Dressed Blades versus Non Dressed Blades

- Low diamond exposure: Low machinability
- High diamond exposure: High machinability
- High loads
Profile Grinding

- Blade
- Sil. Car. Grinding wheel
- Angled cut
Advanced Dicing Technologies Ltd.

Dressing Machine
Nickel blade
17mic. Grit - 330x / 1000x
after Electropolishing

Nickel blade
17mic. Grit - 100x
after Electropolishing

Nickel blade
17mic. Grit - 100x
After fine grinding
with a Si. Ca. wheel
On Line Dressing

* After each cut the blades is passing a dressing media.

Sil. Carbide or Al. Oxide Dressing Stick.
Recommended dressing Procedure for Nickel Blades up to .003” thick

**On a Sil. Carbide dressing block:** - ADT P/N – 767- 000 - 001
- 10x cuts .002” deep at 6” / sec.
- 10x cuts .002” deeper than production depth at .2”/sec.
- 10x cuts .002” deeper than production depth at .5”/sec.

**On a blank Sil. wafer or on a production wafer:**
- 10x cuts .001” deeper than production depth at .1”/sec.
- Continue with .2”/sec steps 10-20x cuts depending on cut quality up to production speed.

**Hub blades recommended dressing procedure:**
- On a sil. Wafer 10-20 cuts at .5”/sec and gradually increasing the feed rate depending on kerf quality up to production speed

**Spindle speed:**
- 2” blades - 30-40Krpm
- 4” blades - 14-16Krpm
Recommended dressing Procedure for Nickel Blades Over .003” thick

On a Sil. Carbide dressing block:
- 20x cuts .002” deep at 6”/sec.
- 10x cuts .020” deep at .5”/sec
- Make a height calibration on the saw
- 10-20x cuts .001” - .002” deep at 1”/sec

On a production substrate:
- Depending on the material being diced, start at min. feed rate and at production depth.
  Increase the feed rate every 10-20x cuts depending on kerf quality up to production speed

Spindle speeds:
- 2” blade - 25-35Krpm
- 3” blade - 15-25Krpm
- 4” blades - 10-15Krpm
Pre dressed nickel blades are grounded on the edge to get a 90° flat edge and to expose the diamonds.

For best results, to minimize the load on the blade and get better cut quality, the following is recommended before production cuts.

- On a Sil. Carbide dressing block, make 20-30x cuts at .0005” - .001” cut depth and 1”/sec. Feed rate.

**Spindle speed:**
- 2” blades - 25-30Krpm
- 3” blades - 15-24Krpm
- 4” blades - 10-15Krpm
Follow this procedure to achieve the best cutting results, by dressing the blade on the dicing saw:

**New (unused) blade:**

A. Dressing the blade edge:

1) Dressing block - Sil. Car. 320 mesh ADT P/N 767--320-001
   
   3.5” x 1” x 3/16” (88.9 x 25.4 x 4.8mm)

   A 3mm thickness block is also available -
   
   ADT P/N 767-0320-001-030

2) Spindle speed 5Krpm

3) Cutting speed - 4”/sec (100mm/sec.)

4) Cut depth - .005” (0.13)mm)

Measure and set the dressing block thickness on each new dressing block prior to setting the .005” cut depth.

5) cut mode -scribe (cutting both directions)

6) Index - equal to blade thickness.

7) Number of cuts - to cut the entire length of the dressing block (3.5” / index)

*Do not perform “height” on the saw during this dressing*
BGA - Recommended Dressing Procedure for Nickel Blades 30, 50 & 70mic. Grit

Cont.

**B. Dressing the blade edge & side surface:**
1) Dressing block - Same as above.
2) Spindle speed - 2” blades - 20Krpm. 3” blades 15Krpm
3) Cutting speed - 1”/sec (25mm/sec)
4) Cut depth - .004” - (0.1mm) deeper than production depth
5) Cut mode - Dice
6) Index - .040” (1mm)
7) Number of cuts - 4x

**C. In process dressing (After production overloading):**
1) Dressing block - same.
2) Spindle speed - 5K
3) Cutting speed - 1”/sec (25mm/sec)
4) Cut depth - .004” (0.1mm) deeper than production depth
5) Cut mode - Dice
6) Index - .040” (1mm)
7) Number of cuts - 6-8x
Follow this procedure to achieve the best cutting results, by dressing the blade on the dicing saw:

**New (unused) blade:**

A. Dressing the blade edge:

1) Dressing block - Sil. Car. 320 mesh ADT P/N 767--320-001
   
   3.5” x 1” x 3/16” (88.9 x 25.4 x 4.8mm)

   A 3mm thickness block is also available -
   
   ADT P/N 767-0320-001-030

2) Spindle speed 5Krpm
3) Cutting speed - 4”/sec (100mm/sec.)
4) Cut depth - .003” (0.076)mm)

Measure and set the dressing block thickness on each new dressing block prior to setting the .003” cut depth.

5) cut mode -scribe (cutting both directions)
6) Index - equal to blade thickness.
7) Number of cuts - 40x

*Do not perform “height” on the saw during this dressing*
BGA - Recommended Dressing Procedure for Metal Sintered Blades 30, 50 & 70mic. Grit

Cont.

B. Dressing the blade edge & side surfaces:
   1) Dressing block - Same as above.
   2) Spindle speed - 2” blades - 20Krpm. 3” blades 15Krpm
   3) Cutting speed - .5”/sec (13 mm/sec)
   4) Cut depth - .002” - (0.05mm) deeper than production depth
   5) Cut mode - Dice
   6) Index - .040” (1mm)
   7) Number of cuts - 4x

Perform a height calibration prior to dicing production wafers

Remark:
The above dressing procedure should be optimized per each application
Re-Dressing During the Cutting Process

Powder residue from the dicing

Blade edge
Application Characteristics

- Spindle: Diameter, RPM, Torque, Vibrations
- Blade: Diameter, Thickness, Binder, Grit & %, Edge geom.
- Chuck, Fixture: Holding: Magnetic, E. Magnetic, Vacuum, M. Clamping
- Part: Material, Thickness, Straightness, Conductivity, Patterns
- Substrate: Glass, Alumina, Silicon, Lava, None
- Medium: Tape, None, Cement, Double stick, Wax
- Feed rate
- Coolant
- Substrate
- Spindle
- Blade
- Flange
- Part
- Medium
- Parting of the diagram indicates the flow of operations.
Cutting Mode

Dice mode

Blade

Scribe mode

Topside chipping

Table movement (X)
Application Characteristics
Mounting Methods

- Vacuum (Ring chuck)
- Glue, Wax
- Tape on vacuum
- Magnetic
  - Mechanical
  - Electrical
Special Clamping Methods

Fiber optic
Special Clamping Methods

Heavy gauge glass plate

-0.010”

90°

0.050”

Wax

Fibers
Special Mounting

Trimming 4 sides

Hard Al.

Mechanical clamp

Substrate

Mechanical vacuum / fixture

Vacuum

Release groove
Special Clamping

Mechanical / Laminated fixture on chuck for MLC - Green Ceramic

- Ash-free paper
- Green ceramic
- Aluminum plate
- Clamps
- Chuck
Special Clamping

Vacuum chuck

Clamps
Blade Cooling

Front view

Side view

Air knife
• **Direction & Flow rate:**
  
  **Main jet adjustment:**
  – Too low - does not provide effective cooling
  – Too high - may increase blade vibrations, blade straightness & poor substrate coolant
  – Too much pressure can lead to die lift off
Coolant additives results in:

- Lowers the surface tension of the coolant for better coolant penetration.
- Minimizes the load
- Better washing of dicing dust
The Effect of Hub Geometry on the Coolant Flow

- Vacuum chuck
- Dicing blade
- Normal water flow
- Deflected water flow by the air knife effect
- Old hub design
- Air knife
- Sil. wafer
- Tape
Effect of hub geometry on Die lift off / Blade Breakage

- Dicing blade
- Die lift off
- Die hitting the blade
- Vacuum chuck
- Sil. wafer
- High water flow lifting the die
- Air knife
- Deflected water flow by the air knife effect
- Tape

Old hub design
The Effect of Hub Geometry on the Coolant flow

- Vacuum chuck
- Sil. wafer
- New hub design
- Air knife
- Deflected water flow by the air knife effect
- Dicing blade
- Normal water flow
- Tape

Advanced Dicing Technologies Ltd.
Effect of Hub Geometry on Die Lift off / Blade Breakage

- Dicing blade
- New hub design
- Air knife
- Deflected water flow by the air knife effect
- High water flow lifting the die
- Sil. wafer
- Die lift off
- Die far away from the blade exposure
- Vacuum chuck
- Tap
Blade Characteristics

Green Ceramic diced with nickel serrated

.6” thick Green Cer. (M.L.C.) diced with a 5” O.D. nickel serrated blade
High Cooling Flange set-up

Coolant

Front guard

Cooling nozzle
High Cooling Flange set-up
Blade Wear - Coolant Compensation

Standard small dia. Cooling nozzle

Wide long opening Cooling nozzle
Cutting Through into Tape

- Silicon wafer or others
- Tape
- Adhesive

- .0002” (0.005mm)
- .001” min. (0.025mm)
Maximum Recommended Blade Exposure:

**Nickel Blades**
- Blade thickness X 30

**Sintered Blades**
- Blade thickness X 20

**Resin Blades**
- Blade thickness X 10

\[ E = A + S + \frac{T}{2} \]

- **A** = min .300mm (12mil)
- **T** = Blade Thickness
- **S** = Substrate thickness
Recommended exposure left on thin blades for Sil. application

Min. Exp. Left
.005” (0.127mm)

Max Exp. Left
.010” (0.254mm)

Exposure Left
The Theoretical max. radius on the blade edge = 50% of blade thickness

$$R = \frac{T}{2}$$

It is important to dice .005” - .010” (0.13-0.25mm)

A shallower cut will result in a lip effect at the back side = Back side chipping & device size issues
Kerf Profile Measurement

<table>
<thead>
<tr>
<th>Measurement location</th>
<th>Kerf width um</th>
</tr>
</thead>
<tbody>
<tr>
<td>W4-W1</td>
<td>22</td>
</tr>
<tr>
<td>W4-W2</td>
<td>8</td>
</tr>
<tr>
<td>W4-W3</td>
<td>3</td>
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<tr>
<td>W1=0.050</td>
<td>236</td>
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<tr>
<td>W2=0.075</td>
<td>250</td>
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<tr>
<td>W3=0.100</td>
<td>253</td>
</tr>
<tr>
<td>W4=0.300</td>
<td>258</td>
</tr>
<tr>
<td>Height</td>
<td>70/70</td>
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</table>

Kerf width

<table>
<thead>
<tr>
<th>Measurement location</th>
<th>Kerf width um</th>
</tr>
</thead>
<tbody>
<tr>
<td>W-1</td>
<td>0.258mm</td>
</tr>
<tr>
<td>W-2</td>
<td>0.250mm</td>
</tr>
<tr>
<td>W-3</td>
<td>0.253mm</td>
</tr>
<tr>
<td>W-4</td>
<td>0.236mm</td>
</tr>
</tbody>
</table>

Height 70/70
Process Parameters
Cut Depth into tape

Deeper cut

- Deeper cut reduces blade radius affect.
- Optimum cut depth = 0.5 x blade thickness.
**Wet process:**
Using nickel serrated blades 17, 30, 50 & 70mic. Grit
For better cut quality anon serrated blade can be used

**Dry Process:**
Using nickel blades and Tungsten carbides
(Same diamond grit as with the wet process)

**Nickel blade:**
Advantages - Minimum blade wear
Easy handling
Availability
Disadvantages - Powder build-up
Extra blade cleaning is needed

**Tungsten carbide blade:**
Advantages - A cleaner cut in some applications
Disadvantages - Short life, poor availability, blade breakage
Major Applications - Material Dicing Guide
### Material Dicing Guide - Blade related

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard</td>
<td></td>
<td></td>
<td>Resin, Grit</td>
<td>Nick., Grit</td>
</tr>
<tr>
<td>Sapphire</td>
<td>Yes</td>
<td></td>
<td>QKP 53,63</td>
<td>No</td>
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<tr>
<td>Ruby</td>
<td>Yes</td>
<td></td>
<td>GWK 53,63</td>
<td>No</td>
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<tr>
<td>Alumi. Nitride</td>
<td>Yes</td>
<td></td>
<td>KUP, RUP 63-105</td>
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<tr>
<td>Alumina</td>
<td>Yes</td>
<td></td>
<td>KUP, RUP 45-63</td>
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<tr>
<td>Titanium Car.</td>
<td>Yes</td>
<td></td>
<td>KUP, QKP 30-53</td>
<td>Yes</td>
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<tr>
<td>Kovar</td>
<td>No</td>
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<td>AUP 53,63</td>
<td>No</td>
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<tr>
<td>Quartz</td>
<td>Yes</td>
<td></td>
<td>QIP, KUP 30</td>
<td>No</td>
</tr>
<tr>
<td>Glass / Pyrex</td>
<td>Yes</td>
<td></td>
<td>KUP, QIP 30,45</td>
<td>No</td>
</tr>
<tr>
<td>PZT</td>
<td>Yes</td>
<td></td>
<td>AUP 9-45</td>
<td>Yes</td>
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<tr>
<td>Barium Titan.</td>
<td>No</td>
<td></td>
<td>QUP, QKP 20-45</td>
<td>No</td>
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<tr>
<td>Led Telluride</td>
<td>Yes</td>
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<tr>
<td>Lithium Niob.</td>
<td>Yes</td>
<td></td>
<td>KUP, QUP 15-30</td>
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<tr>
<td>Bismuth Telur.</td>
<td>Yes</td>
<td></td>
<td>RUP, KUP 45,53</td>
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</tr>
<tr>
<td>Silicon</td>
<td>Yes</td>
<td></td>
<td>QUP 9</td>
<td>Yes</td>
</tr>
<tr>
<td>GaAs</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferrite</td>
<td>Yes</td>
<td></td>
<td>AUP, QIP 4-30</td>
<td>Yes</td>
</tr>
<tr>
<td>QFN</td>
<td>No</td>
<td></td>
<td>E06,T04&amp;6 53-70</td>
<td>No</td>
</tr>
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</table>
## Popular Resin Matrices

<table>
<thead>
<tr>
<th>Matrix Code</th>
<th>Hardn.</th>
<th>Subst. Material</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUP, RFP</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>KUP &amp; KKP</td>
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<tr>
<td>IUP</td>
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<tr>
<td>QUP</td>
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<td>QKP</td>
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<td>QIP</td>
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<tr>
<td>AIP</td>
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</table>

<table>
<thead>
<tr>
<th>E- Series: E01, E03, E06</th>
</tr>
</thead>
<tbody>
<tr>
<td>To minimize wear and improve cut quality on QFN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T- Series: T04 &amp; T06</th>
</tr>
</thead>
<tbody>
<tr>
<td>New developments for QFN</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>C- Matrices: C02 &amp; C03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved wear and quality for hard Alumina</td>
</tr>
</tbody>
</table>

- **Hardn.**
- **Subst. Material**
- **Remarks**

### Hard Alumina and others.
- Graphite Fib. Min. Wear.

- **Hard Al., some Glass, Bismuth Tel. Others**
- **Best wear on new matrix.**

- **------"------ , Al. Nitr. T.Carbide, Lithium - -Niobate, others.**
- **Direct [First] replacement to our Standard m.**

- **Same as above but thicker subst., more Loading.**
- **Softer than KUP**

- **Same subst.materials as KUP but more Brittle.**
- **Will Minimize chipping.**

- **Same subst. materials as KUP but more brittle & thicker.**
- **Will minimize Chipping & loading.**

- **Sapphire & Ruby**
- **53 & 63mic grit**

- **Quartz, Glass, Barium Titanate & other brittle mat.**
- **Soft wearing mat. resulting in good edge quality.**

- **PZT, some thicker Al. Kovar, some ferrites.**
- **Soft resin but high dia. % For small grits.**

- **Hard materials Requiring high blade wear**
- **V. Soft bond with Low diamond %**
# Resinoid Blade Selection

## Resin matrix types

<table>
<thead>
<tr>
<th>Resin type</th>
<th>Cut Quality</th>
<th>Blade life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>QIP</td>
<td></td>
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<tr>
<td></td>
<td>QKP</td>
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</tr>
<tr>
<td></td>
<td>QUP</td>
<td>C03</td>
</tr>
<tr>
<td>K</td>
<td>KIP</td>
<td>T06</td>
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<tr>
<td></td>
<td>KKP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>KUP</td>
<td>C02</td>
</tr>
<tr>
<td>R</td>
<td>RUP</td>
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</tr>
<tr>
<td></td>
<td>RFP</td>
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</tr>
<tr>
<td>E</td>
<td>E03</td>
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<tr>
<td></td>
<td>E01</td>
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<tr>
<td>T</td>
<td>T04</td>
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<tr>
<td>C</td>
<td>C03</td>
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</tr>
<tr>
<td></td>
<td>C02</td>
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</table>
# Material Dicing Guide - Blade related

<table>
<thead>
<tr>
<th>Blade Type</th>
<th>Diamond size Micron</th>
<th>Product</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel Blade</td>
<td>30,50,70</td>
<td>PBGA</td>
<td>FR4, Plastic &amp; BT Resin</td>
</tr>
<tr>
<td></td>
<td>6-8,10,17</td>
<td>PCB</td>
<td>FR4 &amp; Copper</td>
</tr>
<tr>
<td></td>
<td>3-6,10,17</td>
<td>Magnetic &amp; Tape Heads</td>
<td>TiC &amp; Ferrite</td>
</tr>
<tr>
<td></td>
<td>2-4,4-8,10</td>
<td>Ultrasound Sensors</td>
<td>PZT</td>
</tr>
<tr>
<td></td>
<td>2-4,3-6</td>
<td>Active Devices (Discrete)</td>
<td>GaAs</td>
</tr>
<tr>
<td></td>
<td>4-8</td>
<td>SAW Devices</td>
<td>LiNbO3, LiTaO3</td>
</tr>
<tr>
<td>Steel Core Ni Blades</td>
<td>30,50,70</td>
<td>MLC (Multi Layer Capacitors)</td>
<td>Green Ceramic</td>
</tr>
<tr>
<td></td>
<td>30,50</td>
<td>PBGA</td>
<td>FR4, Plastic &amp; BT Resin</td>
</tr>
<tr>
<td>Resinoid Blades</td>
<td>53,88,105</td>
<td>CBGA</td>
<td>Alumina</td>
</tr>
<tr>
<td></td>
<td>53,63,88</td>
<td>Ceramic Packages</td>
<td>Alumina</td>
</tr>
<tr>
<td></td>
<td>75,88,105</td>
<td>QFN/MLP (F/C &amp; H/E)</td>
<td>Copper + Resin</td>
</tr>
<tr>
<td></td>
<td>15,20,30</td>
<td>SAW Devices</td>
<td>Quartz, LiNbO3, LiTaO3</td>
</tr>
<tr>
<td></td>
<td>6,9</td>
<td>Tape for VTR</td>
<td>Ferrite</td>
</tr>
<tr>
<td></td>
<td>30,45</td>
<td>Ink Jet Print Heads, Fiber Optics</td>
<td>Glass, Quartz</td>
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<tr>
<td>Sintered Blades</td>
<td>9,15,25</td>
<td>Magnetic Heads</td>
<td>TiC</td>
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<tr>
<td></td>
<td>30,50</td>
<td>PBGA (Tape &amp; Tapless application)</td>
<td>FR4, Plastic &amp; BT Resin</td>
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<td></td>
<td>9,10,15</td>
<td>Fiber Optics</td>
<td>Glass, Quartz</td>
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<tr>
<td></td>
<td>30,40,50</td>
<td>QFN/MLP (H/E)</td>
<td>Copper + Resin</td>
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<tr>
<td></td>
<td>20,30,40</td>
<td>Ceramic Packages</td>
<td>Alumina</td>
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## Blade Selection

### Recommended Values

<table>
<thead>
<tr>
<th>Product</th>
<th>Material</th>
<th>Blade Type</th>
<th>Blade O.D</th>
<th>Matrix</th>
<th>Diamond size</th>
<th>Spindle Speed</th>
<th>Feed Rate</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mic</td>
<td>mm/s, KRPM</td>
<td>mm/s, Inch/s</td>
</tr>
<tr>
<td><strong>PBGA</strong></td>
<td>Epoxy &amp; Molding</td>
<td>Sintered / Nickel</td>
<td>2&quot;</td>
<td>3&quot;</td>
<td>30, 40, 50</td>
<td>2&quot;: 30-45; 3&quot;: 20-30</td>
<td>100-200, 4-8</td>
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<tr>
<td></td>
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<td></td>
<td>3&quot;</td>
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<td></td>
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</tr>
<tr>
<td><strong>QFN</strong></td>
<td>Cooper &amp; Molding</td>
<td>Resin</td>
<td>2&quot;</td>
<td>3&quot;</td>
<td>Resin: E type</td>
<td>88, 105, 125</td>
<td>2&quot;: 25-30; 3&quot;: 15-28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PCB</strong></td>
<td>FR4 / Epoxy &amp; Cooper</td>
<td>Nickel</td>
<td>2&quot;</td>
<td>&quot;T&quot;, &quot;V&quot;, &quot;Z&quot;</td>
<td>10, 13, 17</td>
<td>2&quot;: 25-30; 4&quot;: 15-28</td>
<td>100-150, 4-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4&quot;</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ceramic Packages</td>
<td>Alumina</td>
<td>Resin</td>
<td>2&quot;</td>
<td>* KUP, RUP</td>
<td>45, 53, 63</td>
<td>18-28</td>
<td>4-20, 0.15-0.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4&quot;</td>
<td></td>
<td></td>
<td>10-18</td>
<td></td>
</tr>
<tr>
<td>Multi Layer Capacitor</td>
<td>Green Ceramic, Steel Core</td>
<td>Nickel</td>
<td>4&quot;</td>
<td></td>
<td>30, 50, 70</td>
<td>12-18</td>
<td>100-250, 4-10</td>
</tr>
<tr>
<td>Ultrasound Sensors</td>
<td>PZT</td>
<td>Nickel</td>
<td>2&quot;</td>
<td></td>
<td>2-4, 4-8, 10</td>
<td>25-35</td>
<td>0.5-10, 0.02-0.4</td>
</tr>
<tr>
<td>IC</td>
<td>Silicon</td>
<td>Nickel</td>
<td>2&quot;</td>
<td></td>
<td>2-4, 3-6</td>
<td>30-50</td>
<td>25-75, 1-3</td>
</tr>
</tbody>
</table>
### Recommended Values (cont.)

<table>
<thead>
<tr>
<th>Product</th>
<th>Material</th>
<th>Blade Type</th>
<th>Blade O.D</th>
<th>Matrix</th>
<th>Diamond size mic</th>
<th>Spindle Speed KRPM</th>
<th>Feed Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical and Electro-Optics components</td>
<td>Sapphire</td>
<td>Resin</td>
<td>2&quot; 4&quot;</td>
<td>* QIP , QKP , QUP</td>
<td>30, 45, 53</td>
<td>16-20</td>
<td>1-10</td>
</tr>
<tr>
<td>Fiber Optics components</td>
<td>Quartz</td>
<td>Resin</td>
<td>2&quot; 4&quot;</td>
<td>* QIP , QKP , QUP</td>
<td>30, 45, 53</td>
<td>18-30</td>
<td>2-10</td>
</tr>
<tr>
<td>Fiber Optics components</td>
<td>Glass / Fused Silica</td>
<td>Resin</td>
<td>2&quot; 4&quot;</td>
<td>* QIP , QKP , QUP</td>
<td>30, 45, 53</td>
<td>16-30</td>
<td>2-10</td>
</tr>
<tr>
<td>Fiber Optics components</td>
<td>Si On Glass</td>
<td>Resin</td>
<td>2&quot; 4&quot;</td>
<td>* QIP , QKP , QUP</td>
<td>9, 15, 25</td>
<td>20-30</td>
<td>0.5-2.5</td>
</tr>
<tr>
<td>SAW Devices</td>
<td>Quartz</td>
<td>Resin</td>
<td>2&quot; 4&quot;</td>
<td>* QUP , KUP , RUP</td>
<td>30, 45, 53</td>
<td>18-30</td>
<td>2-10</td>
</tr>
<tr>
<td>SAW Devices</td>
<td>LiNbO3 ; LiTaO3</td>
<td>Nickel / Resin</td>
<td>2&quot;</td>
<td>* QUP , KUP , RUP</td>
<td>Nickel: 4-8 Resin: 15, 20, 30</td>
<td>16-30</td>
<td>2-10</td>
</tr>
<tr>
<td>Tape Head</td>
<td>Ferrite</td>
<td>Resin / Nickel</td>
<td>2&quot;</td>
<td>* QUP , KUP , RUP</td>
<td>Nickel: 3-6, 4-8, 10 Resin: 15, 20, 30</td>
<td>25-35</td>
<td>2-10</td>
</tr>
<tr>
<td>Magnetic Heads</td>
<td>AlTiCO3</td>
<td>Sintered / Nickel</td>
<td>4&quot;</td>
<td></td>
<td>Sintered: 10, 17 Nickel: 3-6, 10, 15 Parting: 8-12</td>
<td>Slicing: 8-12</td>
<td>1-5</td>
</tr>
</tbody>
</table>
## Maximum Recommended Spindle RPM - *(Safety - only)*

<table>
<thead>
<tr>
<th>Nickel Blades:</th>
<th>Resinoid:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2” O.D. - 40 - 60Krpm</td>
<td>2” up to .015” thick - 35Krpm</td>
</tr>
<tr>
<td>3” O.D. - 35Krpm</td>
<td>2” .016” - .025” thick - 25Krpm</td>
</tr>
<tr>
<td>4” O.D. - 30Krpm</td>
<td>2” .026” - .035” thick - 20Krpm</td>
</tr>
<tr>
<td><strong>M. Sintered:</strong></td>
<td>3” up to .015” thick - 25Krpm</td>
</tr>
<tr>
<td>2” O.D. - 40 - 60Krpm</td>
<td>3” .016” - .025” thick - 22Krpm</td>
</tr>
<tr>
<td>3” O.D. - 35Krpm</td>
<td>3” .026” - .035” thick - 16Krpm</td>
</tr>
<tr>
<td>4” O.D. - 30Krpm</td>
<td>4” up to .015” thick - 16Krpm</td>
</tr>
<tr>
<td></td>
<td>4” .016” - .025” thick - 14Krpm</td>
</tr>
<tr>
<td></td>
<td>4” .026” - .035” thick - 12Krpm</td>
</tr>
</tbody>
</table>