ADT Dicing Saw Operation

Overview

This procedure covers the configuration and operation of the ADT Dicing Saw.

Restrictions & Precautions

- Safety glasses, a smock (Flame Resistant, CAT 1 arc rating and is NFPA® 2112 compliant) and gloves are required in the Backend Lab. Always wear gloves as there is the potential for arsenic exposure.
- Never put your hands near moving parts especially the blade.
- Always open the spindle cover from the top.

Operation

Install Your Blade and Flange

1. For proper blade selection, reference the table posted in the dicing room or on the Wiki. Proper flange selection (using standard blades) is based on the thickness of the material being cut:

   - <700 µm= 53 mm flange
   - 700 µm – 1.2 mm= 52 mm flange
   - 1.2 – 1.7 mm= 51 mm flange
   - 1.7 – 2.7= 49 mm flange
   - 2.7 – 3.7= 47 mm flange

2. The flanges are in the labeled small wood boxes. Select the flange you require; it should be separated into two pieces. If it is not in 2 pieces, separate it per Step 11 of the Finishing UP section in this SOP.

Place the bottom half of the flange on the table and load your blade on to it. Carefully place the other half of the flange on top of the bottom half of the flange.

Now, using your thumbs, press down firmly on the raised flat area that surrounds the through hole of the top half of the flange. The flange assembly should snap together fairly easy.

NOTE: It is always a good idea to make sure the flange in the box is the correct one. You can do this by comparing the PN on the flange with the PN on the box. Making sure the top and bottom halves of the flange have the same outer diameter is also recommended.

3. When you approach the tool, it should be on the login screen. Login in to the tool as Operator, the password is o.
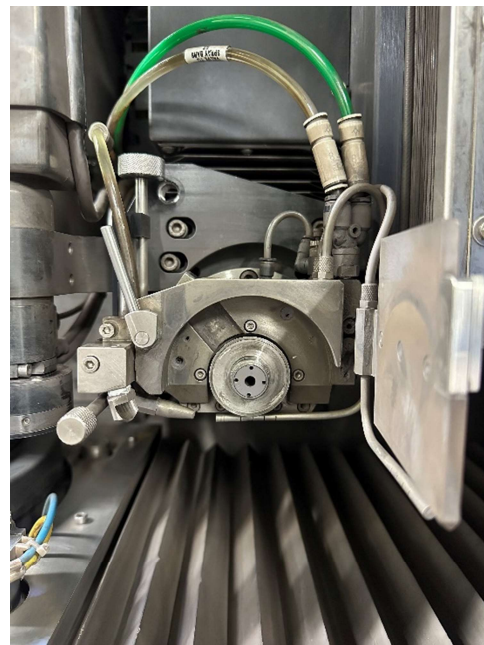
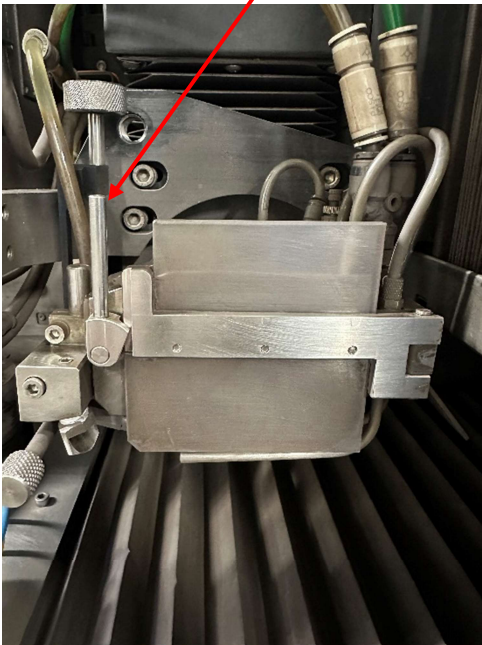4. Click on the 'Blade Change' button.
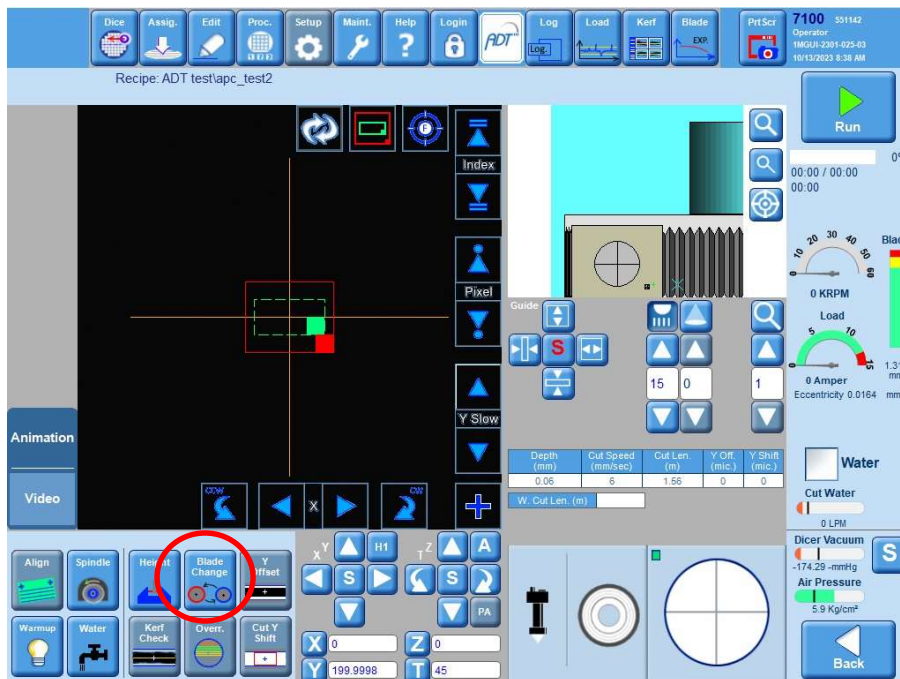
5. Once the blade selection screen appears, lift open the spindle access cover and place the interlock defeating key in the door interlock.

6. Carefully pull <u>the spindle cover lock</u> to the left and open the spindle cover by <u>grasping it from the top.</u>

7. Verify that the spacer that is used for hub blades is in its case and not on the spindle hub.
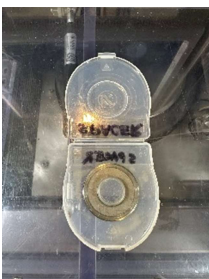
8. Using the correct size pick-up tool, pick up the bladed loaded flange and **CAREFULLY** slide it onto the spindle hub. You need to slide it on in a very linear fashion, **do not come in at an angle!** This should require very little force. If the flange doesn't easily slide onto the spindle hub, **STOP**, pull it back off and try again. If you continue to have an issue getting it to slide on, **STOP and please contact Staff immediately.**

9. Verify the flange is fully seated on the spindle hub. First visually verify that the entire threaded section of the spindle hub is showing and then lightly press against the left and right sides of the flange using two fingers.
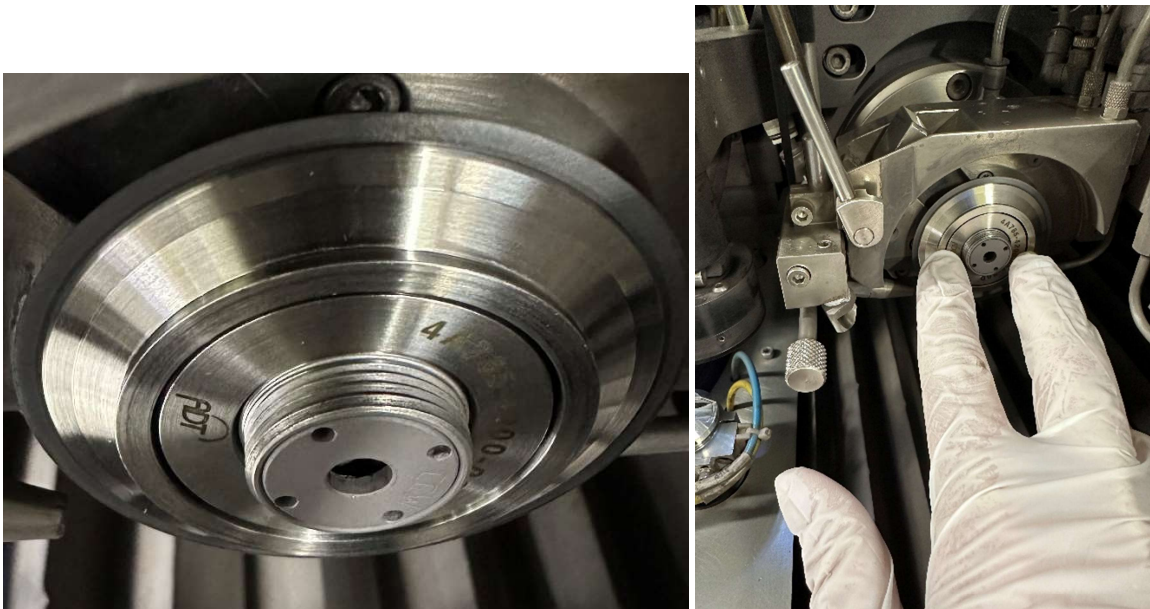
10. Once you have installed your blade and flange onto the spindle you must secure it with the lock nut. To do this:

   a) Place the lock nut on the torque driver with the side labeled 'REAR' facing down (towards the handle of the torque wrench).
   b) Line up any of the two holes on the lock nut with the two pins on the two-piece torque driver.
   c) While holding the lock nut on the torque driver with your fingers, insert the hex head tip of the torque driver into the hole on the spindle hub.
   d) While holding the torque driver in place on the ridged section with one hand, use your other hand to move the front part of the torque driver forward and turn it clockwise to thread it on the spindle hub until it is hand tight.
   e) Once the lock nut is hand tight, you'll have to crank on the torque driver until you hear a click. **DO THIS TWICE, SO THAT YOU HEAR A TOTAL OF TWO CLICKS!** This ensures that the appropriate amount of torque was used to keep the flange on the spindle and prevent catastrophic damage to the system!

f) Verify you installed the lock nut correctly, the side with beveled edges (labeled 'REAR') should be facing outward and the face of the lock nut should be even with the face of the spindle hub.
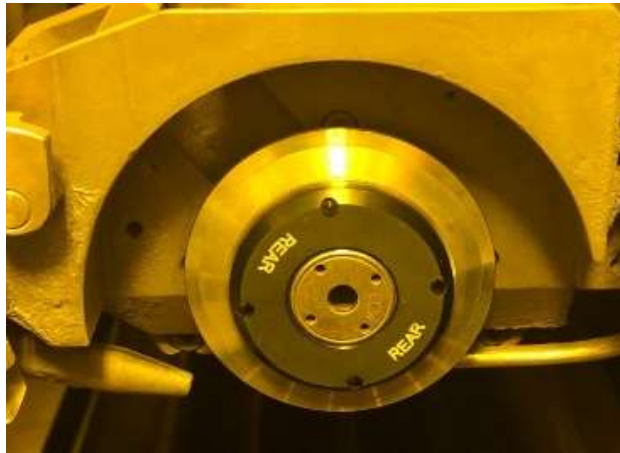
11. Close the spindle cover <u>by grasping it from the top</u> and then locking it by pulling the spindle cover lock to the right.

12. From the 'Blade' drop down menu, choose blade you just installed. If you are using a different flange diameter from the one already selected in the software, click the 'Change flange' box and select the correct flange size from the 'Flange' drop down menu. You can also select User Defined from the drop down menu and enter the flange size in the 'Flange Diameter' field.

NOTE: If out are using a hub blade, then the flange size will be auto filled from the blade's profile.

13. Click 'Next, and then click 'Finish'.

14. **DO NOT STICK YOUR HANDS INTO THE SYSTEM!** The saw will eventually start to rotate and go through its blade exposure measurement sequence. The blade exposure measurement sequence is completed once the blade exposure value has been updated from its default and an eccentricity value appears.

IMPORTANT: If you get the error message "Blade is bigger than expected", STOP and contact Staff.

Adjust the Cut Water

1. **BE EXTREMELY CAREFUL!** The spindle is still rotating! Carefully pull the spindle cover lock to the left and, handling it from the top, open the spindle cover.

2. Click on the 'Water' box to turn on the three different water sources. Next, click on the 'S' button to open the Sensors window. These are both located in the lower right quadrant of the screen.
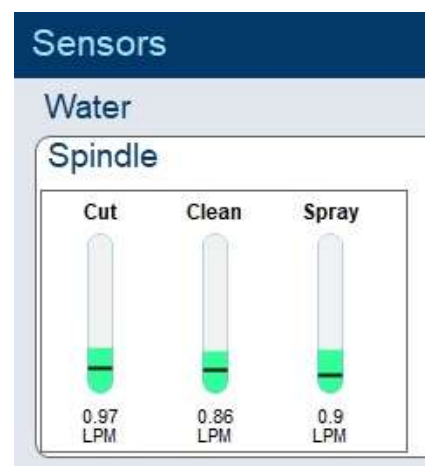
Verify that the water flow rates are approximately:

- Cut= 0.9 LPM

- Clean= 0.8 LPM

- Spray= 0.8 LPM

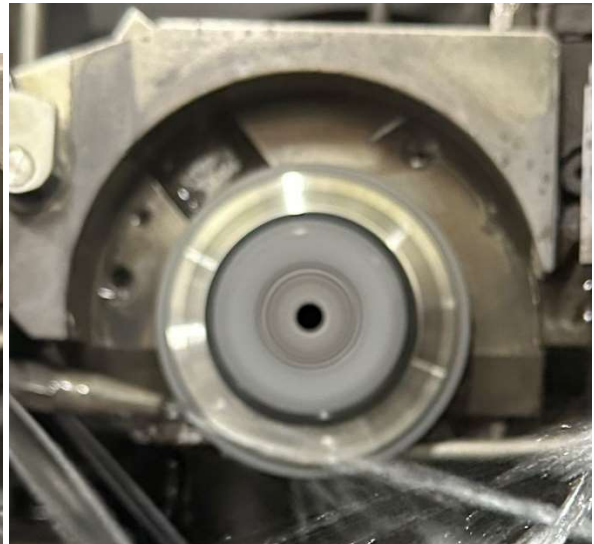You can change the flow rates by adjusting the three small regulator knobs below and behind the computer monitor. The water sprayers all share the same water source so when you lower one flow rate the others will rise and vice versa, so you will need to balance this out via regulator adjustments.

3. Next, verify that the Cut water is being forked by the blade (you should see a stream of water in front of the blade and two behind it). The Cut water should be hitting the blade/flange at approximately 8 to 7pm if the blade was a clock. If adjustments are needed, you can move the Cut water nozzle by holding the knob behind the nozzle with one hand and turning the top knob above counterclockwise. This will unlock the Cut water nozzle and give you free range of motion. Make sure you do not rotate the Cut water nozzle up into the blade! Once the Cut water looks good you can lock it in place by turning the top knob clockwise until it's tight.

Used to secure cut water nozzle position

If the cut water nozzle is positioned below the bottom of the blade it will hit and damage your sample during dicing!! This can also damage the tool!!

Used to adjust position of cut water nozzle
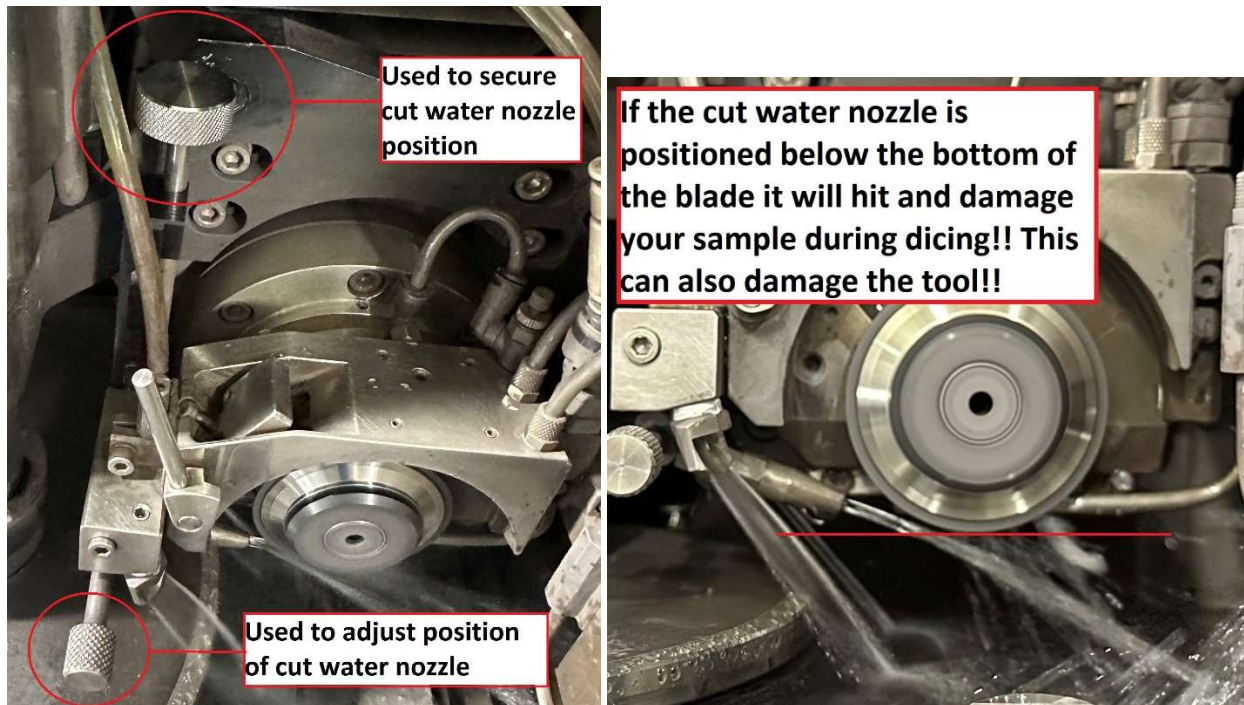
4. Once the water situation looks good, click 'CLOSE' to close the Sensors window and then click on 'Water' box to turn off the water.

5. Click the 'Spindle' button to turn the spindle off.
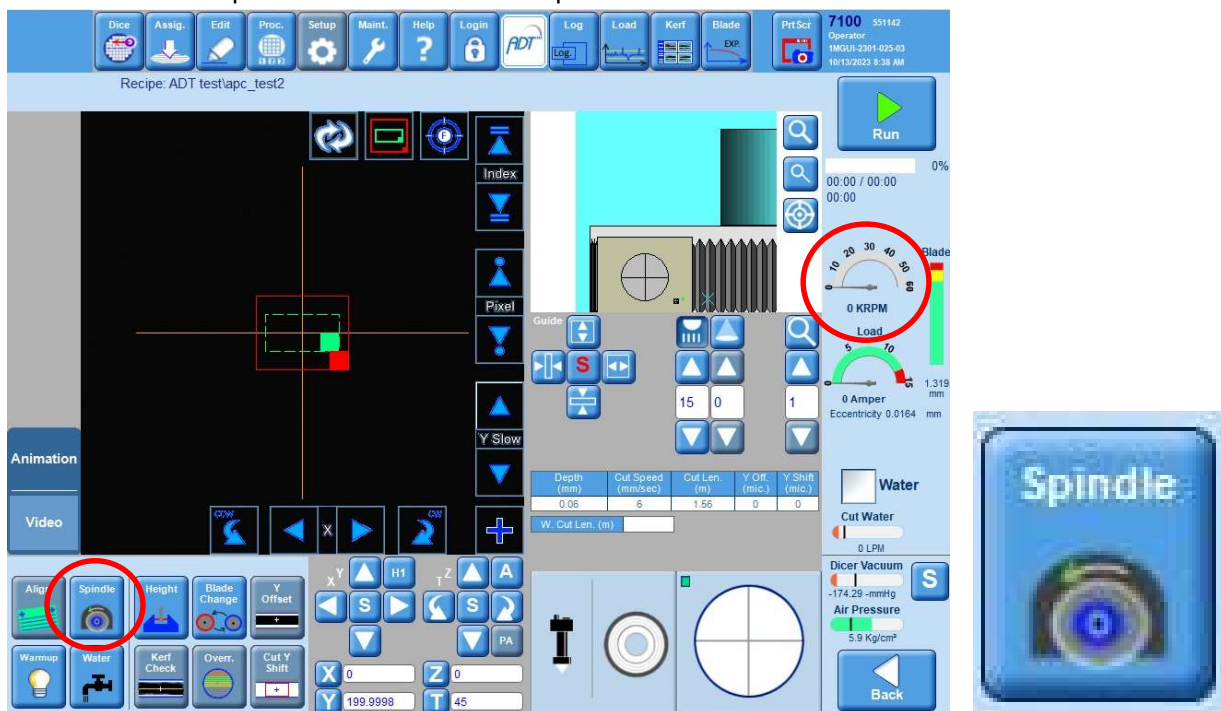
6. Once the spindle has reached 0 KRPM; close the spindle cover and lock it, <u>remove the interlock key and close the dicing saw cover fully</u>.

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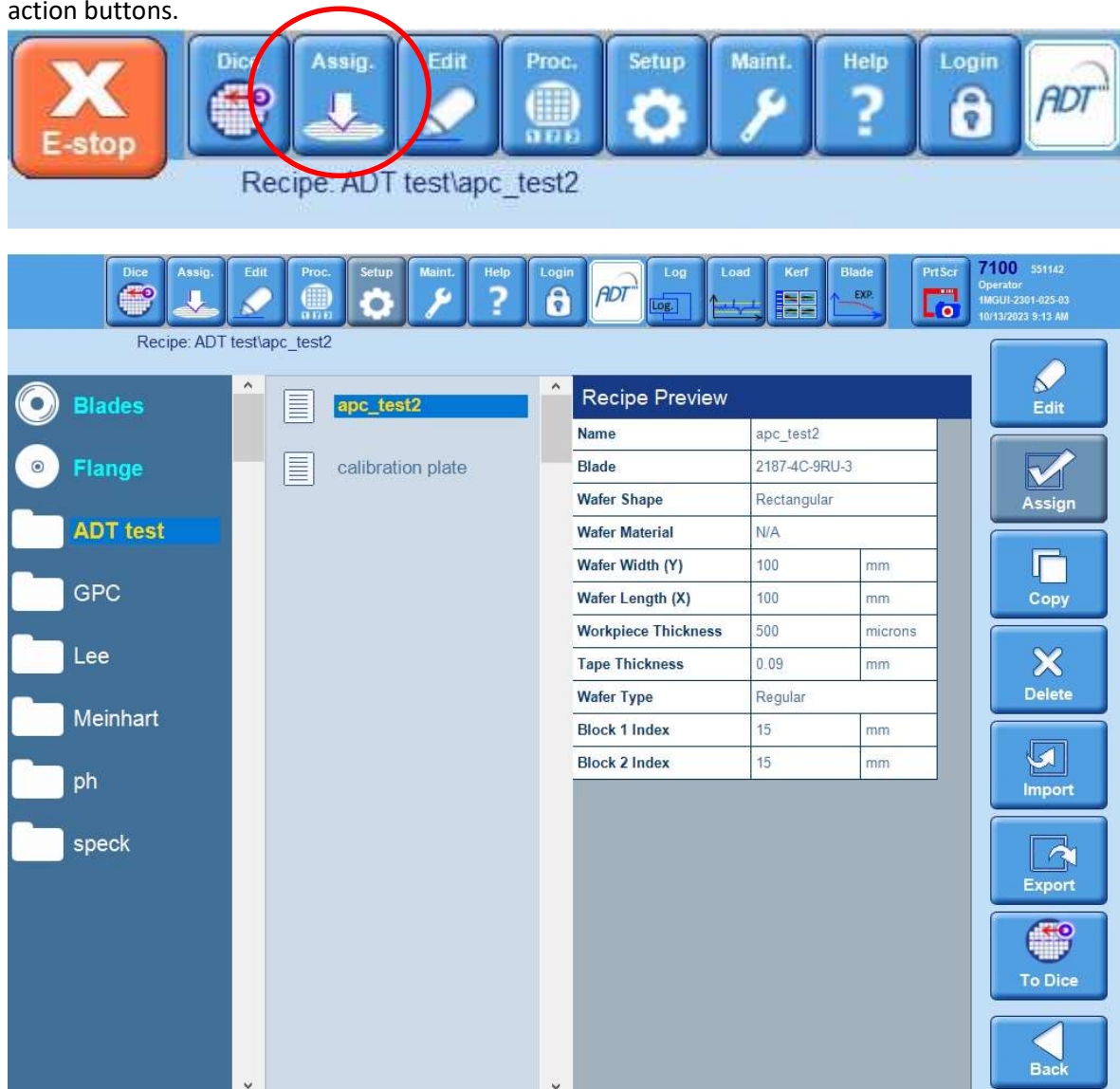**Creating and Editing a Recipe**

1. To create (or edit) a recipe, click on the 'Assig.' button at the top of the screen. A screen will open with four columns; recipe folders, folder contents, selected recipe preview and available action buttons.

2. If you are editing and existing recipe, highlight the recipe and click on 'Edit'.

3. If you need to create a new recipe you must copy an existing recipe. You can either copy a group/company member's recipe or select the 'RECIPES' folder and select 'Recipe_TEMPLATE'.

   NOTE: If you are dicing a 200 mm (8") wafer, select 'Recipe_TEMPLATE_Wfr'.

4. Next click 'Copy' and a pop-up window will appear. Make sure you save your recipe in any other folder besides the 'RECIPES' folder. You can either find your folder by using the drop-down menu or you can create a new folder selecting 'Type new group name'. Click 'Ok' when finished.

   IMPORTANT: DO NOT USE THE WORD 'TEMPLATE' IN YOUR RECIPE!!!

5. There are five parameters you need to enter in the 'Setup' section of the recipe:

Description	▼	Idx	General	Block 1 - 0	Block 2 - 90	Units
Setup						
Name			Training			
Group			Lee			
Blade			ThermoCarbon_2187-4C-9RU-3			
Author			ADT software engineer			
Created			10/17/2023 7:46:39 AM			
Updated			10/17/2023 8:01:21 AM			
Cut			Standard APC			
Wafer Shape			Rectangular			
Wafer Width (Y)			100			mm
Wafer Length (X)			100			mm
Workpiece Thickness			550			microns
Tape Thickness			0.09			mm

- **Blade** (click on the entry field to access drop down menu).

  IMPORTANT: You will get a "Wrong mounted blade error" if the blade description you select does not match exactly with the blade you selected in Step 12 of the "Install You Blade and Flange section".

- **Wafer Width** (front to back) and **Wafer Length** (left to right). Make sure orientation is correct if you're dicing a rectangular or elongated sample.
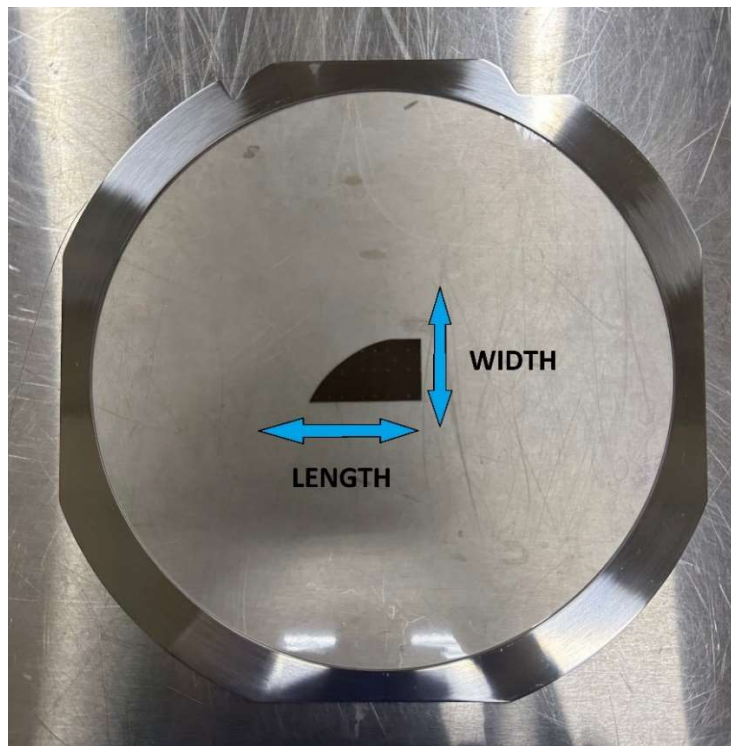
  NOTE: For 200 mm wafer recipes you must input Wafer Diameter. You can ignore the Wafer Width and Length settings.

- **Workpiece Thickness**. This value only governs the starting camera height and does not affect the actual dicing of your sample.

- **Tape Thickness**. The tape we provide is 0.09 mm (90 µm) thick. This value only governs the starting camera height and does not affect the actual dicing of your sample.

6. Next is the 'Cut' section of the recipe. This section is broken down into 2+ columns; General and Blocks. Blocks are the angles you will be making your cuts at. So, for example 'Block 1 – 0' would be for cuts on your first angle and at 0 degrees.

7. For the General column of the Cut section there are 6 parameters you need to enter:

Cut	General	Block 1 - 0	Block 2 - 90	
Index		10	10	mm
Depth - Head 1		0.06	0.06	mm
Cutting Speed	6	6	6	mm/sec
Spindle Speed - Head 1	35	35	35	KRPM
Cuts Number		5	5	
Cut Length		120	120	mm
Overtravel	10	10	10	mm
Cut Entry Speed	0	0	0	mm/sec
Cut Exit Speed	0	0	0	mm/sec
Overcut	0	0	0	mm

- **Cutting Speed (mm/s)** – How fast the saw travels across your sample. There are ranges for various materials developed here at UCSB which are in the table posted in the dicing room or on the Wiki. As a general rule of thumb start on the slower end of the range and verify cut quality before turning up the speed.

- **Spindle Speed** – Head 1 (KRPM) – How fast the spindle rotates. Recommended spindle speeds are posted on the same sheet as the cut speeds.

- **Overtravel (mm)** – The distance the saw travels before and after each cut. This parameter prevents the saw from lowering directing onto the edge of your sample (which could potentially break the blade or the sample). We generally use an overtravel value of 10 mm.

- **Cut Entry Speed (mm/sec)** – How fast the saw travels at the beginning of a cut. It is recommended to set this the same as the cutting speed.

- **Cut Exit Speed (mm/sec)** – How fast the saw travels at the end of a cut. It is recommended to set this the same as the cutting speed.

- **Overcut (mm)** – The distance that the blade will travel at the different Cut Entry and Exit speeds if they are not set to the same value as the Cutting Speed. If all the speeds are set to the same value, as recommended, set this to 0.

8. For each Block column there are four parameters you need to enter:

**NOTE: You will only enter Depth and Index for 200 mm wafer recipes.**

- **Index (mm)** – This is the distance between cuts in mm.

  <mark>NOTE: Since a 200 mm wafer recipe has no Cut No. parameter, the tool will make as many cuts as it can based on the Index value and the Cut Position (next section).</mark>

- **Depth – Head1 (mm)** – This is the cut depth, <u>we recommend a value in the range of 0.05 to 0.07 mm</u>. A value of 0 here would place the blade right at the chuck surface (BAD!).
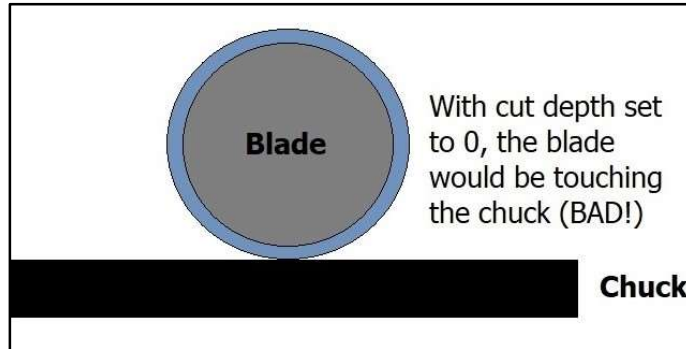
All values entered in this field are positive and result in the blade's distance from the chuck increasing. If you are using the provided 0.09 mm thick mounting tape and dicing all the way through your sample (without a carrier sub), you would set this value to 0.07 mm. This would result in the blade cutting all the way through your sample and into the tape 0.02 mm (20 μm), which is what is recommended.
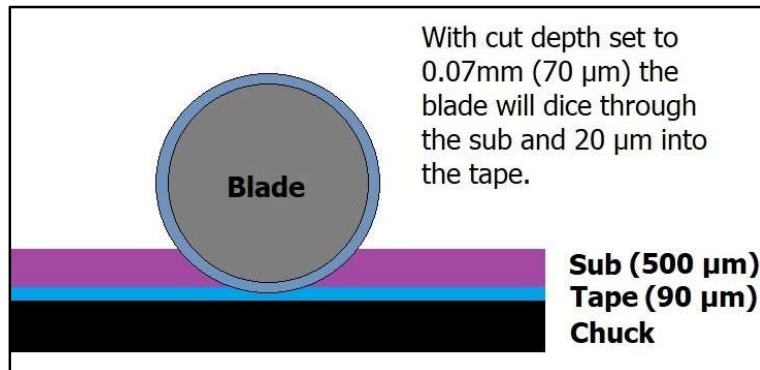
Here is an example of using a carrier substrate:
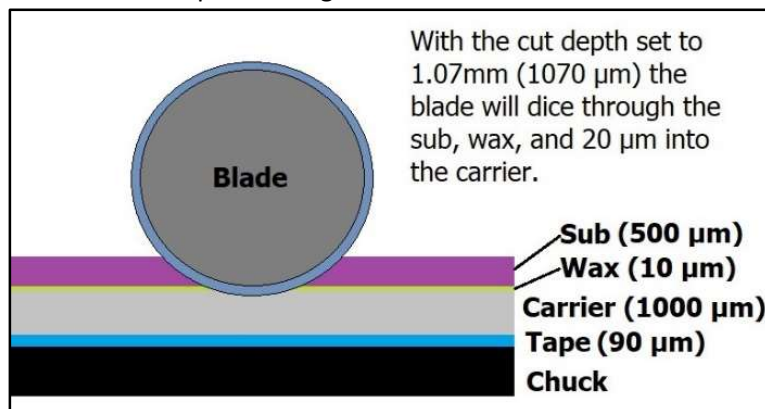
A simple formula to figure out the cut depth when using a carrier wafer is:
<mark>(0.09 Tape + Carrier Thickness + Wax Thickness) – 0.02 to 0.04</mark> ALL IN MM!

- **Cuts Number** – The number of cuts you will make at this angle.
- **Cut Length (mm)** – This is your sample length plus two times the overtravel. So, for a 100 mm sample with a 10 mm overtravel, this value would be 120 mm.

9. In the 'Height' section there is one parameter you need to enter one parameter:

Height				
Heights Check Rate	4	4	4	cuts

- **Heights Check Rate (cuts)** – The amount of cuts the saw makes before it moves over the NCH sensor to measure the exposure of the blade. The significance of this is that every time the system does an exposure measurement and your blade exposure decreases, the saw lowers to accommodate for the blade wear. If you allow for too many cuts in between measurements on a hard material (i.e., this value is too high) you may notice that your cuts won't be going all the way through your sample. For harder substrates like sapphire or thick GaN you want the blade exposure to update every 1-2 cuts in order to stay up with the blade wear. For silicon you can turn this value up to 40 or more.

NOTE: One drawback to setting this value to a high number is that the only way the tool can tell if your blade has broken is when it measures the blade wear. You can opt to manually check the process height at any time by pausing the dicing process, right-clicking on the spindle icon, and selecting Height from the pop-up menu.

10. If you only require 1 cut or more than 2 cuts, click on the 'Blocks' button and use the 'Edit Blocks' pop-up window to edit, insert, or remove a block.

11. If you require cuts at 2 different indexes on the same angle perform the following steps to add this to your recipe. The 2nd index will be based off of the cut position for the 1st index.

- Click the 'Add Param' button on the right side of the screen. An 'Add Parameter' pop-up window will appear.

- Make the following selections in this window:

Add Parameter

From activity:	Cut
With parameter name:	Index
In block:	General
	General
	Block 1 - 0
In Idx =	0	Block 2 - 90
With a value:	All blocks

OK   Close

For the 'In block' field specify the angle(s) that you want to have 2 indexes.
You can also specify a specific value for this index now or just edit it in the recipe screen later.

- Click 'OK' when finished, the 'Cut' section of your recipe will look like this now:

Cut

Index	0		10	10	mm
	1		3	3	mm
Depth - Head 1			0.06	0.06	mm
Cutting Speed		6	6	6	mm/sec
Spindle Speed - Head 1		35	35	35	KRPM
Cuts Number			5	5	
Cut Length			120	120	mm
Overtravel		10	10	10	mm
Cut Entry Speed		0	0	0	mm/sec
Cut Exit Speed		0	0	0	mm/sec
Overcut		0	0	0	mm

12. Click on the 'SAVE' button to save all your changes.

SAVE

Loading a Recipe

1. Click on the 'Assig.' button at the top of the screen, highlight the recipe from your folder and click the 'Assign' button. Make sure your recipe shows up in the recipe field near the top of the software window!
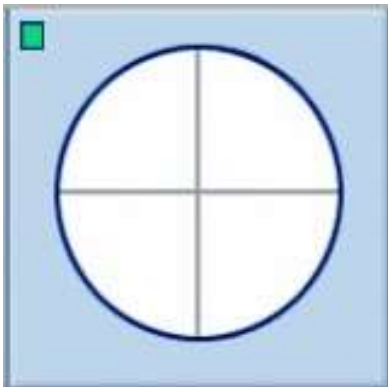
Assign
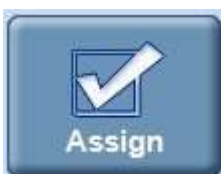
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Load and Align Your Sample, Define Cut Positions

1. Perform the following:

    Click on ![Maint.] , then ![Sys Init] , and then ![Dice] .

2. Click the 'Chuck' icon and select 'Load Workpiece' from the pop-up menu.

    Load Workpiece
    Unload Workpiece
    Partial Wafer Cut
    View Alarm

3. Open the chuck cover, ensure that there are no large particles/debris on the chuck. It is recommended to use the DI and compressed air spray gun to clean off the chuck. If you hold down both the water and air buttons simultaneously the gun will act like a pressure washer.

4. Load your tape frame and sample face up (tacky side up!) and slide the two notches of the tape frame underneath the two button heads at the back of the chuck. There is a magnet in front of the chuck that will help hold the frame in place.

5. Click 'OK'. Watch your hands! The chuck vacuum will turn on and the chuck will move underneath the camera. You can now close the chuck cover.

6. Click the 'Camera' icon and select 'Align' → 'Manual' from the pop-up menu. Follow the directions in the dialogue box that appears where the icons were.

There are various controls at your disposal to navigate across your sample:

- There are three different camera magnifications; Low, Medium and, High. These are selected by clicking on the magnifying glass icon, the icon will get bigger or smaller each time you click on it. Also, within each magnification level there is a magnification multiplier that can be applied by clicking on the up or down arrow. The amount of multiplier is displayed in the field between the arrows.

Example of high magnification with a 1X multiplier

- There are two different types of camera lighting, direct and oblique, each with their own intensity adjustment. A good starting point for the direct lighting intensity is ~20. The oblique lighting does not affect the displayed image much but is useful for visually verifying where you are at on the sample chuck or for looking at sample edges. The lighting modes are turned on and off by clicking on the icon above the up arrow.

Example of direct lighting on and at 15 with oblique lighting off.

- There are two sets of controls for chuck/camera movement:

    ❖ The 4 arrows. These are used to move around the chuck. Click on the letter in the center to change the movement mode; S= Slow, P= Pixel, F=Fast

    ❖ The curved arrows with the up and down arrows. The curved arrows are used for rotation and the up and down arrows are used for camera focus. Click on the letter in the center to change the movement mode; S= Slow, P= Pixel, F=Fast
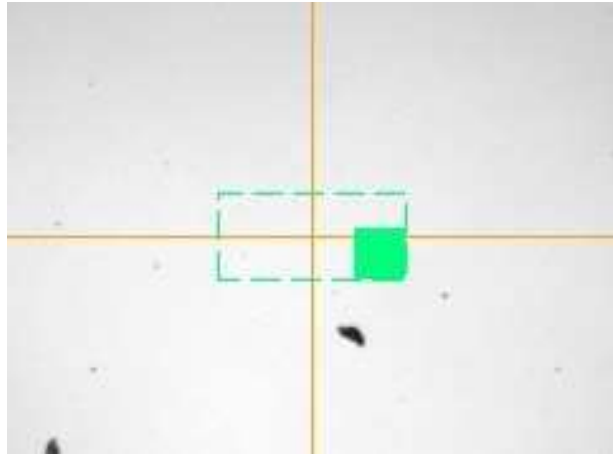

    You can also switch the movement mode to Angle by clicking on the 'A'.

- There are also movement arrows you can use in the camera view panel. This is also where you access the Index movement mode.
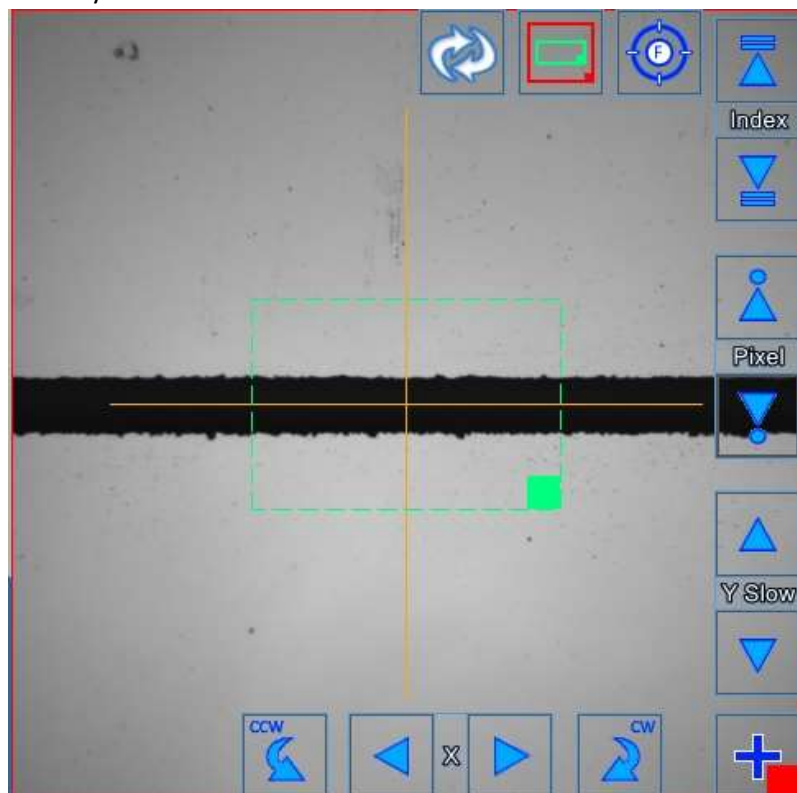
- You can also adjust the size of the green box around the crosshair by clicking on solid green box in the corner and dragging it.

7. Move to either a flat edge or some features on your sample and adjust the rotation to get things looking straight.

8. Now locate a right alignment point (double click on a feature to automatically move the yellow crosshair). Once you have selected your right alignment point click 'Next'. The camera will automatically move to the left side of your sample and prompt you to select a left alignment point. Make sure you select a feature in the same row as the one you selected for your right alignment mark otherwise you could cross align rows. Click 'Next' and your sample will be aligned to your two selected points. Click 'Finish' to complete alignment or click 'Next' to make adjustments to alignment marks.
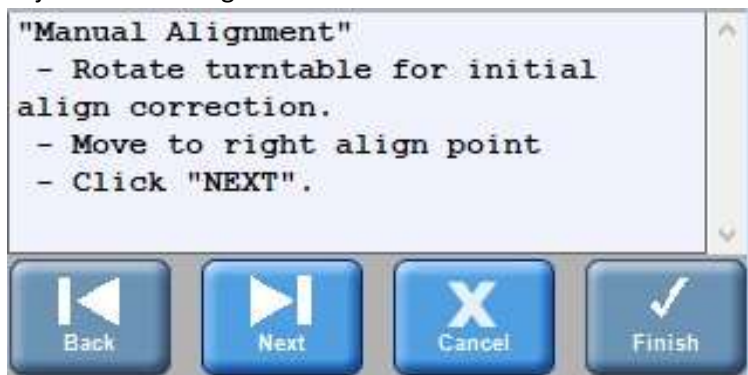
9. After finishing alignment, you will be prompted to 'Define Cut Position'. This is the spot where the saw will first enter your sample. Your top most cut. If you are dicing a full wafer or non-rectangular piece, make sure you define this cut position, in X, at the right most part of your sample. When you define this point every cut will start at this position in the X dimension. If you define this position at the edge of your sample where the diameter is smaller you will cause the saw to come down on your sample in areas where the diameter is larger. So, for a full wafer you would:

    a. Move the crosshair to the far-right apex of your wafer's edge

    b. Click on X/Xr until Xr=0

    c. Locate the top dicing lane and center the crosshair in it (in the Y) at high mag

    d. Enter 0 in the Xr field. Do not click Xr!

NOTE: For 200 mm wafer recipes you just need to locate the middle of the dicing lane for your top most cut. You do not need to be at the sample edge or perform the X/Xr operation.

10. Click 'Finish' and a cut map of all your cuts will appear on the sample representation in the software (to the right of the camera view). Ensure that all the cuts are in the appropriate spots. To do this, move back over to the middle of your wafer or sample. Use the 'Index' arrows on the camera view panel to jump from cut to cut across your sample. Verify every cut position looks right. To make changes to the cut map, you will have to go back to the 'Assig.' screen and edit (and save) your recipe. Once you're done with the changes you must reload the recipe and click 'Manual Alignment' again. The camera should move to the original cut position. Click 'Finish' and the new cut map will appear.

11. You now need to set up the cut map for your second angle (90°). Set the rotation arrows' movement mode to 'Angle' by clicking on the 'A'. Now when you press a rotation arrow your sample will rotate 90°. Select the left rotation arrow (counterclockwise) so that your wafer flat is on the left.

12. Click the 'Camera' icon again and select 'Align' → 'Manual' from the pop-up menu. You do not need to perform alignment at the second angle but <u>you do need to perform this step or you will get an error when you go to cut your wafer</u>. Just click; Next, Next, and Finish.

13. You will now need to define your cut position for this second angle, repeat Steps 9.c., 9.d. & 10.

Manual Y-Offset Correction

Before dicing your wafer, it is recommended to perform a Y-offset correction. This is especially true if the previous user brought in their own blade (a non 2.187 blade). This means that the cut street could be off by a couple millimeters in the Y dimension from where you set it. When performing a Y-offset correction you will make a test cut into the tape for a coarse correction and then into a non-critical section of your sample (or a witness piece) for a fine correction.

1. Depending on where you will make the test cut into your sample, you made need to rotate it 90° (back to its original loading position). Set the rotation arrows' movement mode to 'Angle', 'A'. Select the right rotation arrow (clockwise), this will result in the wafer flat facing the front of the system.
2. Click the 'Spindle' icon and select 'Y Offset' from the pop-up menu. The dialog box will prompt you to move to a position and click 'Test cut'. It is recommended you do this in two steps.
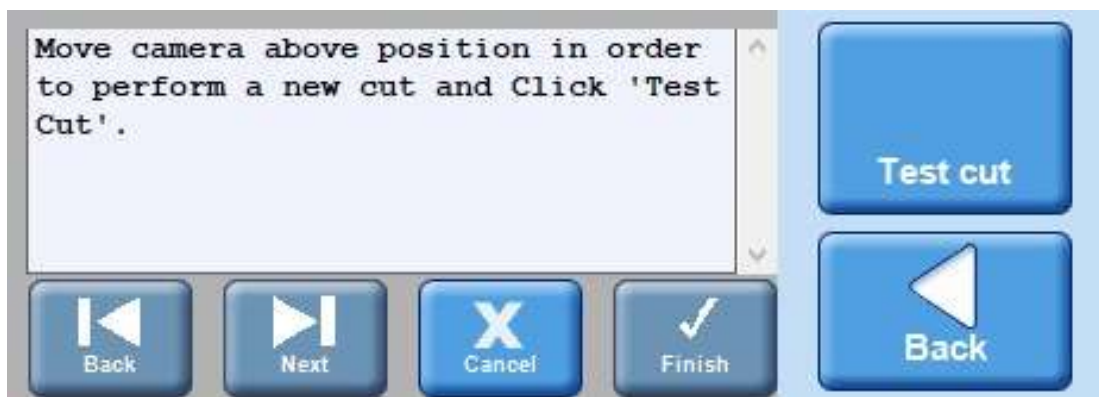
3. For your first cut, move the camera somewhere above or below your sample. This will prevent any damage to devices if the previous user created a large offset. Click 'Test cut' and the software will prompt you to turn on the spindle (if it isn't on already).
4. Once you click 'Test Cut' the saw will perform a blade exposure measurement and make a cut where you initially moved the camera to. Once the saw is done with the cut the camera will move back over it. If you do not see a cut on the screen, you'll have to move the camera up or down to find it.

5. Once you do see the cut, place the crosshairs right in the middle of the cut street. You can click and drag the green box for reference and also to measure the cut width. Once the green crosshairs are centered on the cut click 'Finish'. Your "coarse" Y-offset correction will be completed.
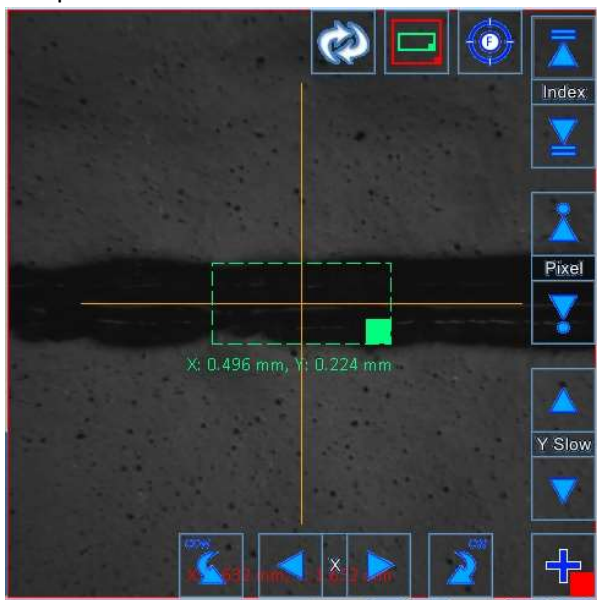
NOTE: At this point your alignment can still be off by 5-10um because the tape will pull apart when cut which makes it hard to find the exact middle.

6. If you want even better alignment, perform Y-offset correction again. But this time cut somewhere on your sample without any important features or devices (or on a witness piece). Now that it is cutting into something more rigid, you'll be able to align the crosshairs more accurately. Your "fine" Y-offset correction will be completed and you are ready to cut your sample.

Cut Wafer

1. Perform any final verifications on your sample.
2. Click the 'Run' button (near the top right corner of the screen) the saw will start cutting.

FINAL VERIFICATION TIP: Clicking the 'Stop' button (same place as 'Run') during a cut will cause the saw to finish the current cut and then bring the camera back over it once it's completed. You can do this as many times as you see fit and is a good way of doing one last verification that the saw is cutting in the right position. This is not necessary and you should be fine as long as you previously verified your cuts after defining the cut position and you completed your manual y-offset alignment. Click the 'Run' button to resume.

BLADE BREAKAGE: If your blade breaks while dicing the only way the tool can tell it has broken is if it performs a height check. When a height check is performed on a broken blade the tool typically gives an error, however the error does not state broken blade or something to that effect. It is:
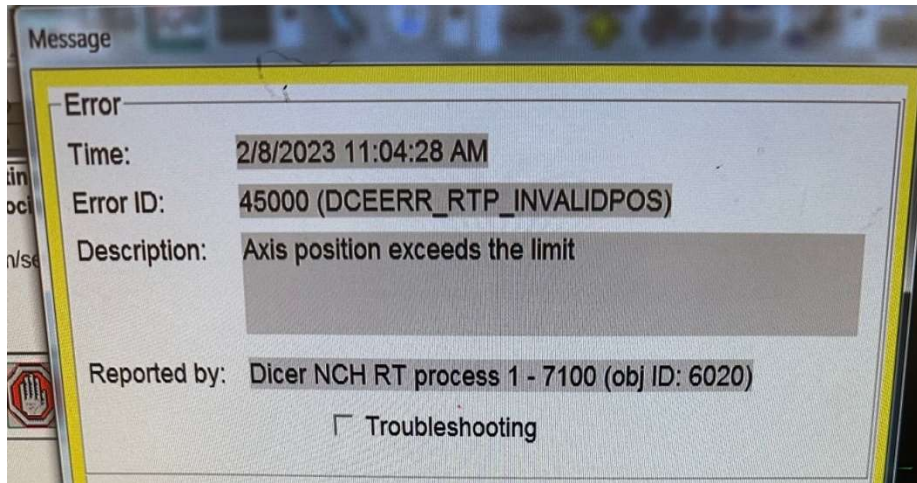
If you get this error; select blade change, change the blade, and resume your dicing.

MANUAL DICING

1. Install blade and flange, adjust the cut water, and initialize the system.
2. You must create (or modify) a recipe with the correct parameters.
   - For each angle you need to enter at least 1 cut.
   - If possible, you should enter a correct index value.
   - If you are only dicing at one angle, you need to delete the other angle(s) (right click on tab).
3. Perform manual alignment and define the cut position (for each angle). When defining the cut position, you must define it at the right most part of your sample (refer to this SOP for proper steps).
   NOTE: It is recommended that you accurately define the cut position even though you will be cutting manually.
4. Perform coarse and fine manual Y-offset correction.
5. You are now ready to perform single cuts using the manual Y-offset correct:
   a) You can use index movement to get to the first cut quickly.
   b) Place the crosshairs right in the middle of the cut street.
   c) Click 'Test cut' and a single cut will be made.
   d) The camera will return to the cut after and the crosshairs should be in the middle in the cut. Make any fine adjustments to the crosshair position if needed.
   e) **You must click 'Finish'. If you do not, you will be changing the Y-offset correction for any subsequent cuts. THIS IS BAD!**
   f) Repeat the above steps for any additional cuts. If you need to make cuts at another angle use angle rotation movement.
6. Click the 'Chuck' icon and select 'Unload Workpiece' from the pop-up menu.
7. Follow the steps in the 'Finishing Up' section of this SOP.

FINISHING UP

1. Once all the cuts have been performed the system will prompt you to unload your sample. Open the chuck cover and rinse and dry your sample with the DI and compressed air spray gun.
2. Click 'OK' to release the chuck vacuum and unload the tape frame.
3. The system will prompt you to load another workpiece, if that is the case load your sample and click 'OK'. If you are finished with the tool, click 'Cancel'.
4. Click on the 'Blade Change' button. Once the blade selection screen appears, open the dicing saw cover.
5. Carefully pull the spindle cover lock to the left and, grasping it from the top, open the spindle cover.
6. Get the two-piece torque wrench tool and insert it into the hub lining up the pins. Hold the back part of the wrench in place with one hand and turn the front part of the wrench counter-clockwise with the other hand to loosen and remove the lock nut.
7. Grab your blade/flange (with the grabbing tool or hand) and CAREFULLY remove it from the spindle. Place it on the table and release it from the grabbing tool.
8. Close the spindle and dicing saw covers.
9. Click 'Cancel' in the change blade window.
10. Logout of the system by clicking on the 'Login' button at the top of the screen.

11. Get the flange separation tool (black disk with 3 pins) and insert it into the back of the flange lining up the 3 pins on the tool with the three holes on the flange. Set them down on the table with the tool on the bottom. Now press down on the inner diameter flange assembly to separate it.

12. Remove your blade and placed the 2 flange pieces back in the correct wood box.
13. Fill out the log book with the following info:
    - Date
    - Name
    - Blade used
    - Flange used
    - Material you diced
    - The number of cuts made