

# Cutting disk specimens for transmission electron microscopy

*Ultrasonic disk cutting is an extremely successful method for producing transmission electron microscopy specimen disks from any hard, brittle material, such as ceramic, semiconductor, and geological materials. This rapid technique directly produces either disk specimens from materials as thin as 40  $\mu\text{m}$  or cylindrical rods up to 10 mm in length from bulk materials. For this application note, the material type is 1 mm thick glass.*

## Materials

- Model 170 Ultrasonic Disk Cutter with 3 mm titanium cutting tool
- Bulk glass 1 mm thick and no larger than 20 mm width x 30 mm height
- Aluminum specimen plate
- Hot plate
- Crystalbond™ 509 adhesive
- 600-grit silicon carbide (SiC) abrasive powder
- Water
- Tweezers
- Wooden stick
- Cotton swabs (optional)

## Mounting the bulk material for cutting

1. Place the aluminum specimen plate on a hot plate (heated to approximately 120 °C to melt the Crystalbond adhesive).
2. Coat the middle of the specimen plate with enough Crystalbond adhesive to accommodate the bulk glass.
3. Use tweezers to place the bulk glass onto the melted Crystalbond adhesive and gently press the glass down with a wooden stick until any air bubbles beneath the glass are expelled.
4. Remove the specimen plate from the hot plate and allow it to cool to room temperature.

## Cutting the disk

1. Ensure that the 3 mm titanium cutting tool is mounted on the disk cutter.
2. Place the specimen plate under the thumb screws of the disk cutter's specimen container assembly. Tighten the screws firmly.

3. Set the specimen container assembly onto the disk cutter's magnetic stage. Adjust the position of the assembly on the stage as needed.
4. Flip the disk cutter's power switch up to turn on the power. The red **ON** indicator illuminates.
5. Situate the glass under the cutting tool. If you need to target a specific area of interest, use the optional microscope attachment to target this region (see the *Model 170 Ultrasonic Disk Cutter Instruction Manual* for more information).
6. Use the cutting head height adjustment knob (located on the right side of the disk cutter) to gently lower the cutting tool onto the glass.

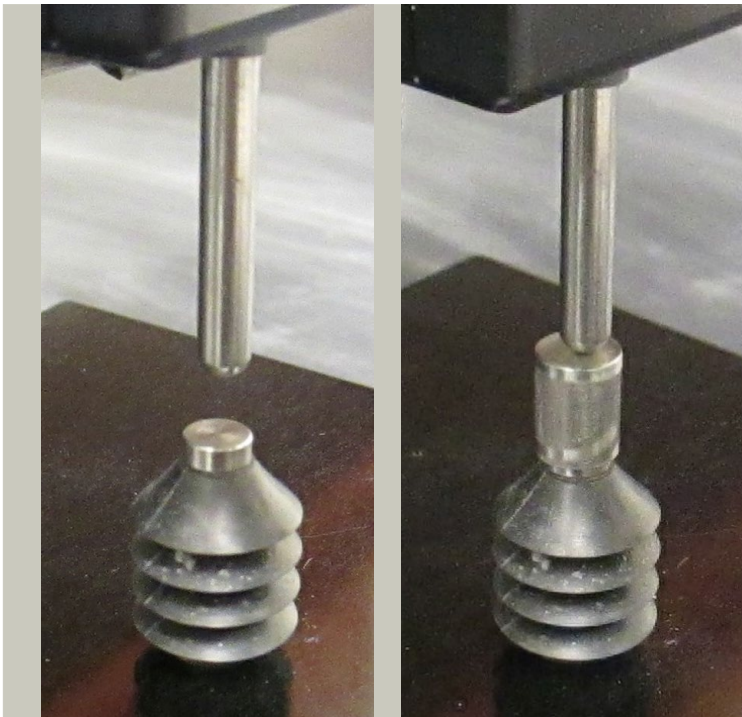
If the dial indicator needle (located on the top of the disk cutter):

- **Moves**, that means that the indicator connecting rod is making contact with the indicator contactor assembly (Figure 1). Skip to step 8.
  - **Does not move**, that means that the indicator connecting rod is not making contact with the indicator contactor assembly. Proceed to step 7.
7. Lift the cutting tool off of the surface of the glass and place an extender onto the indicator contactor assembly (Figure 1) and bring the cutting tool down onto the surface of the glass. If the dial indicator needle begins to move, proceed to step 8. If not, remove the extender and replace it with a longer extender. Continue to

- increase the size of the extender until the needle moves.
8. Raise the cutting tool from the surface of the glass.
  9. Add SiC abrasive powder to the surface of the glass beneath the cutting tool.
  10. Fill the disk cutter syringe with water and attach it to the front of the instrument.
  11. Add water from the syringe onto the surface of the glass. The SiC powder will become a paste.
  12. Lower the cutting tool until it touches the SiC paste on the surface of the glass. Continue to lower the tool until the stage is slightly compressed.
  13. Move the ultrasonic transducer switch to the auto termination position (move the three-position switch all the way up). Cutting begins immediately. The dial indicator will display, in positive units, the current depth of the cut.
- If the disk cutter stalls or cuts very slowly, see the *Troubleshooting* section.
14. Continue to add water during the cutting process to keep the specimen surface lubricated. Lower the cutting head as needed to further compress the stage.
  15. When the specimen material is cut fully through, cutting automatically terminates and the **Auto** indicator illuminates. Move the ultrasonic transducer switch to the middle position. You may also turn off the power to the instrument at this time.
  16. Lift the cutting tool from the surface of the glass.
  17. Remove the specimen plate from the specimen container assembly.

### Removing the disk from the specimen plate

1. Place the specimen plate onto the hot plate.
2. Once the Crystalbond adhesive melts, use tweezers to gently release the disk from the specimen plate.
3. Soak the disk in acetone for at least 30 minutes to remove the Crystalbond adhesive.



#### ADJUSTING THE CUTTING HEAD HEIGHT

Figure 1. Lower the cutting head onto the specimen. If the indicator connecting rod does not come into contact with the indicator contactor assembly (left), the dial indicator will not engage. Add an extender (right) to bridge the distance between the indicator connecting rod and the indicator contactor assembly.

## Troubleshooting

Refer to the table below for disk cutter troubleshooting information. If you cannot resolve the issue, please contact Fischione Service ([service@fischione.com](mailto:service@fischione.com)).

Issue	Possible solution
Cutting is too slow	<p>If you have experience cutting materials of comparable hardness and thickness and the cutting rate is slower than experience would dictate:</p> <ul style="list-style-type: none"><li>• Add SiC powder around the base of the cutting tool.</li><li>• Reduce the amount of compression on the cutting tool by slightly raising the cutting head height.</li></ul>
Disk cutter stalls (no cutting occurs)	<ol style="list-style-type: none"><li>1. Move the ultrasonic transducer switch to the center position.</li><li>2. Lift the tool from the specimen material.</li><li>3. Add more SiC powder and water to the specimen surface.</li><li>4. Resume cutting.</li></ol>



E.A. Fischione Instruments, Inc.  
9003 Corporate Circle  
Export, PA 15632 USA  
Tel: +1 724.325.5444  
Fax: +1 724.325.5443  
[info@fischione.com](mailto:info@fischione.com)  
[www.fischione.com](http://www.fischione.com)