GENERAL PROCESS AND OPERATION SPECIFICATION

Disco Dicing Saw Model DAD3241

I. SCOPE

A. The purpose of this document is to describe the basic operating procedure and necessary requirements of the Disco Model DAD3241 Dicing Saw. It will also include instructions on how to mount samples onto tape and metal tape rings using the Wafer Tape Applicator, enables full-depth cuts on samples without damaging the wafer chuck.

II. SAFETY

A. Be sure that you have been trained and signed off on using this tool.

B. Be sure to close both doors to the machine before operating the equipment or activating the saw blade spindle.

C. Be sure to always wear safety glasses when operating this tool.

D. Contact a staff member if you are unsure of the operating procedure for this tool, or if any unknown errors are encountered.

III. APPLICABLE DOCUMENTS, MATERIALS, AND REQUIREMENTS

A. For more information about the operation of this tool refer to the ‘Disco Dicing Saw Operation Manual,’ located both in hardcopy near the Wafer Tape Applicator and online on the AggieFab website.

B. Please contact a staff member for assistance in changing broken or worn saw blades.

IV. OPERATION

A. Preparing and Mounting Samples.

i. Turn on the Wafer Tape Applicator machine and prepare a sample to be diced.

ii. Open the lid of the Applicator, and the metal tape ring should already be placed on the machine’s table.

iii. Place your sample in the middle of the metal tape ring, turn on the vacuum switch on the front console of the machine. If the vacuum does not engage, make sure the pump underneath the table is turned on.

iv. Draw the tape out from the topmost edge of the applicator table. Stick the tape to the bottom most edge of the applicator table.

v. A thin, clear film will be separated from the tape and collected in a roll above the rear of the Applicator. Using the black wheel attached, draw the film away from the sample.

vi. Flatten out the tape using the rubber roller, then close the lid.

vii. To cut the tape away from the main roll, slide the black knob located one of the topmost corners of the table across the top edge. To cut the excess tape away from the sample, push down the black knob on top of the lid and circle the table twice.

viii. Open the lid of the Applicator and peel away the excess tape. Remove the mounted sample by disengaging the vacuum and turning off the Wafer Tape Applicator. See **Figure 1**.

B. Prepare Dicing Saw for Use.

i. Start the iLab session for the Disco Dicing Saw.

ii. Once the display turns on, the Disco saw application should already be running.

iii. Make sure both doors of the tool are closed before pressing ‘System Initial’ (which resets the position of the wafer chuck and dicing blade).

iv. Open the right door of the Dicing Saw and place the mounted sample onto the wafer chuck such that the upraised bars at the top of the chuck align with the divots on the top of the metal wafer tape ring.
v. Press 'C/T Vacuum' to hold the sample in place by engaging the chuck table vacuum.

C. Edit Recipes
i. Enter the 'Device Data' menu (F3) to open the recipes directory, select the recipe you would like to modify, then press 'ENTER'
ii. To create a new recipe, highlight the '12 TRAINING' recipe located in the 'USER_RECIPES' folder. Select 'Copy.' Under the dropdown menu select 'USER_RECIPES,' and in the yellow input box put any numbers. Select this new recipe, and press 'ENTER.' To rename, locate the 'ID' section to change the title.
iii. See **Appendix A** and **Figure 2** for information about the recipe parameters.
iv. Press 'ENTER' to save changes to the recipe.

D. Align Sample for Dicing
i. Navigate to the main menu, then select 'Manual Operation,' (F2) then 'Cutting SemiAuto' (F4)
ii. Select 'Manual Align' (F4) to begin the focusing and alignment process.
iii. Navigate to an identifiable pattern on the sample. Select 'Focus' (F9) then 'Auto Focus.' (F9) The approximate work and tape thickness will be displayed on the right of the screen. Press 'EXIT' when done focusing scope.
iv. Align sample using two parallel points on the sample:
   1. Find a pattern or edge on the sample with which to align the sample. Use the fine adjustment scrolling to aim the crosshairs at this pattern.
   2. Press 'Align θ,' (F6) then find the same pattern or edge (with the same altitude) in another part of the sample.
   3. Press 'Align θ' again once the crosshairs are aimed at that pattern.
   4. The sample should be automatically straightened in preparation for dicing.
v. Place the crosshairs at the location which you would like the first cut to be. Press 'ENTER' when done.
vi. Three methods to dice the sample after this point are outlined below in Sections E, F, G.

E. MULTIPLE CUTS (regular cuts)
i. In the 'Cuts' section of the recipe in the 'Device Data' menu, both channels should be set to 0. (0 = all possible cuts within allowed workspace)
ii. In the Semi-Automatic Cutting menu, make sure 'Cut line' is set to 0.
iii. Choose the direction in which the dicing saw will index:
   1. Align the crosshairs at either the topmost or bottommost edge of the sample.
   2. If at the top of the sample, select 'Front' (F12). Front starts making cuts at the farthest index from observer and moves forwards.
   3. If at the bottom of the sample, select 'Rear' (F6). Rear starts at the closest index to the observer and moves backwards.

iv. Press 'START.'
v. After the first dimension of cuts, dismiss the alarm by pressing 'Alarm/Cir'
vi. Press 'Ch +' to rotate the chuck.
vii. Optionally, align the sample again using the method in **Section D**.
viii. Select either 'Front or 'Rear', then press 'START' to make the second dimension of cuts.

F. INDEX CUTTING (irregular cuts)

i. In the 'Semi-Automatic Cutting' menu, make sure 'Cut line' is set to 1. This means a single cut will be made by the tool.
ii. Use the scrolling functions of the scope display to align the crosshairs at the cut you would like to make.
iii. Select either 'Front' (F12) or 'Rear' (F6), then press 'START.'

G. PARTIAL DEPTH DICING

i. Edit the recipe so that the 'Blade height' exceeds 0.090 mm, or the thickness of the tape.
ii. After alignment (see **Section D**), in the Semi-Automatic Cutting menu, select either 'Front' or 'Rear' and then press 'START.'
iii. Cuts can be made using the methods of both **Sections E** and **F**.

H. DICING HARDER SAMPLES (FOR SAPPHIRE AND GLASS)

i. Contact staff regarding making a blade change. Sapphire samples must use KR15 blades, glass samples may use R07 blades, and silicon samples use Z09 blades.
ii. When creating a new recipe, use the recipe 'SAPPHIRE_GLASS_TEMPLATE,' located in the 'Device Data' menu, as a template.
iii. The recipe must include a 'depth steps' function, which makes multiple passes over each cut, lowering the blade height in increments until the target depth is reached.
iv. Change the 'Work and tape thickness' to the measured work + tape thickness.
v. For sapphire samples, make 4-6 passes per cut. For glass samples, make 2-3. Change 'Depth steps' under CH1 and CH2 to be the calculated increment height which the blade should lower for each pass.
vi. Press 'ENTER' to save changes, and proceed with methods in **Sections E, F, G**.

I. MAKING CHOPPER CUTS (small cuts, non-index)

i. Making small, precise cuts around a pattern requires the use of a chopper function in the recipe. Consult **Appendix B** on how to modify a user recipe to include the correct parameters.
ii. Within the recipe, be sure to select either 'A_CHOP' or 'A_UP_CHOP' as the Cut mode.
   1. 'A_CHOP' cuts from left to right, 'A_UP_CHOP' cuts from right to left.
   2. Without doing this, the tool will cut the entire sample index.
iii. When making only single cuts, make sure that Cut line is set to 1.
iv. Navigate to the 'Cutting Semi-Auto' menu. Before making a cut, select 'Manual Align' (F4) and complete the steps in **Section D** to line the sample up correctly.
   1. The X-offset parameter in the recipe will determine how far from the crosshairs the cut will start from.

2. The X-length parameter in the recipe will determine how far the blade travels once it has reached its target depth.
3. The sample MUST be re-aligned using the method in **Section D** before making each chopper cut.
4. If when attempting 'Single CH Alignment' in Channel 2, the program keeps reverting to Channel 1, this is caused by exiting the Cutting Semi-Auto menu and changing the recipe in between channels. To avoid this, make all chopper cuts within Channel 1 first, then change to Channel 2 and continue with alignment without leaving the menu.

v. Select either 'Front' or 'Rear', then press 'START.'

J. Performing Hairline Alignment

i. Hairline alignment tests and measures the thickness of a cut being made while specifying spindle revolutions, feed speed, etc.
ii. From the main menu, select 'Blade Maintenance' (F4) then 'Hairline Alignment.'
iii. Change the parameters within the 'Hairline Alignment' menu, including spindle speed and feed speed.
iv. Follow the steps in **Section D** to align a sample to where the cut should be made.
v. Press 'START.' Once cut has been made, use 'Widen Hair' (F11) and 'Narrow Hair' (F5) to adjust the crosshairs to sit within the cut. Press 'ENTER' when done

K. Unloading Sample and Powering Off tool

i. Press 'System Initial' to return the chuck and sawblade spindle to their original positions.
ii. Make sure the spindle is not rotating. Doors will not open if the saw is active.
iii. Press C/T Vacuum to disengage wafer chuck vacuum, then remove sample.
iv. Power off the machine by ending the iLab session.

V. SIGNATURES AND REVISION HISTORY

A. Author: Sharanya Shivani, Student Technician

i. Date: 16th August 2023

ii. Revision: A

iii. Updates: Revised Appendix A, added Appendix B, added dicing for sapphire, blade change instructions, hairline alignment, making chopper cuts

Approvals:

Technical Manager Signature: ____

Date: ____

Revision History:

Revision	**Author**	**Date**
Original Issue	S. Shivani	6/26/2023
Revision A	S. Shivani	8/16/2023

Figures

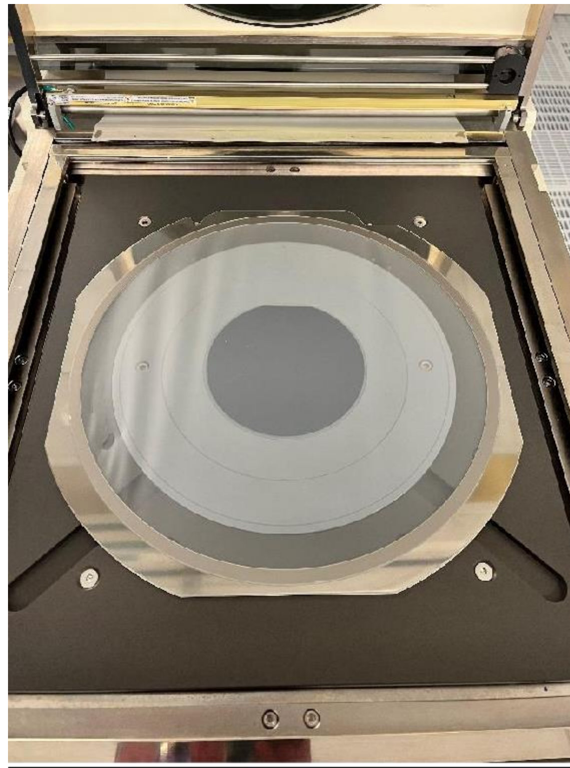

Figure 1: Mounted sample in Wafer Tape Applicator machine with excess tape removed.

Figure 2: Device Data menu with parameters in millimeters.

Appendix A: ‘Device Data’ parameters and descriptions

Recipes can be edited by entering ‘Device Data,’ selecting a recipe or copying a new recipe, and the program can further be modified in the Cutting Semi-Auto menu,

ID = **USER TBD**. Rename the recipe under the USER_RECIPES directory.

Work shape and size: **USER TBD.** Round samples have DIAMETER input, Rectangular/Square samples input length and width in mm.

Spindle rev. = 30,000 rev/min recommended for silicon samples, use a spindle speed of 15,000 rpm or less for harder samples

Work and tape thickness = **USER TBD**. Use ‘Measure’ (F10) then ‘Focus’ (F9) then ‘Auto Focus’ (F9) to find the approximate thickness of the sample and tape.

Tape thickness = 0.090 mm

θ Deg. = **USER TBD**, 0° and 90° for rectangular pieces

Cut mode = A, A

Cut dir. = REAR, REAR

Cut = **USERTBD**. (If making all possible cuts in the work shape, enter 0 lines, otherwise specify the number of cuts to make)

- USE SEQ1 for both channels.

Blade height = **USER TBD**. Default is 0.060 mm above the wafer chuck for full depth dicing, will cut 0.030 mm into the mounting tape.

Feed speed = **USER TBD**. Default is 20, which works well for both silicon and glass samples. Decrease to 5 when dicing sapphire samples.

Y-index = **USER TBD**. In Ch.1 and Ch.2 SEQ1, the size of the dice in mm. Ch.1 will cut horizontal relative to the original position of the wafer, Ch.2 will cut horizontal after rotating the wafer chuck.

After editing the recipe, select ‘ENTER’ to save changes.

Appendix B: 'Device Data' special function parameters

Specialized functions and their parameters can be added to a recipe in the 'Device Data' menu. While editing the recipe parameters, select 'Function Selection' (F4) to view a list of functions available for use.

Depth-Steps Function

- Function is used to incrementally decrease the blade height until the target blade height is reached.
- Is a requirement to dice harder samples (sapphire and glass)

Depth steps = **USER TBD**. The interval for which the blade height decreases per pass. Calculate this approximate height by making 4-6 passes for the hardest samples, and 2-3 passes for glass, etc.

Chopper Function

- Function is used for making small cuts away from the major indexes. Using this method requires 'Manual Alignment' before making each cut.
- The minimum length of cut possible varies depending on the total sample thickness and the target blade depth. It is best to run tests on the sample to determine this length before making cuts.
- Due to the circular nature of the sawblade, areas on the periphery of the chopper cut may not have reached full target depth. These areas need to be carefully carved further using a razor or small knife.

Cut mode: **USER TBD**, set to either 'A_CHOP' or 'A_UP_CHOP' when making small cuts.

Z down speed: **USER TBD.** Default speed is 0.100 mm/s for relatively clean cuts. The speed at which the blade lowers over the part to be chopper cut.

X-offset: **USER TBD**. When set to 0, the sawblade will navigate to the location of the crosshairs and lower to the specified blade height. X-offset is the distance from the crosshairs that the blade will navigate to.

X-length: **USER TBD**. The distance the sawblade will travel once it has lowered to the target depth. When set to 0, the full length of the cut of a sample with thickness 0.600 mm (due to the circular saw blade) is approximately 9.78 mm. Input any additional length past this point for the necessary length of cut to be made.

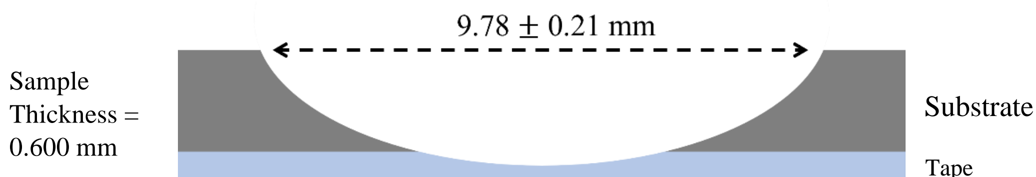

Figure 3: Diagram showing smallest possible chopper cut cross section at a blade height of 0.06 mm.