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Owner's Manual

Apogee™ 450 Spin Coater

Cost Effective Equipment

Published 10/31/19 Rev A

Contents

1. Apogee™ 450 Spin Coater Introduction

1.1. Confidentiality Statement

Information supplied is for the use in the operation and/or maintenance of Cee equipment.
Neither this document nor the information it contains shall be disclosed to others for manufacturing or any other purpose without written authorization from, Cost Effective Equipment, LLC.

1.2. Warranty

Cost Effective Equipment, LLC warrants to the original purchaser (Buyer) that equipment is free from defects in material and workmanship under normal use and service in accordance with Cee instructions and specifications. Buyer Shall promptly notify Cee of any claim against this warranty, and any item to be returned to Cee shall be sent with transportation charges prepaid by Buyer, clearly marked with a Return Authorization (RMA) number obtained from Cee Customer Support. Cee's obligation under this warranty is limited to the repair or replacement, at Cee option, of any equipment, component or part which is determined by Cee to be defective in material or workmanship. This obligation shall expire one (1) year after the initial shipment of the equipment from Cee.
This warranty shall be void if:

(a) Any failure is due to the misuse, neglect, improper installation of, or accident to the equipment.
(b) Any major repairs or alterations are made to equipment by anyone other than a duly authorized representative of Cee. Representatives of Buyer will be authorized to make repairs to the equipment without voiding warranty, on completion of the Cee training program.
(c) Replacement parts are used other than those made or recommended by Cee.

CEE MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, WITH RESPECT TO EQUIPMENT. NO WARRANTY IS MADE AS TO THE MERCHANTABILITY OF THE EQUIPMENT NOR ITS FITNESS FOR ANY PARTICULAR PURPOSE. In no event shall Cee be liable for consequential loss or damages, however caused. No person or representative of Cee is authorized to assume for Cee any liability in connection with Equipment nor to make any change to this warranty unless such change or modification is put in writing and approved by an authorized representative of Cee in writing.

This warranty shall be governed by the laws of the state of Missouri U.S.A.

1.3. Returned Materials

Any materials, parts, or equipment returned Cost Effective Equipment, LLC must be clearly labeled with a Return Material Authorization (RMA) number.

To obtain a RMA number, contact:

Cee Customer Support
Telephone: (573) 466-4300
E-Mail: support@costeffectiveequipment.com
Web Address: http://www.costeffectiveequipment.com
Shipping information with RMA number:

Attn: Cee Customer Support
Cost Effective Equipment
3703 HyPoint Blvd
Rolla, Missouri 65401

1.4. Model and Revisions

The model and serial number information for the Cee® Apogee™ are located on the rear panel near the power inlet. Software version information can be found on the About screen. See DataStream™ Manual for screen shots and a detailed explanation of the system software.

1.5. Safety Hazards/Precautions

 Read this manual in its entirety before operating the machine.

1.6. Overview of Equipment-Specific Hazards

The unit is very heavy and proper precautions should be taken when handling the machine to minimize risk of injury. Labels are placed on the machine to identify areas where caution is needed during operation.

1.7. Electrical

 High voltage is present in the machine. Disconnect the power before servicing.

 Stored electrical energy is present in the machine. Before servicing allow sufficient time for discharge. The servo amp has a charge light; do not service the machine until this light has gone out.

1.8. Mechanical

 This machine uses compressed gasses, which can provide motive force for components and can expand violently upon decompression. Disconnect N2 or CDA before removing any panels.

 The machine is capable of very high-speed rotation. Ensure all lids and panels are in place before rotating these devices.

 Ensure that all panels are on and in their correct locations before powering up or operating.

 When opening the lid be aware of the pinch point at the hinge cover. Open the lid only by using the handle on the lid.

 The unit is very heavy and proper precautions should be taken when handling or moving the machine to minimize risk of injury.

1.9. Chemical

 Ensure chemical compatibility of all chemicals and materials being used inside the machine. This includes all wetted parts of the storage, supply, dispense, and waste systems.

 Ensure chemical compatibility of all chemicals with each other. All dispensed materials are held in one common waste storage tank. Check for reactions between chemicals before use.

 Flammable Chemicals. No open flames/sparks.

 Relieve pressure before opening canisters, tanks, cartridges, or syringes to refill.

 Relieve pressure and shut off chemical valves before servicing supply lines, dispense valves or other components.

 Relieve pressure and shut off chemical valves before removing spin lid or changing BSR tubes, EBR tubes, or any other dispense nozzle or spray tip.

 Flush tubing and valves with an appropriate solvent and drain system before servicing. When draining waste tank, use appropriate containers and connection methods.

 Ensure proper ventilation/exhaust is used at all times.

 Always wear the proper Personal Protective Equipment for the job. This includes safety glasses, gloves and other equipment as needed to protect from mechanical and chemical hazards.

1.10. Lockout/Tagout Procedures and Information

Before servicing, turn off the machine and remove the power inlet cord by disconnecting the plug where it enters the machine.

1.11. Intended Use of Machine

The Cee® Apogee™ 450 Spin Coater is intended for use as a Semiconductor/Optical application spin coating machine. It is primarily intended for substrates up to the maximum size.

The Cee® Apogee™ 450 Spin Coater is not intended for use in food or medical applications or for use in hazardous locations.

The Cee® Apogee™ 450 Spin Coater is intended for use only by properly trained personnel wearing the proper personal protective equipment. Anyone not trained in the proper use of the Apogee™ 450 Spin Coater and have not fully read this manual should not operate the equipment.

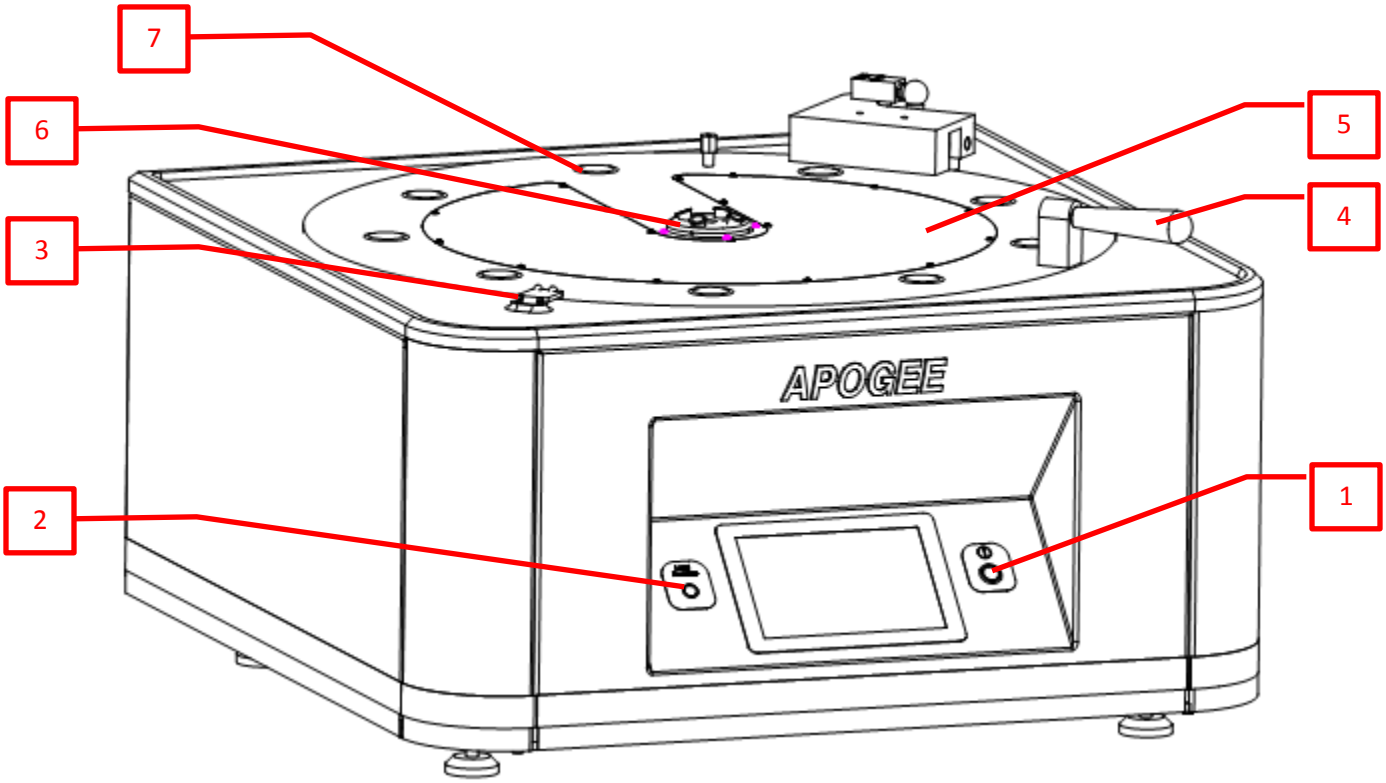
The Cee® Apogee™ 450 Spin Coater is intended for use in a cleanroom environment to provide the proper processing conditions for the substrates. If it is used outside of a cleanroom environment, the substrate cleanliness may be compromised.

The Cee® Apogee™ 450 Spin Coater is not intended for use in a hazardous or explosive environment.

2. Equipment Description

The Cee® Apogee™ 450 spin coater delivers track-quality performance with revolutionary interface capabilities and the utmost in chemical compatibility in an efficient, space-saving design. The heavy-duty-drive spin coater combines extremely accurate spin speed control and a high torque drive for aggressive acceleration of 300-mm and larger LCD squares up to 14” × 14”.

Fully programmable and user-friendly, the Cee® Apogee™ 450 Spin Coater features the accuracy and repeatability needed to eliminate processing variability from critical experiments. With its convenient compact footprint, wide array of chemical compatibility, and durability, this easy-to-use benchtop system will provide years of high-performance operation, making the Cee® Apogee™ 450 Spin Coater purchase a smart and cost-effective decision.



1. **Power Button –** Used to turn on and off the tool
2. **User Presence Button –** Used for remote access (see DataStream™ Manual)
3. **Lid Sensor and Latch –** Detects when the lid is closed and locks
4. **Lid Handle –** Used to open and close the lid
5. **Spin Coater Lid –** Cover for the spin bowl
6. **5 - Hole Dispense Hub –** Used to dispense material through
7. **Lid Plugs (x9) –** Used to adjust airflow and solvent vapor in the spin bowl

2.1. Dimensions

- 27-5/8” (70.2cm) W × 30-3/4” (78.2cm) D × 15-1/2” (39.4cm) H*
- Machine weight: 115 lb (52.2 kg)
- Shipping weight: 250 lb (113.4 kg)

*H is with lid closed. With lid open H is 30-1/4” (76.9cm)

2.2. Programmability

- Touch screen interface and display
- Full-color alphanumeric-capable graphical user interface (GUI)
- A virtually unlimited number of user-defined recipe program steps
- 0.1-second resolution for step times (9,999.9 seconds maximum step time)
- Spin speed: 6,000 rpm
- Spin speed acceleration:
  - 0 to 30,000 rpm/s unloaded
  - 0 to 23,000 rpm/s with a typical 300-mm silicon wafer
  - 0 to 3,000 rpm/s with a 350mm x 6mm round recessed spin chuck
  - 0 to 400 rpm/s with a 14” × 14” × 1.1 mm photomask in a recessed chuck
- Connectivity: USB/Ethernet port for communications for uploading/downloading process parameters with DataStream™ technology
- Simultaneous, automated, multi-dispense capability

2.3. Precision

- Spin speed repeatability: < 0.2 rpm
- Spin speed resolution: < 0.2 rpm
- Substrate sizes: < 1 cm to 450 mm round; 14” x 14” square

2.4. Reliability

- Indirect drive system protects the spin motor from contact with process chemicals and solvents
- Vacuum and lid interlock
- Industry-leading reliability and uptime
- 1-year full warranty on parts and labor
- Free remote technical support (phone, email) for the life of the product
- Application process assistance for life of the product

2.5. Bowl Design

- High-density polyethylene (HDPE) spin bowl for material compatibility
- Versatile lid design allows process flexibility and repeatability
- Optional nitrogen purge for an inert spin environment
- Integrated drain and exhaust ports

2.6. Utilities

- Voltage ranges: 208-240 VAC, Single Phase, 50/60 Hz
- Power requirements: 1440 watts (6A)
- Drain port: 3/4” OD
- Exhaust port: 1.5” OD, 20 to 50 cfm at 0.2” water (0.6-1.4 cubic meter/min)
- Vacuum: > 20” Hg (< 33 kPa abs)
- Nitrogen or CDA (for automated dispense): 70 psi (482 kPa)

3. Installation

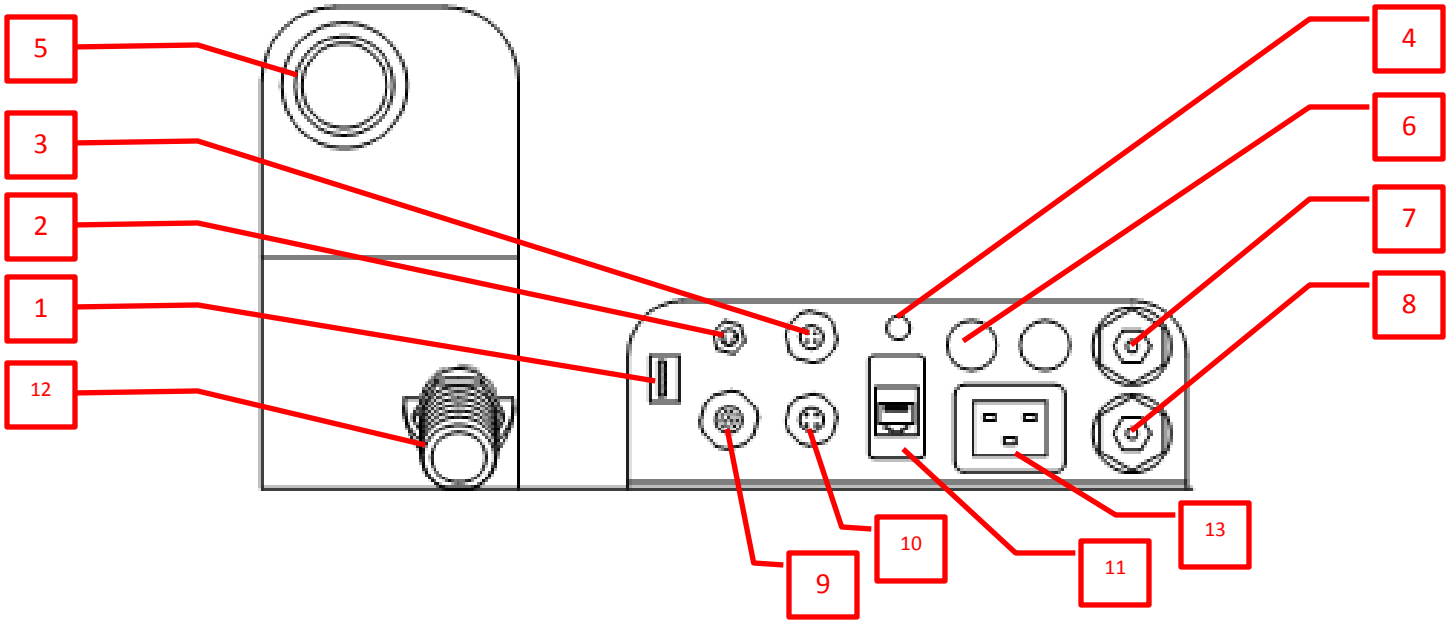
3.1. Floor Space Requirements

The Apogee™ 450 Spin Coater is a bench top unit and requires a table or bench top for location. In most cases the supporting structure will be larger than the unit itself. The recommended freestanding space requirements are: 12" (30.5cm) back to front and 3" (7.5cm) side to side.

Dimensions: 27-5/8” (70.2cm) W × 30-3/4” (78.2cm) D × 30-1/4” (30.48cm) H
Weight: 115 lbs (52.2 kg)

3.2. Facilities Requirements

The Apogee™ 450 Spin Coater requires the following utilities for operation. Locations for connections are shown in the figure below.



1. **USB Port** – Used to update the software or download log files (see DataStream™ Manual)
2. **Programmable Exhaust (Optional)** – Communication port for optional Programable Exhaust module
3. **Light Tree (Optional)** – Port for optional light tree
4. **Backside Rinse (BSR) (Optional)** – Fitting for dispense material for optional Backside Rinse
5. **Spin Bowl Exhaust Port** – Exhaust port for spin bowl vapors. Port is 1-1/2 Inch OD and 20-50 CFM of exhaust is recommended (0.6-1.4 cubic meter/min)
6. **Fuses** – System protection fuses
7. **System Nitrogen or CDA** – System nitrogen or CDA for lid latch. Recommended nitrogen/CDA Supply is 70 psi (482 kPa). Port is ¼" barb fitting in ¼" NPT fitting
8. **System Vacuum** – System vacuum for vacuum chuck. Recommended vacuum Supply is 20 in Hg (<33 kPa abs) at a flow of 5 l/min. Port is ¼" barb fitting in ¼" NPT fitting
9. **Dispense Trigger** – This port us used to connect to the optional dispense control box. This is used when using automated dispenses
10. **Temp/Humidity Sensor and Accessory Port** – This is used to talked to external I/O device to support extra outputs and inputs.
11. **Ethernet** – The ethernet can be used for remote recipe writing and remote control (see DataStream™ Manual)
12. **Spin Bowl Drain** – The port that removes the liquid waste from the machine. The port is ¾" OD.
13. **AC Power In** – Cord is Provided. Single Phase 208-240C A/C, 6A

3.3. Environment

The Apogee™ 450 Spin Coater should be operated in a clean, low humidity environment.

3.4. Unpacking/Inspection

Thoroughly check machine for shipping damage. If physical damage is seen, **DO NOT APPLY POWER!** Contact Cee™ immediately.

The following items should be included with the shipment.

(1) Apogee™ 450 Spin Coater
(1) Temperature and Humidity Sensor
(1) Power Cord with female power connector
(1) User & Installation Manual – USB Drive

Optionally included items:

Spin Chucks with Screws
Dispense Controllers
Dispense Valves
Dispense Nozzles
Dispense Hubs

3.5. System Installation and Setup

1. Lift the unit out of the packing crate by grasping the bottom only. **Do not** lift the by any of the top covers or protrusions. **Do not** roll or turn the unit on its side or ends.
2. Remove plastic wrap and packing foam.
3. Place Cee® Apogee™ 450 Spin Coater on a table of proper height and strength so that the controls and spin chuck are at the proper ergonomic height.
4. Level the machine using the feet so that the spin chuck is level front-to-back and side-to-side.
5. Thoroughly clean the spin bowl and spin chuck.
6. Connect utilities to the reference diagram in Section 3.2
   (1) Connect the temperature/humidity sensor to the CAN terminal (#10).
   (2) Connect the vacuum supply to the vacuum fitting (#8)
   (3) Connect the nitrogen/CDA supply to the vacuum fitting (#7)
   (4) Connect the drain to the drain port (#12)
   (5) Connect the exhaust lines to the exhaust port (#5)
   (6) Connect the optional dispense box is equipped to the dispense triggers (#9)
   (7) Connect the optional programmable exhaust if equipped to the programmable exhaust terminal (#10)
7. Connect optional dispenses as indicated on the diagrams located on the USB.
8. Plug in the machine.
9. Once plugged in, only the cooling fan should be powered, not the display.

3.6. Start Up

***For detailed software information, please refer to the DataStream™ manual**

1. Install the tool as shown earlier in Section 3.5.
2. Press the lighted power switch to turn the tool power on.
3. The display should momentarily show boot screen and then show main screen.
4. Enter the username and password.
    (1) The default username and password are “admin” and “admin2” respectively.
5. The tool will login and display the Process page.
6. Navigate to Tools- Manual Control to run system checks to ensure the tool is working properly. Use the system values located on the left side of the screen to verify measurements.
    (1) Turn vacuum on using a value of 64 kPa. Use your gloved hand to ensure vacuum is coming through the hole of the shaft.
    (2) Turn vacuum and off and check that the vacuum is turned off at the hole of the shaft.
    (3) Close the lid and set the spin speed to 1000 rpm. Make sure that the shaft spins and that the tool is reading 1000 rpm.
    (4) Raise the lid to check the lid interlock. Lid should be locked and not able to open.
    (5) Ensure that the temperature/humidity sensor is reading on the parameter list.
    (6) If equipped with optional dispenses, ensure that dispenses are triggering.
    (7) If equipped with an optional programmable exhaust, ensure it is working properly.
7. Check that the spin chuck(s) with the tool work properly.
    (1) The spin chucks have a slot that mates with the pin of the spin shaft.
    (2) Position the spin chuck so the slot and the pin line up and press onto the shaft by hand.
    (3) Ensure that the pin fully engages the slot.
    (4) If equipped with a screw, insert screw and tighten.
    (5) Test vacuum of the spin chuck with a substrate using manual control. Set the vacuum threshold to 64 kPa and turn vacuum on. Use the system values located on the left side of the screen to verify measurements. If vacuum is less than 64 kPa, the chuck passes inspection. ***Note: values less than 64kPa indicate better vacuum which is acceptable.***
    (6) Turn vacuum off and remove the substrate.
    (7) Removal of spin chuck is reverse of installation.
8. If the tool passes these checks, the tool is ready to operate. Begin by creating a recipe.

4. Spin Coater Use and Operation

4.1. Spin Chuck

1. Locate Spin Chuck Screw (Located in the center of Vacuum chuck).
2. Use a hex key wrench and remove the spin chuck screw from the spindle.
3. Grasp the spin chuck and pull up and remove vertically.
4. Place new spin chucks in the same orientation as old and ensure that the spindle key aligns with chuck slot.
5. Use a hex key wrench to secure spin chuck screw in the center of new chuck.

4.2. 5- Hole Dispense Nozzle Hub

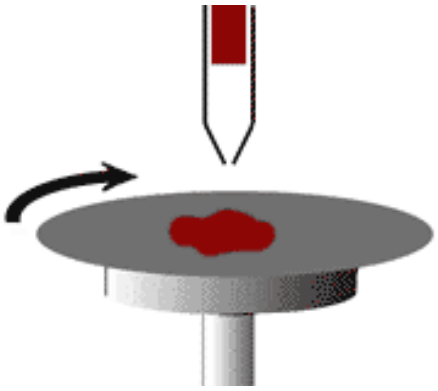
All Cee® 450 Spin Coaters utilize a standard multi-nozzle dispense center hub. This design allows up to five (center-positioned) dispense nozzles to be mounted into the lid simultaneously and triggered independently in any sequence or combination. The auto-dispense nozzles are all angled to the center of the wafer and utilize precision suck-back control. Additionally, each nozzle features a female luer adapter that houses a disposable tip to be placed at the point of use. This tip can easily be changed to clear any dried material residue and/or manipulate the volume of the dispense flow.

4.3. Air Flow Adjustment

The Apogee™ 450 spin coater is furnished with 9 holes along the perimeter of the lid. This allows the operator to regulate the exhaust flow through the bowl region. Removal of the plugs can be a variable in optimizing coating results. Results vary depending on coating materials.

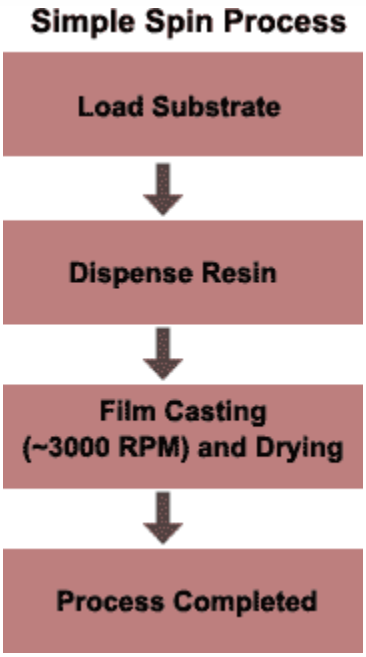
5. Spin Coater Theory

Spin coating has been used for several decades as a method for applying thin films. A typical process involves depositing a small puddle of a fluid material onto the center of a substrate and then spinning the substrate at high speed. Centripetal acceleration will cause the resin to spread across the substrate, leaving a thin film of material. Final film thickness will depend on the fluid material properties (viscosity, drying rate, percent solids, surface tension, etc.) and the spin process parameters (rotation speed, acceleration, and fume exhaust). One of the most important factors in spin coating is repeatability, as subtle variations in the parameters that define a spin-coating process can result in drastic variations in the coated film



5.1. Spin Coating Process Description

A typical spin process consists of a dispense step in which the resin fluid is deposited onto the substrate surface, a high speed spin step to thin the fluid, and a drying step to eliminate excess solvents from the resulting film. Two common methods of dispense are Static dispense, and Dynamic dispense.



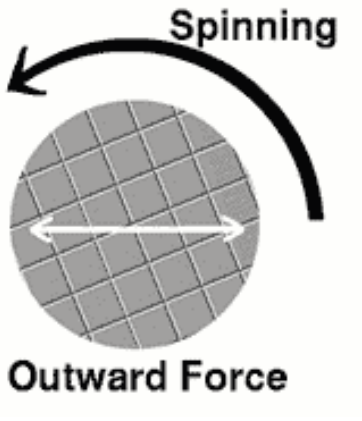
Static dispense is simply depositing a small puddle of fluid on or near the center of the substrate. This can range from 1 to 10 cc depending on the viscosity of the fluid and the size of the substrate to be coated. Higher viscosity and or larger substrates typically require a larger puddle to ensure full coverage of the substrate during the high speed spin step. Dynamic dispense is the process of dispensing while the substrate is turning at low speed. A speed of about 500 rpm is commonly used during this step of the process. This serves to spread the fluid over the substrate and can result in less waste of resin material since it is usually not necessary to deposit as much to wet the entire surface of the substrate. This is a particularly advantageous method when the fluid or substrate itself has poor wetting abilities and can eliminate voids that may otherwise form.

After the dispense step it is common to accelerate to a relatively high speed to thin the fluid to near its final desired thickness. Typical spin speeds for this step range from 1500-6000 rpm, depending on the properties of the fluid as well as the substrate. This step can take from 10 seconds to several minutes. The combination of spin speed and time selected for this step will generally define the final film thickness. In general, higher spin speeds and longer spin times create thinner films.

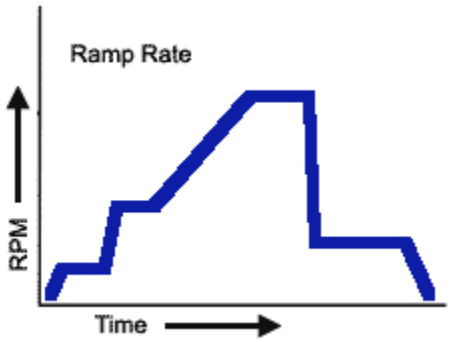
A separate drying step is sometimes added after the high speed spin step to further dry the film without substantially thinning it. This can be advantageous for thick films since long drying times may be necessary to increase the physical stability of the film before handling. Without the drying step problems can occur during handling, such as pouring off the side of the substrate when removing it from the spin bowl. A moderate spin speed will aid in drying the film without significantly changing the film thickness.

5.2. Spin Speed

Spin speed is one of the most important factors in spin coating. The speed (rpm) affects the degree of centrifugal force applied to the resin and the turbulence of the air immediately above it. Relatively minor speed variations at this stage can result in large thickness changes. Film thickness is largely a balance between the force applied to shear the fluid resin towards the edge of the substrate and the drying rate of the resin. As the resin dries, the viscosity increases until the radial force of the spin process can no longer move the resin over the surface. At this point, the film thickness will not decrease significantly with increased spin time. All Cee® spin coating systems are specified to be repeatable to within ±0.2 rpm at all speeds.



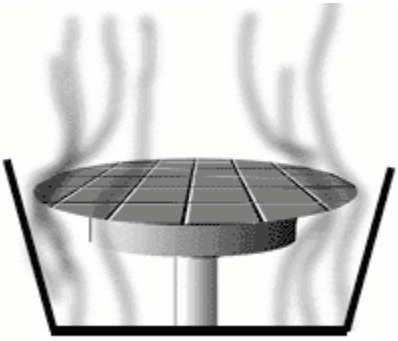
5.3. Acceleration



In addition to spin speed, acceleration can also affect the coated film properties. Since the resin begins to dry during the first part of the spin cycle, it is important to accurately control acceleration. In some processes, 50% of the solvents in the resin will be lost to evaporation in the first few seconds of the process.

Acceleration also plays a large role in the coat properties of patterned substrates. In many cases the substrate will retain topographical features from previous processes; it is therefore important to uniformly coat the resin over and through these features. While the spin process in general provides a radial (outward) force to the resin, the acceleration aids in the dispersal of the resin around topography that might otherwise shadow portions of the substrate from the fluid. Cee® spinners is programmable with a maximum acceleration of 30,000 rpm/second (unloaded).

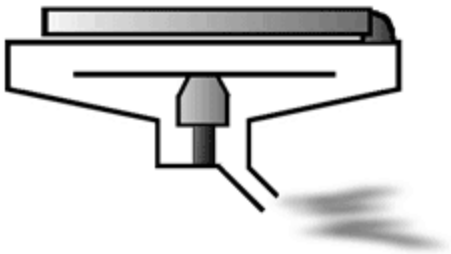
5.4. Fume Exhaust



The drying rate of the resin is defined by the properties of the fluid, as well as by the air surrounding the substrate during the spin process. It is well known that such factors as air temperature and humidity play a large role in determining coated film properties. It is also very important that the airflow and associated turbulence above the substrate itself be minimized, or at least held constant, during the spin process.

All Cee® spin coaters employ a “closed bowl” design. While not actually an airtight environment, the exhaust lid allows only minimal exhaust during the spin process. Combined with the bottom exhaust port located beneath the spin chuck, the exhaust lid becomes part of a system to minimize unwanted random turbulence.

The distinct advantage to this system is slow drying of the fluid resin. The slower rate of drying offers the advantage of increased film thickness uniformity across the substrates. The fluid dries out as it moves toward the edge of the substrate during the spin process. This can lead to radial thickness non-uniformities since the fluid viscosity changes with distance from the center of the substrate. By slowing the rate of drying, it is possible for the viscosity to remain more constant across the substrate.

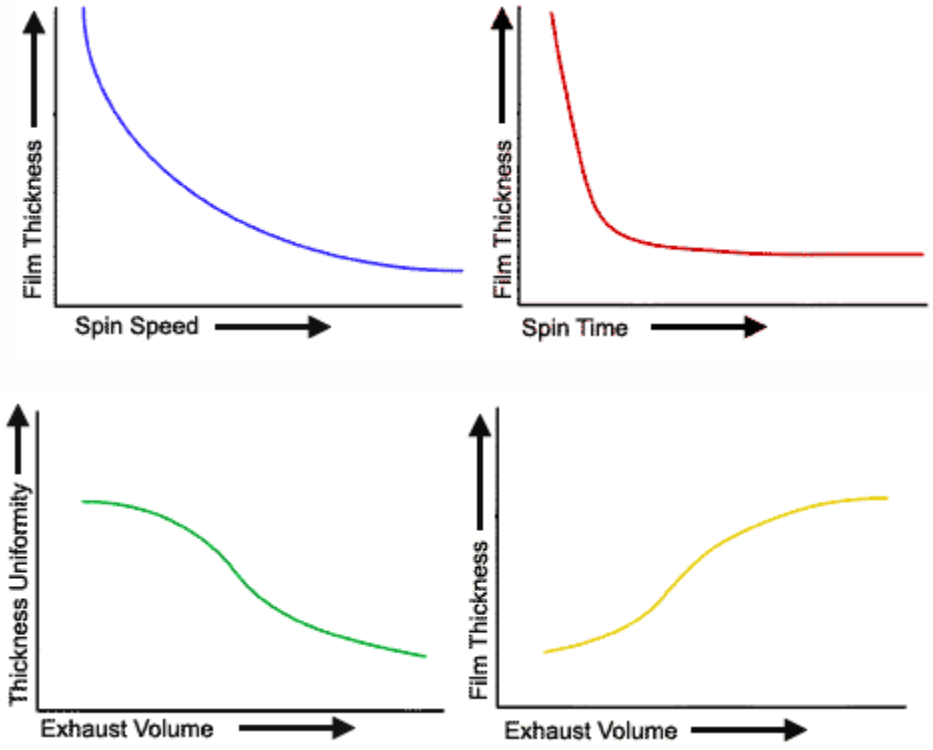


Drying rate and hence final film thickness is also affected by ambient humidity. Variations of only a few percent relative humidity can result in large changes in film thickness. By spinning in a closed bowl the vapors of the solvents in the resin itself are retained in the bowl environment and tend to overshadow the effects of minor humidity variations. At the end of the spin process, when the lid is lifted to remove the substrate, full exhaust is maintained to contain and remove solvent vapors.

Another advantage to this “closed bowl” design is the reduced susceptibility to variations in air flow around the spinning substrate. In a typical clean room, for instance, there is a constant downward flow of air at about 100 feet per minute (30m/min). Various factors affect the local properties of this air flow. Turbulence and eddy currents are common results of this high degree of air flow. Minor changes in the nature of the environment can create drastic alteration in the downward flow of air. By closing the bowl with a smooth lid surface, variations and turbulence caused by the presence of operators and other equipment are eliminated from the spin process.

5.5. Process Trend Charts

These charts represent general trends for the various process parameters. For most resin materials, the final film thickness will be inversely proportional to the spin speed and spin time. Final thickness will also be somewhat proportional to the exhaust volume although uniformity will suffer if the exhaust flow is too high since turbulence will cause non-uniform drying of the film during the spin process.



5.6. Spin-Coating Process Troubleshooting

As explained previously, there are several major factors affecting the coating process. Among these are spin speed, acceleration, spin time and exhaust. Process parameters vary greatly for different resin materials and substrates so there are no fixed rules for spin coat processing, only general guidelines. Following is a list of issues to consider for specific process problems.

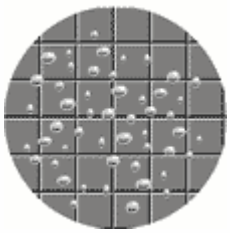
Film too thin

Spin speed too high	Select lower speed
Spin time too long	Decrease time during high speed step
Inappropriate choice of resin material	Contact resin manufacturer

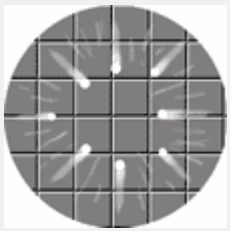
Film too thick

Spin speed too low	Select higher speed
Spin time too short	Increase time during high speed step
Exhaust volume too high	Adjust exhaust lid or house exhaust damper
Inappropriate choice of resin material	Contact resin manufacturer

Air bubbles on wafer surface
Air bubbles in dispensed fluid (resin)
Dispense tip is cut unevenly or has burrs or defects

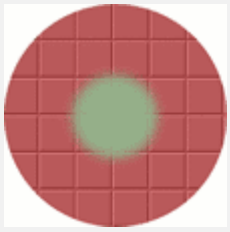


Comets, streaks, or flares
Fluid velocity (dispense rate) is too high
Spin bowl exhaust rate is too high
Resist sits on wafer too long prior to spin
Spin speed and acceleration setting is too high
Particles exist on substrate surface prior to dispense
Fluid is not being dispensed at the center of the substrate surface

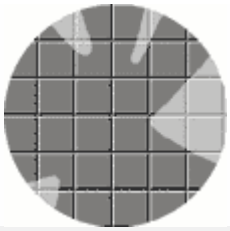


Swirl pattern
Spin bowl exhaust rate is too high
Fluid is striking substrate surface off center
Spin speed and acceleration setting is too high
Spin time too short

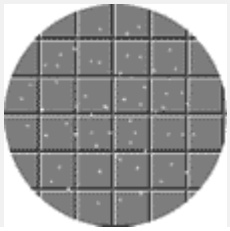
Center circle (chuck mark)
If the circle is the same size as the spin chuck, switch to a Delrin spin chuck



Uncoated areas
Insufficient dispense volume



Pinholes
Air bubbles
Particles in fluid
Particles exist on substrate surface prior to dispense



Poor reproducibility

Variable exhaust or ambient conditions	Adjust exhaust lid to fully closed
Substrate not centered properly	Center substrate before operation
Insufficient dispense volume	Increase dispense volume
Inappropriate application of resin material	Contact resin manufacturer
Unstable balance in speed / time parameters	Increase speed / decrease time or vice versa

Poor film quality

Exhaust volume too high	Adjust exhaust lid or house exhaust damper
Acceleration too high	Select lower acceleration
Unstable balance in speed / time parameters	Increase speed / decrease time or vice versa
Insufficient dispense volume	Increase dispense volume
Inappropriate application of resin material	Contact resin manufacturer

6. Preventative Maintenance

This maintenance manual provides personnel with procedure and guidelines for maintaining a Cee® Apogee™ 450 Spin Coater. Below is a chart of recommend maintenance scheduling.

Maintenance Section	Maintenance Schedule
Safety Checks	Before daily tool use
Cleaning	After daily tool use
Mechanical Checklist	See Section 5.2 for Details
Utility Checks	See Section 5.3 For Details

6.1. Safety Checks

Inspect spin coater lid for the following defects:

(a) Loose assemblies
(b) Improper closure
(c) Improper bowl ring placement

6.2. Mechanical Checklist

1. **Spin chuck cleanliness:** If any material has built up on the spin chuck, it can be wiped clean with most organic solvents isopropyl alcohol, or acetone. For major buildup of material, a glass slide can be used to gently scrap the material away. Follow by wiping clean. A dirty spin chuck could cause vacuum errors. See section 2.1 on detailed cleaning instructions. **Daily**
2. **Spin chuck flatness:** This can be seen visually with a straight edge. Small uniformity issues such as a burr can be gently removed with a razor blade or a glass slide. Larger deformations such as a damaged area from dropping can be removed with fine sandpaper. A non-uniform spin chuck can cause vacuum errors. **Quarterly**
3. **Bearing wear:** Rotate the spindle shaft by hand. The shaft should easily spin with little noise. If not bearing should be replaced. If grinding noise is heard during a process, bearing should be replaced. Bad bearings can cause erratic spin speed and acceleration. **Quarterly**
4. **Vacuum liquid trap:** There should be no material in the vacuum trap. Material in the vacuum trap will cause vacuum issues. **Quarterly**
5. **Axial spindle shaft play:** There should be no axial play in the shaft. Axial play will cause excess bearing wear and possible vacuum error. **Bi-annually**

6.3. Utility Checks

1. Check all pressures for ranges specified in tool manual. **Daily**
2. Verify that there is a proper drain facility. **Daily**
3. Verify that the exhaust is functioning. **Daily**
4. Inspect all connections for proper installation. **Bi-Annually**
5. Verify that the AC power is of the proper voltage, and is connected. **Bi-Annually**

6.4. Cleaning

For cleaning, it is good practice to use the mildest solvent possible. The machine cabinet may be cleaned using most organic solvents, acetone, isopropyl alcohol, or N-methylpyrrolidinone (NMP). Caustic acids or bases should not be used. The spin bowl lid may be cleaned with isopropyl alcohol, acetone, or water based cleaners.

Keep solvent from getting into the vacuum system. When cleaning the spin bowl, a small substrate should be on the spin chuck to keep solvent from getting into the vacuum system. Spin the wafer at approximately 100 RPM, and use solvent in a wash bottle to flush out the spin bowl. Keep solvent from going down the spin shaft or the spin shaft tube. Shields and seals will protect the bearings from a small amount of solvent, but they will not be able to handle large doses. Do not direct the solvent stream down the shaft or tube.

Use only water-based cleaner on the labels on the rear of the machine. Use only isopropyl or water based cleaner on the "power on-off", Cee® logo, the yellow "Caution ... Eye Protection", and the "Cee® model/serial number" labels. The display may be cleaned with glass cleaner, water, or isopropyl alcohol.