation Process

1. Apogee spin coater

There are two Apogee spin coaters installed: The Apogee spin coater-general (**Figure 2** left) is used for standard photoresists, such as S1805, S1818, AZP4620, and nLof2020. The Apogee spin coater-SU8 (**Figure 2** right) is exclusively for SU-8 spin coating.

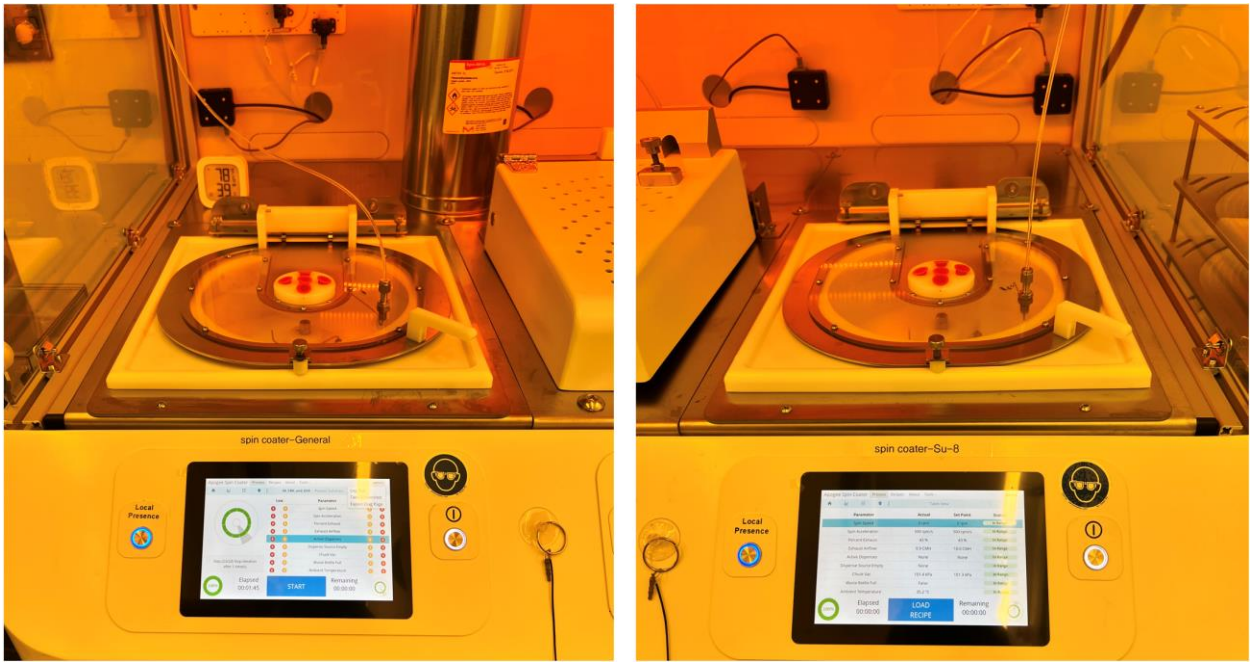


Figure 2. Apogee spin coater-general and Apogee spin coater-SU8 modules.

1.1 Choosing a Chuck for the Substrate

Circular spin chucks are used for processing standard wafers and pieces. With standard thickness (275-750µm) substrates that are centered properly, a maximum spin speed and acceleration range of 3,000 to 6,000 rpm is recommended. As substrate size increases, the use of a centering device, and/or verification of optimal centering of the substrate, becomes increasingly critical. As thickness increases, the maximum speed and acceleration must be decreased for safe operation.

- **Standard circular vacuum chucks are capable of processing substrates with a diameter up to twice the spin chuck diameter.** For example, a 4-inch chuck would be recommended for substrate sizes of 5 inches (125mm) up to 8 inches (200mm) in diameter (**Figure 3**).

Figure 3. The 4-inch chuck would be recommended for substrate sizes of 5 inches up to 8 inches in diameter.

Table 1. CEE spin coater Recommended Sizes for Width of Substrates

Physical Chuck Diameter	Recommended Substrate Size Range
1/8” (0.125”) External O-Ring	3mm-9.5mm/0.125”-0.375”
5/16” (0.312”) External O-Ring	9mm-26mm/0.375”-1.0”
0.75” Circular Vacuum*	25mm-38mm/1.0”-1.50”
1.0” Circular Vacuum*	32mm-50mm/1.25”-2.0”
1.5” Circular Vacuum*	45mm-77mm/2.0”-3.0”
2.25” Circular Vacuum	77mm-127mm/3.0”-5.0”
4.0” Circular Vacuum	125mm-200mm/5.0”-8.0”

*Compatible with optional external O-ring

1.2 Spin Chuck Removal and Installation

- If equipped, locate the spin chuck screw (located in the center of vacuum chuck) and remove with a hex key wrench. If the chuck has a porous insert, locate the push pins on the back side of the chuck and use to lift the insert out to access screw.
- Grasp the spin chuck from accessory box (**Figure 4**) and gently pull straight up to remove.
- Place the new spin chuck onto the spin coater shaft and ensure that the spindle pin/key aligns with chuck slot.
- Use a hex key wrench to secure spin chuck screw in the center of new chuck (if needed).

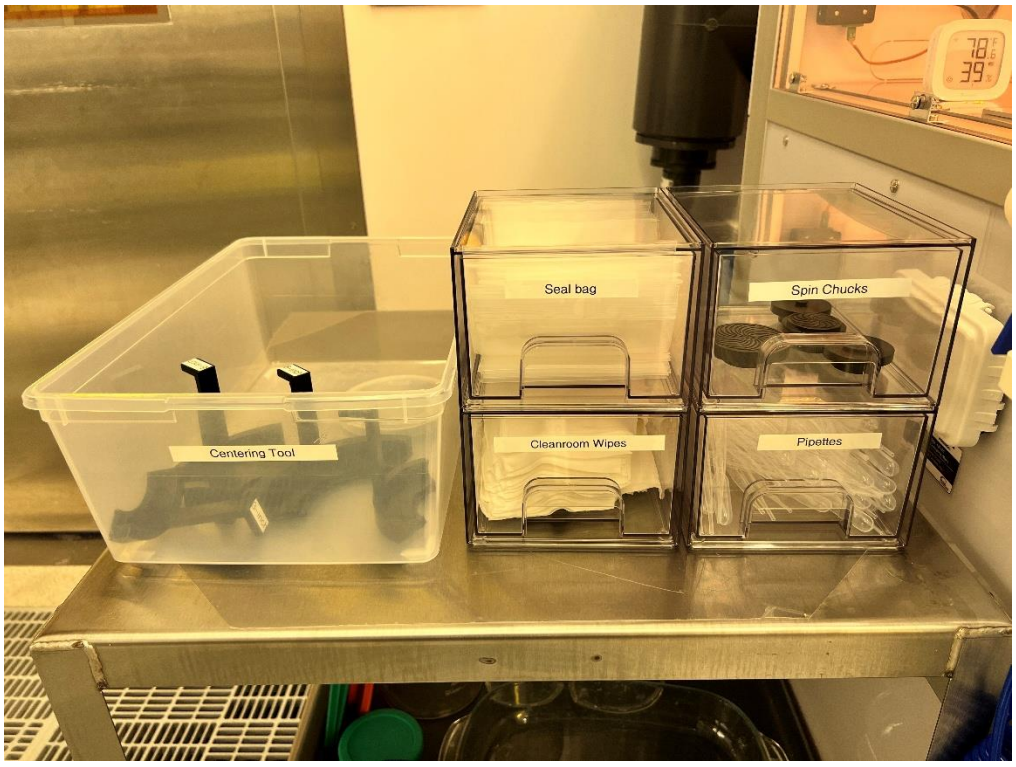


Figure 4. Accessory box for spin coating system, includes centering tool, spin chucks, seal bag, cleanroom wipes, and pipettes.

1.3 Spin Chuck Precautions

1.3.1 Chuck Placement

Align the chuck so that the spindle key engages with the slot of the chuck and slide the chuck onto slide the spindle shaft. If there is resistance, the chuck slot has not been properly aligned with the key. Improper alignment may result in a damaged spindle and vacuum faults.

1.3.2 Substrate Placement

Ensure placement of the substrate covers all vacuum surfaces. Failure to do so may result in damage to the chuck, equipment, and substrate.

1.3.3 Maximum Spin Speed and Acceleration

Maximum spin speed and acceleration vary based on weight and size of substrates and chucks. Though the equipment may support higher speeds and acceleration, using higher than the recommended speeds can cause poor results, damage to the chuck/equipment, or may cause personal harm.

1.4 Spin Coater System Start Up

Turn the machine on by pressing the lighted power switch, and users can enter login credentials at the main login screen.

1.5 Spin Coater System Parameters

Parameter	Actual	Set Point	Status
Spin Speed	0 rpm	0 rpm	In Range
Spin Acceleration	500 rpm/s	500 rpm/s	In Range
Active Dispenses	None	None	In Range
Dispense Source Empty	None		In Range
Chuck Vac	98.8 kPa	101.3 kPa	In Range
Waste Bottle Full	False		In Range
Ambient Temperature	27.9 °C		In Range
Humidity	44.4 %		In Range
Vibration	3		In Range

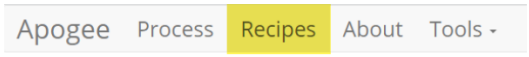
Table 2. Spin coater system parameters and explanation

Spin coater system parameters	Explanation

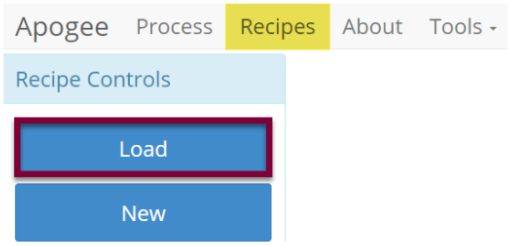
Spin speed	Measured rotational speed of the spin chuck in revolutions per minute (rpm)
Spin Acceleration	Dictates how fast the spin chuck will accelerate in revolutions per minute per second (rpm/s)
Percent Exhaust	Displays the valve opening percentage of the optionally equipped programmable exhaust module
Active Dispenses	Indicates which dispenses are enabled
Dispense Source Empty	Indicates when dispense sources are low or empty
Chuck Vac	Measurement of the vacuum pressure holding the substrate against the spin chuck in KPa
Waste Bottle Full	Indicates whether the sensors detect a full waste bottle
Ambient Temperature	The air temperature of the environment where the equipment is housed
Humidity	The ambient relative humidity in the environment where the equipment is housed
Vibration	Unitless measurement of g-forces at the spindle block; can be used to detect off-center substrates at high speeds

1.6 Running Recipes

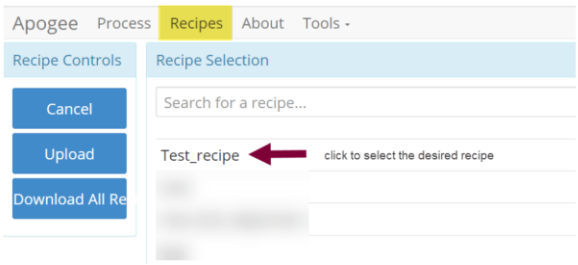
1.6.1 Navigate to the ***Recipes*** page.



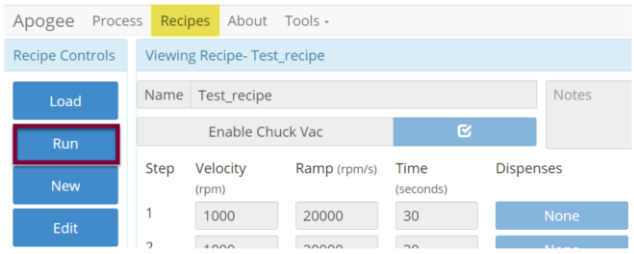
1.6.2 Click ***Load*** to access the recipes list.



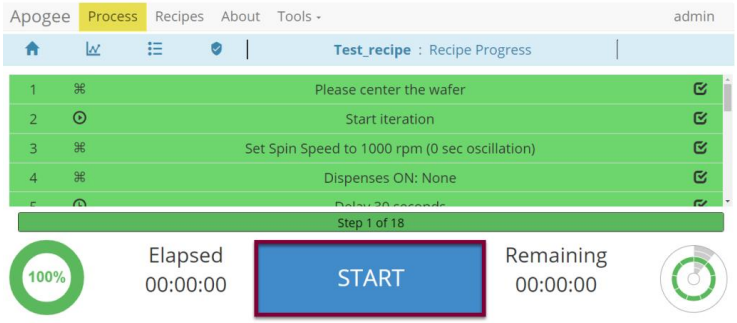
1.6.3 Search for, identify, & select the preferred recipe.



1.6.4 Click ***Run***



1.6.5 Click ***Start*** to initiate the recipe process.



1.6.6 Use the centering activity to center the substrate.

- Place the wafer onto the chuck surface.
- Center the substrate onto the chuck.
- Start the recipe and follow the on-screen centering step instructions.

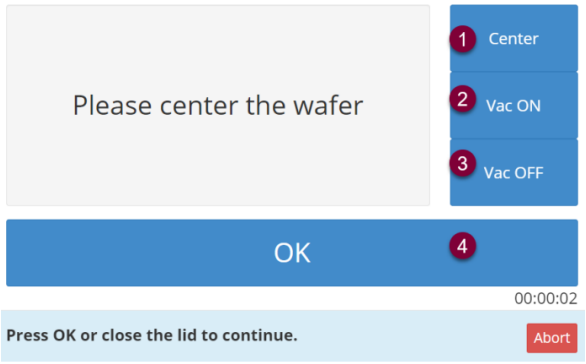


Table 3. Substrate Placement on Spin Coater Chuck and Explanation

Substrate Placement on Spin Coater Chuck	Explanation
Center	Spin chuck rotates slowly with vacuum on then stops rotation & vents vacuum
Vac ON	Toggle chuck vacuum on
Vac OFF	Toggle chuck vacuum off
OK	Resume recipe

1.6.7 Recipe execution

1.7 Editing Recipes

Spin coater recipes may enlist an unlimited number of steps, each capable of defining spin speed, acceleration, spin time, percent exhaust opening, and dispense triggers. Users can easily insert new steps, reorder existing steps, and/or delete a selected step via the *Step Context* Menu.

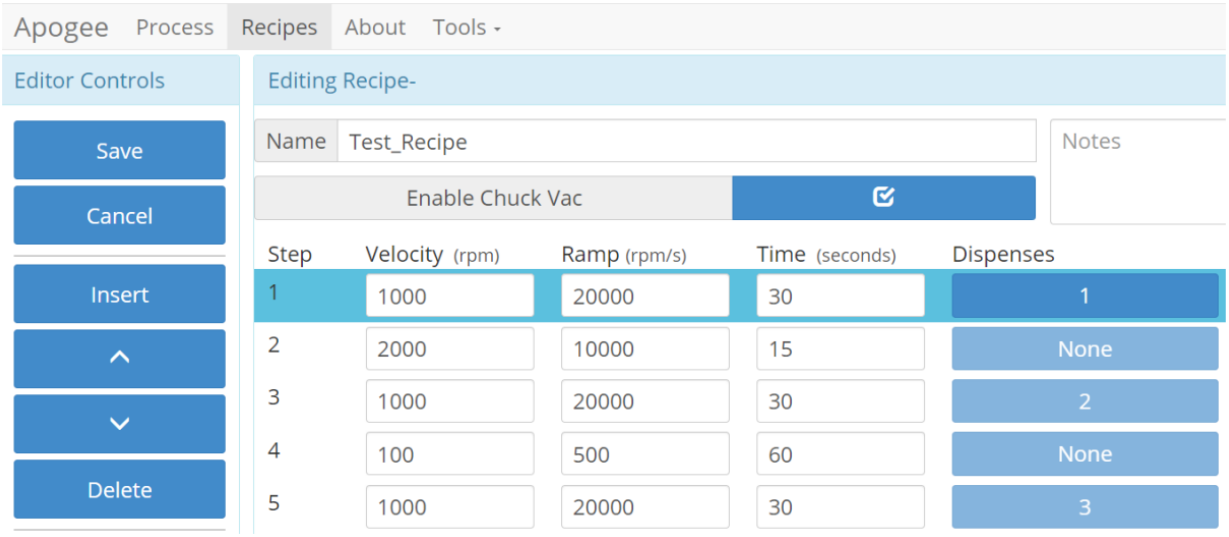


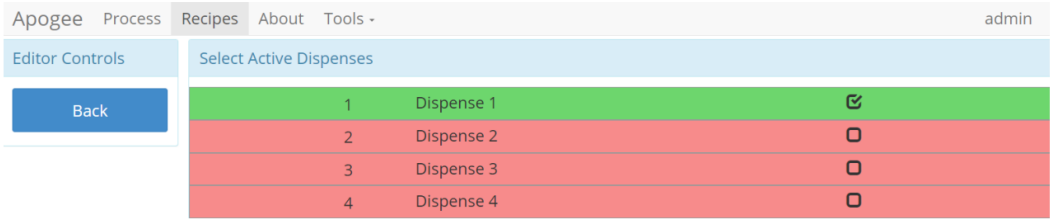
Table 4. Apogee Recipe parameters and Explanation

Recipe parameters	Explanation
Name	Recorded in log files and used as criteria when searching for recipes
Enable Chuck Vac	Used when the substrate requires vacuum to remain on the spin chuck. *If disabled, the centering step does not occur
Step Velocity	Speed in rpm the spin chuck will achieve on a given step
Step Ramp	Rate in rpm/s the spin chuck will ramp on a given step
Step Time	The duration in seconds for a given step
Exhaust	Percent of exhaust opening
Dispense	The dispense triggered during a given step

1.8 Editing Dispense Selection

Enabled dispenses are rendered in green and display a check mark. Multiple dispenses may be selected within the same step. Dispense 1 is edge bead rinse dispenser and filled with acetone, Dispense 2 is backside rinse

dispenser and filled with acetone as well.



2. Apogee bake plate

This bake plate module (**Figure 5**) will be hold at 115 degrees for most users.

Figure 5. Apogee Bake plate module.

2.1 Bake Plate System Start Up

Turn the machine on by pressing the lighted power switch, and users can enter login credentials at the main login screen.

2.2 Bake Plate System Parameters

Parameter	Actual	Set Point	Status
Plate Temperature	59.4 °C	60.0 °C	In Range
Lift Pin Height	19.0 mm	19.0 mm	In Range
Bake Method	Contact	Contact	In Range
Ambient Temperature	26.5 °C		In Range
Humidity	44.8 %		In Range

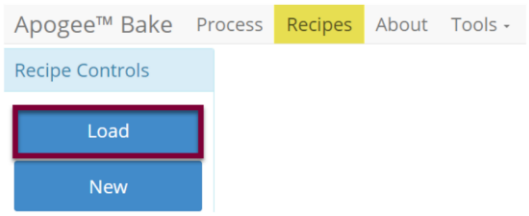
Table 5. Bake Plate System Parameters and explanation

Bake Plate System Parameters	Explanation
Plate Temperature	The current temperature of the hot chuck displayed against the target set point in degrees Celsius
Lift Pin Height	The height of exposed lift pins in relation to the chuck in millimeters; precision control settings range from 0.0-19.0
Bake Method	Dictates the manner in which the substrate is heated; contact, proximity, lift pins
Ambient Temperature	The air temperature of the environment where the equipment is housed
Humidity	The ambient relative humidity in the environment where the equipment is housed

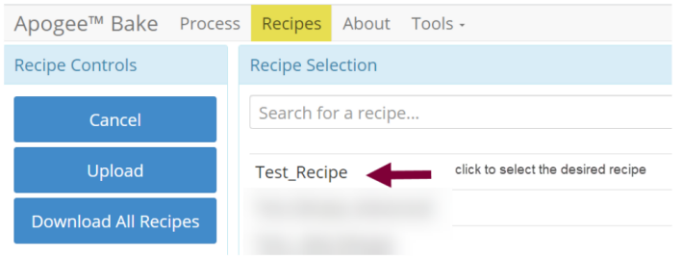
2.3 Running Recipes

2.3.1 Select Recipe Page

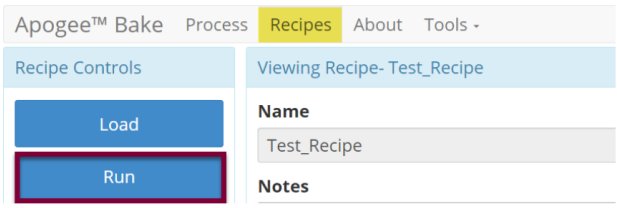
2.3.2 Load Recipe



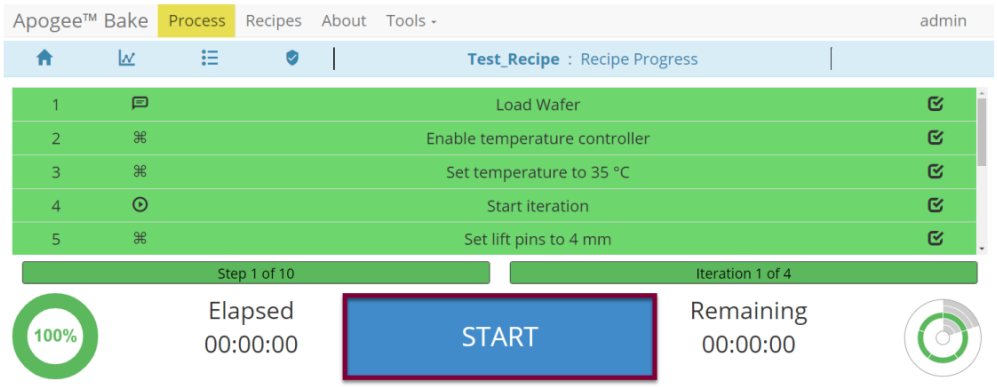
2.3.3 Search For, Identify, & Select Recipe



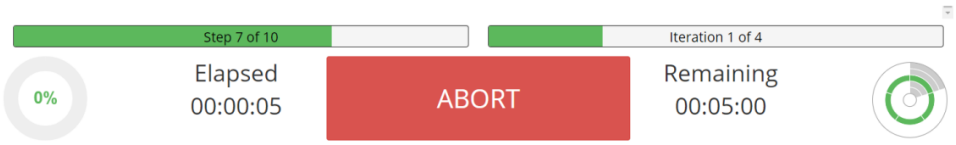
2.3.4 Run Recipe



2.3.5 Start Recipe



2.3.6 Recipe Progression



2.4 Hotplate Bake Variables and Methods

A typical bake process consists of preheating the surface to a known temperature, loading the substrate onto the surface for a specific length of time and removing it promptly at the end of the cycle. The selection of the temperature and time values used as well as the bake method employed all affect the overall performance of the process.

2.4.1 Bake Methods

Apogee hotplates allow for two distinct bake methods:

- **Contact bake**: In a contact bake, the substrate is held onto the hotplate surface by gravity alone to hold the substate to the hotplate. This method is usually preferred for silicon and other flat substrates where

backside contact is not a problem.

- **Proximity bake**: Proximity baking is accomplished by forcing nitrogen through ports in the hotplate surface. This forces the substrate to float at a distance of 1 to 4 millimeters (25-100µm) above the hotplate surface. Proximity baking allows for a slower warm-up than contact bake methods and can be advantageous when baking thick films where blistering would otherwise be a problem.

3. Apogee Vapor HMDS Baker Plate

This vapor HMDS bake plate module (Figure 6) will be held at 100 degrees and pre-set with only one recipe for all users.

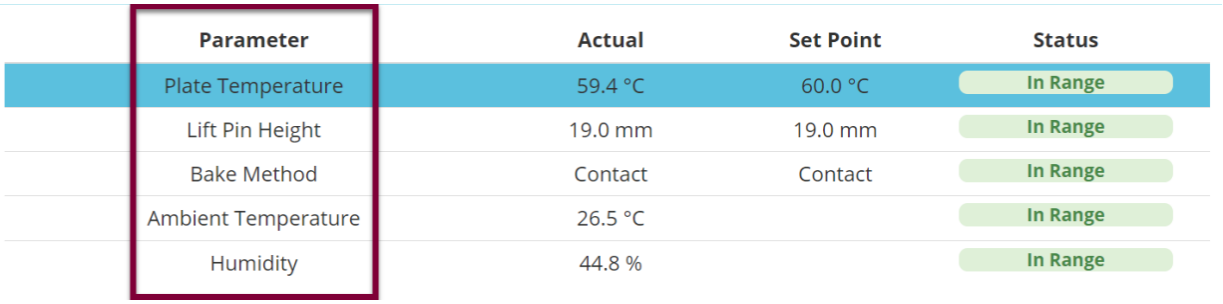
Figure 6. Apogee vapor HMDS bake plate module.

3.1 Vapor Primer Bake Plate System Start Up

Turn the machine on by pressing the lighted power switch, and users can enter login credentials at the main

login screen.

3.2 Vapor Primer Bake Plate System Parameters



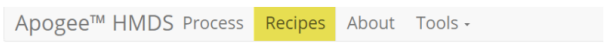
Parameter	Actual	Set Point	Status
Plate Temperature	59.4 °C	60.0 °C	In Range
Lift Pin Height	19.0 mm	19.0 mm	In Range
Bake Method	Contact	Contact	In Range
Ambient Temperature	26.5 °C		In Range
Humidity	44.8 %		In Range

Table 6. Vapor Primer Bake Plate System and explanation

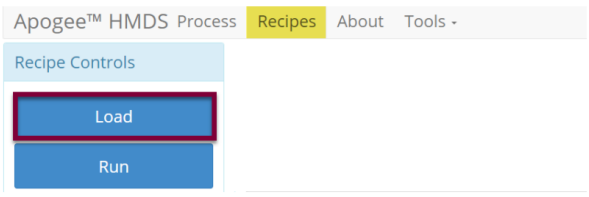
Vapor Primer Bake Plate System Parameters	Explanation
Plate Temperature	The current temperature of the hot chuck displayed against the target set point in degrees Celsius
Lift Pin Height	The height of exposed lift pins in relation to the chuck in millimeters; precision control settings range from 0.0-19.0
Bake Method	Dictates the manner in which the substrate is heated; contact, proximity, lift pins
Ambient Temperature	The air temperature of the environment where the equipment is housed
Humidity	The ambient relative humidity in the environment where the equipment is housed
Empty Sensor	Indicates when HMDS source is low or empty

3.3 Running Recipes

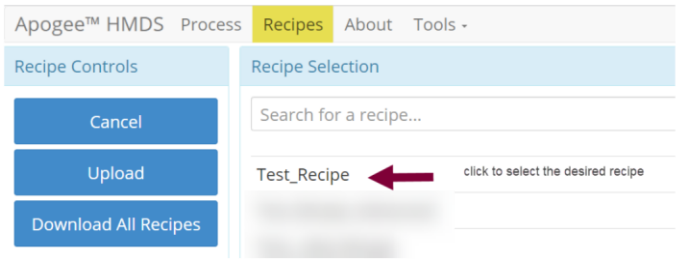
3.3.1 Select Recipe Page



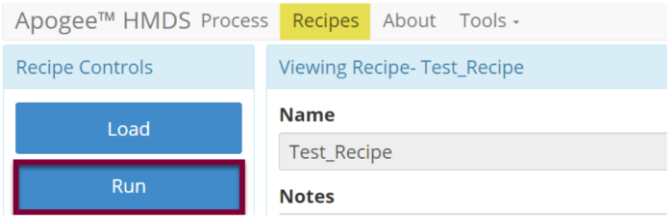
3.3.2 Load Recipe



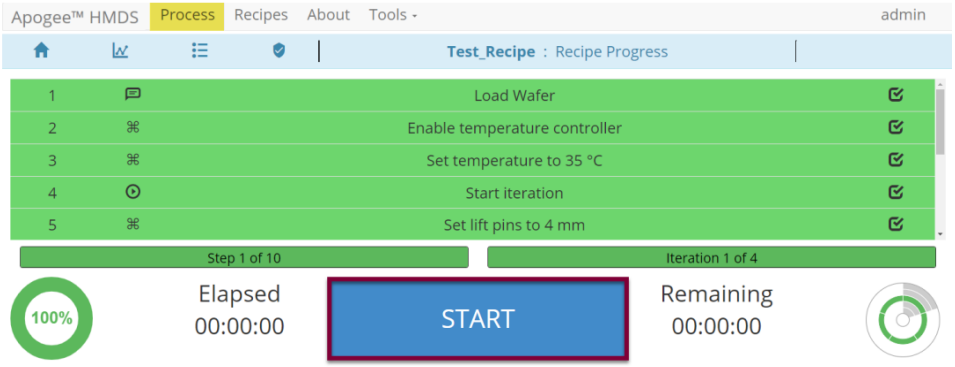
3.3.3 Search For, Identify, & Select Recipe



3.3.4 Run Recipe



3.3.5 Start Recipe



3.3.6 Recipe Progression

Note: Gently press down on the lid of the HMDS bake plate at the **beginning of the pump-down phase (04:37)** and again at the **end of the vapor priming step (01:18)**. This helps the chamber reach vacuum more efficiently and reduces overall processing time.

Signatures and Revision History

Author: Yu Chen, Research Engineer

1. Date: June 18th, 2025
2. Revision: A
3. Updates: Initial version; incorporates full operation of Apogee spin coater, bake plate and vapor primer baker plate.

Technical Manager Signature: Sandra G Malhotra

Date: 7/9/2025

Revision History:

Revision	Author	Date
Original version A	Yu Chen	06/18/2025