

Operating Instructions

Disco Automatic Grinder DAG810



University of Notre Dame
Department of Electrical Engineering

General Precautions

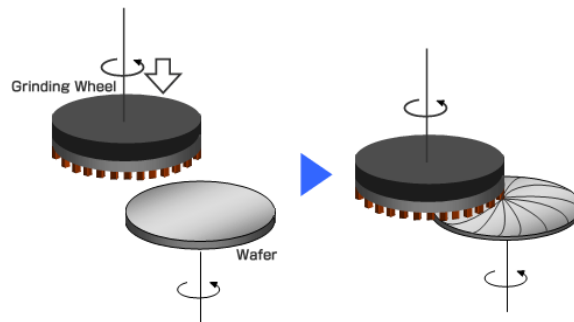
Contacts

For problems, clarifications of procedures, or general information pertaining to this machine, please contact lab staff at staff-ndnf-list@nd.edu

Grinding mechanism

The Disco Automatic Grinder (DAG810) performs back-side grinding on silicon and other semiconductor substrates. It can handle small pieces up to 8" inch wafers (please also check the iLab page of this tool for information on allowed, prohibited materials).

The workpieces are clamped to a rotating chuck table, across the center of which a rotating diamond wheel sweeps. The spindle carrying the wheel moves downward to remove the material from the surface of the workpieces. Water is used to cool the workpieces and to clear particles and mud generated during grinding.



The thickness reduction is accomplished in 3 different phases (from faster to slower grinding) to ensure low-load grinding. This is done by decreasing the feed speed ($\mu\text{m/s}$) of the grinding wheel as finishing thickness is closed.

Installation of the correct wheel **by staff only!**

1. Refer to iLab calendar of this machine to see which wheel is currently installed and other available wheels, and recommended grinding rate should be followed or talk to staff first before changing from the recommendation.
2. If you need another wheel to be installed, contact Fei Cheng for help. A user is NOT allowed exchange the wheel!

Turn ON the machine power

1. Turn the key clockwise as far as it goes and leave the key there.
2. The machine power turns ON and the POWER lamp on the left of the switch lights in green.
3. The **Recipe** screen appears on the monitor in about 20s.

The screenshot displays the 'Recipe' screen of a machine. At the top, there is a status bar with the date and time '02/06/14 14:19', the mode 'Auto', and an 'Alarm/Clr' button. The main area is titled 'Recipe' and contains several input fields for grinding parameters. The parameters are organized into rows: 'No.' (1), 'Comnt' (IF-01-1-40/60-V), 'Work Size' (8 inch), and 'Status' (a dropdown menu). Below these are 'Original Thick.' (725 um) and 'Finish Thick.' (500 um). The next row includes 'Air Cut' (50 um) and 'Spindle Rpm' (4800 rpm). The following three rows are for different cutting stages: 'P1 Cut' (210 um, 5.00 um/s, 200 rpm), 'P2 Cut' (15 um, 3.00 um/s, 100 rpm), and 'P3 Cut' (0 um, 3.00 um/s, 100 rpm). The 'Spark Out' section shows '1 rev.', '100 rpm', and 'Gauge' (Pass). The 'Escape Cut' row has '3 um', '3.00 um/s', and '100 rpm'. The 'Height Adjust' row shows '0.0 um' and 'Grind Time' (58 sec). On the right side of the screen, there are several buttons: 'List', 'Param. Reset', 'Save', and 'Cancel'. At the bottom, there is a row of icons for 'Auto', 'Maint.', 'Data', 'Initial', 'Warm-Up', 'Gauge Zero-Point', and 'Work-Set'.

Parameter	Value
No.	1
Comnt	IF-01-1-40/60-V
Work Size	8 inch
Status	[Dropdown]
Original Thick.	725 um
Finish Thick.	500 um
Air Cut	50 um
Spindle Rpm	4800 rpm
P1 Cut	210 um
P1 Speed	5.00 um/s
P1 Rpm	200 rpm
P2 Cut	15 um
P2 Speed	3.00 um/s
P2 Rpm	100 rpm
P3 Cut	0 um
P3 Speed	3.00 um/s
P3 Rpm	100 rpm
Spark Out	1 rev.
Spark Out Rpm	100 rpm
Gauge	Pass
Escape Cut	3 um
Escape Speed	3.00 um/s
Escape Rpm	100 rpm
Height Adjust	0.0 um
Grind Time	58 sec

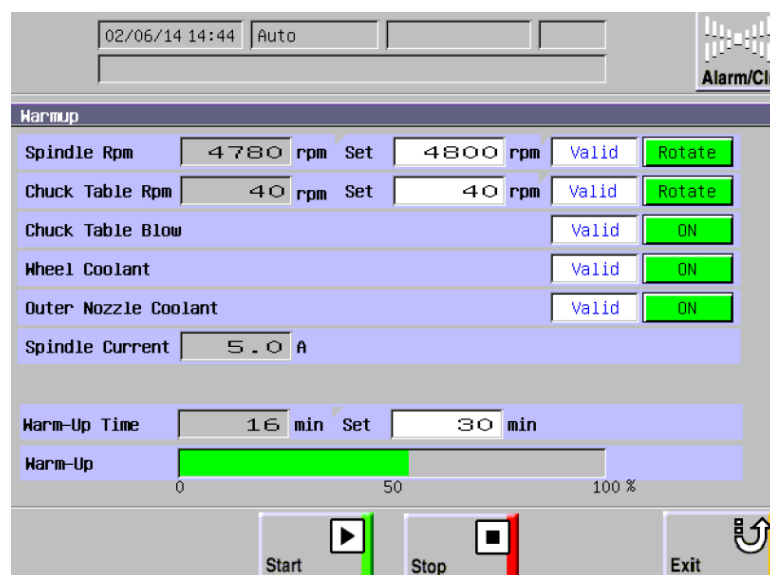
4. If nothing appears on the monitor screen after 20s please contact Fei Cheng as early as you can.

Initialization

1. The initialization process **must always** be executed before starting auto operation. The movable components of the machine will be returned to their respective origins.
2. Hit the **Initial** button from the touch screen.
3. Hit the **Start** button to start the process. Wait until all Chuck table, Z-axis and Y-axis finish the process and you will see **Completed** (green color background) displayed for all three items.
4. Hit **Exit** to return to the recipe screen.
5. If you observe any error happen during the process, stop and contact Fei Cheng as early as you can.

Warm up

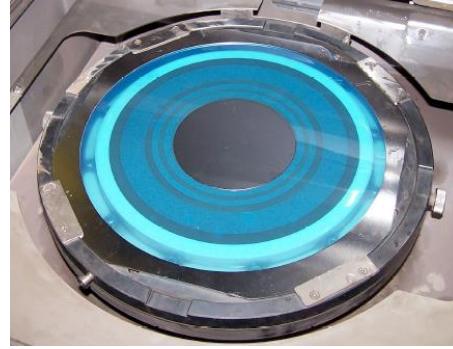
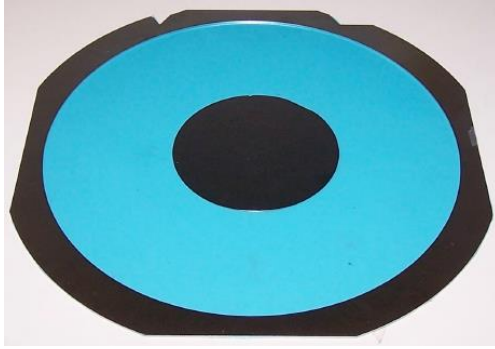
1. Hit the **Warm-Up** button from the screen.
2. Make sure the operation cover is closed. But also check there is nothing left on the chuck table before you close the cover.
3. Hit **Start** button and wait until the warm-up scale bar reaches 100%. Make sure to warm up the machine for at least **30 minutes!!**



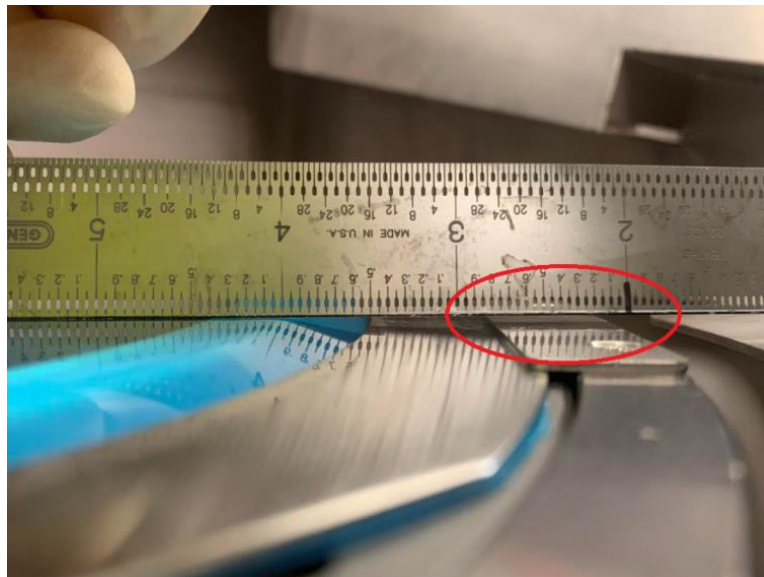
4. Hit **Exit** to return to the recipe screen. The machine startup procedures now complete.

Set up the workpiece

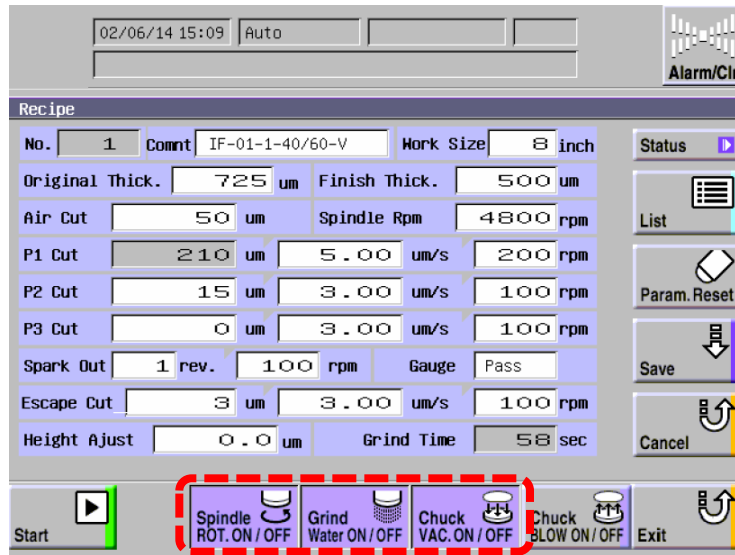
1. After the warmup process, click on **Work-Set** button to bring the chuck table back to loading position from the grinding position.
2. Verify the wafer size (inch). **When a tape is used, use 8 inch!!**
 - a. If UV-release tape (preferred by most users over thermal release tape) is needed, contact Fei Cheng for training on the UV exposure box (set in SR-132). Always store the tape in dark area wrapped.
 - b. You can stop by SR-132 to cut UV-release tape first and take it to 10k space for using the tool or take the whole roll with you BUT you have to bring it back to SR-132 after grinding session because dicing saw has more users who use this tape.
 - c. Additional charge has to be added in iLab if you use the lab supplied UV-release tape!!
3. Measure the original wafer thickness by using the thickness measurement tool set on the wire rack behind the machine.
4. Determine the finished wafer thickness.
5. Hit the **List** button from the recipe screen, and select the one you need (recipe number in blue), hit **Select** and then **Exit**.
6. Check to make sure the work size / Original Thick. / Finish Thick. shown in the boxes agree with those confirmed in step 1-3. Make changes as needed. **Note both original and final Thick. = wafer + tape (60 μ m for UV-release tape)!**
7. Follow the procedure on “**Mounting samples on adhesive film**” at the end of this manual (from page 12) to install your wafer on the tape / 12”ring (left), and also install them correctly on the chuck table (right). **DO NOT hesitate to ask for help if you are not sure if everything is set up correctly! This is very important to your safety and the tool safety!**



8. Ensure that the clamping ring and mounting ring are both below the chuck table grinding surface. To confirm it you may set the 6" ruler flat edge on the tape and check at **all 4 locations!!!** the gap between the ruler edge and the metal piece on the mounting ring. **DO NOT PROCEED until you do confirm this.**

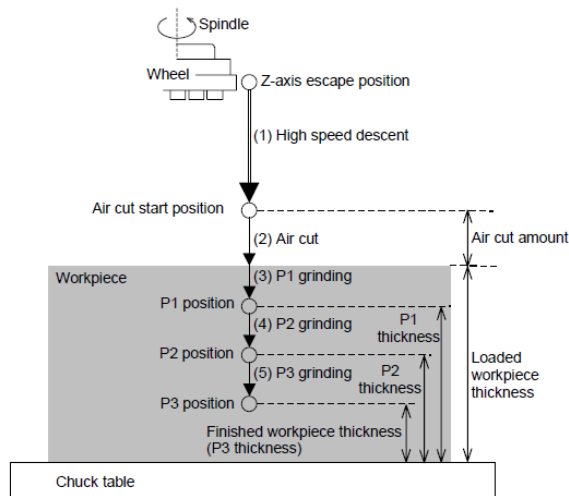


9. Verify that the wafer to be grinded is correctly positioned on the chuck table, then close the cover.
10. Check to make sure that **Spindle ROT. ON / OFF**, **Grind**, **Water ON / OFF** and **Chuck VAC. ON / OFF** buttons are all turned on (down and lit in a single color):



11. Check all paras in the recipe are correct, and then hit the **Start** button.
 - a. You can find the suggested feed rate for each cut step from the machine calendar for the wheel currently installed.
 - b. For 2000 grit wheel, the recommended feed rates are: P1 cut = 0.25 $\mu\text{m}/\text{sec}$, P2 cut = 0.12 $\mu\text{m}/\text{sec}$, P3 cut = 0.05 $\mu\text{m}/\text{sec}$
 - c. For other wheels, these rates can vary quite a lot!
12. The auto operation starts. The status is displayed on the <Machine Monitor> screen. The green light of the status indicator flashes while auto operation is under way.

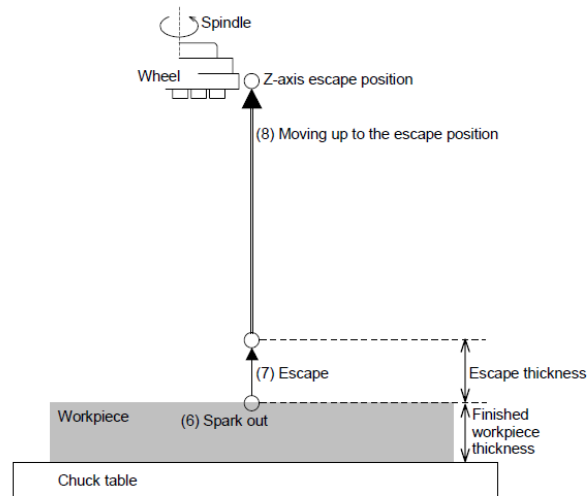




Sequence	Action
(1) High speed descent	The Z-axis moves down in high speed from the escape position to the air cut start position.
(2) Air cut	The Z-axis descent speed changes from high to low (P1 Cut (Z-axis feed rate)) from a point of "Loaded workpiece thickness + Air Cut (set up in the grinding recipe used)". →See Section 6-2 [Role of Air Cut] in this section about the details of air cut.
(3) P1 grinding	The Z-axis grinds the loaded workpiece down to P1 position at the speed of "P1 Cut (Z-axis feed rate)" (set up in the grinding recipe used).
(4) P2 grinding	The Z-axis grinds the loaded workpiece down to P2 position at the speed of "P2 Cut (Z-axis feed rate)" (set up in the grinding recipe used).
(5) P3 grinding	The Z-axis grinds the loaded workpiece down to P3 position at the speed of "P3 Cut (Z-axis feed rate)" (set up in the grinding recipe used).

Operation sequence (grinding down)

13. During the auto operation process, the user is required to monitor the spindle current closely. You may observe gradually increased current (Peak value recorded in the right box) during the P1 Cut. This is normal but the current should not spike over 10 A quickly. If you saw this situation, please hit the red color **Z-EM** button at the top right to terminate the auto operation process. You may hear the buzzer sounds and get the message "Z-EM key has been pressed". Please contact Fei Cheng for assistance.



Sequence		Action
(6)	Spark out	With the Z-axis position unchanged, the chuck table rotates for the specified number of times to improve the flatness of the ground workpiece surface. The number of chuck table rotations to be made for spark out is set up in the grinding recipe used.
(7)	Escape	When the spark out process finishes, the Z-axis moves up in low speed to a point specified in "Escape Cut" (set up in the grinding recipe used) to avoid making any marks on the ground surface when the wheel tooth leaves the workpiece surface.
(8)	Moving up to the escape position	The Z-axis moves up in high speed to the escape position.

Operation sequence (after wafer grinding)

14. When the auto operation completes, the message “Auto operation completed.” appears and chuck table moves to the workpiece loading/unloading position.
15. Check to make sure the chuck table stops moving completely.
16. Hit the **Alarm/Clr** button from the top right **twice**.
17. Open the operation cover, hit the **Chuck VAC. ON / OFF** button to turn off the chuck table vacuum.
18. Hit the **Chuck BLOW ON / OFF** button to turn on the water flow/air blow. Slowly and carefully remove the clamping ring (release two knurled knobs using the provided plier) and mounting ring. Set your wafers aside. Replace the clamping ring on top of chuck table, and retighten these two knurled knobs (plier may needed).

19. Turn off the chuck table blow by hitting the **Chuck BLOW ON / OFF** button once.
20. Close the operation cover.
21. Hit the **Spindle ROT. ON / OFF** button to stop the spindle rotation.
22. Hit the **Grind Water ON / OFF** button to shut off the spindle coolant water.
23. Turn the POWER key counterclockwise to turn off the machine. The POWER lamp goes OFF.
24. If you are using the blue heat release tape, place the tape/sample on a hotplate set at 120°C for about 1 minutes. The tape should turn a lighter blue tint and samples should lift off the tape easily.
25. If you are using the red UV release tape, bring the mounting ring with your sample on it to the room 132. Set the mounting ring with sample / tape interface facing down to the UV LED array, turn on the N₂ gas flow for 2 minutes, then turn on the UV LED for two minutes with N₂ flow turned on. Shut off both UV LED and N₂ flow after exposure.
26. Measure the finished wafer thicknesses (near both edges and center) to verify the thickness grinded. There might be an offset ~ 10-20 microns, which can be taken into account when you set up the Finish Thick. A good way to have accurate grinding on your formal sample is to verify the offset on a dummy sample first.
27. Set the mounting ring with your sample on the black block and remove your sample from the tape.
28. Remember to bring the mounting ring back to the wire rack of grinder. Clean up the work space around for the next user.
29. Log out the machine from iLab.