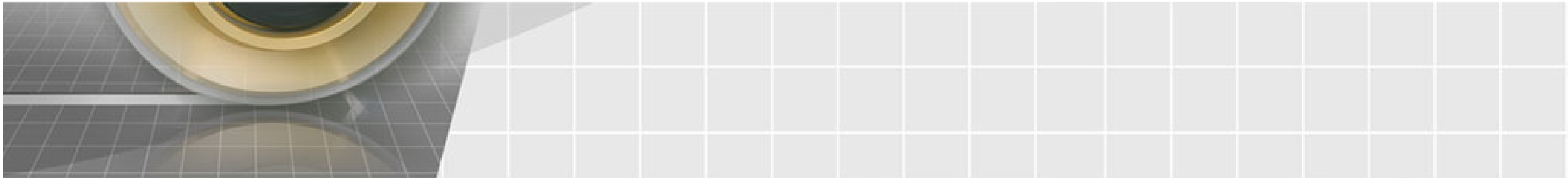


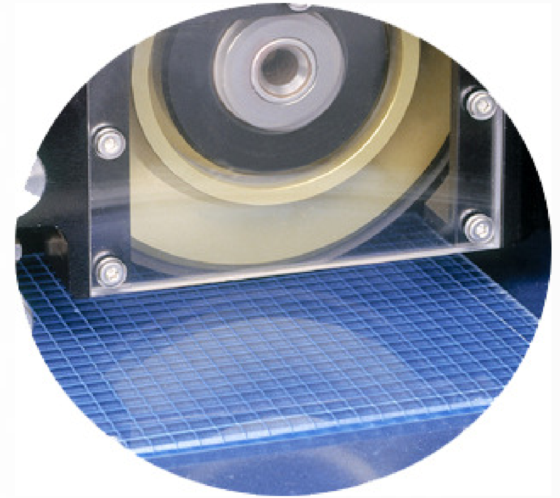
Major Applications - Dicing guide

ADT = Dicing
Advanced Dicing Technologies

Glass Applications

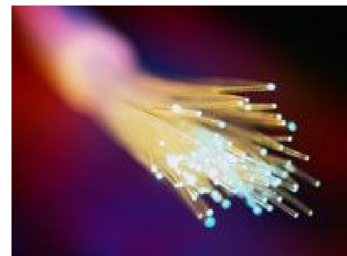
Dicing Glass – Optical Devices

-Blade Characteristics



- 2”, 4” Resin Type “Q”
- Diamond grit size: 15 - 45 mic.
- Thickness: 0.006-0.012” (0.15mm – 0.3mm)
- **Metal Sintered – E08 & New matrices 8-25 mic.**
- Thickness - .004” - .008”

-Cutting Parameters



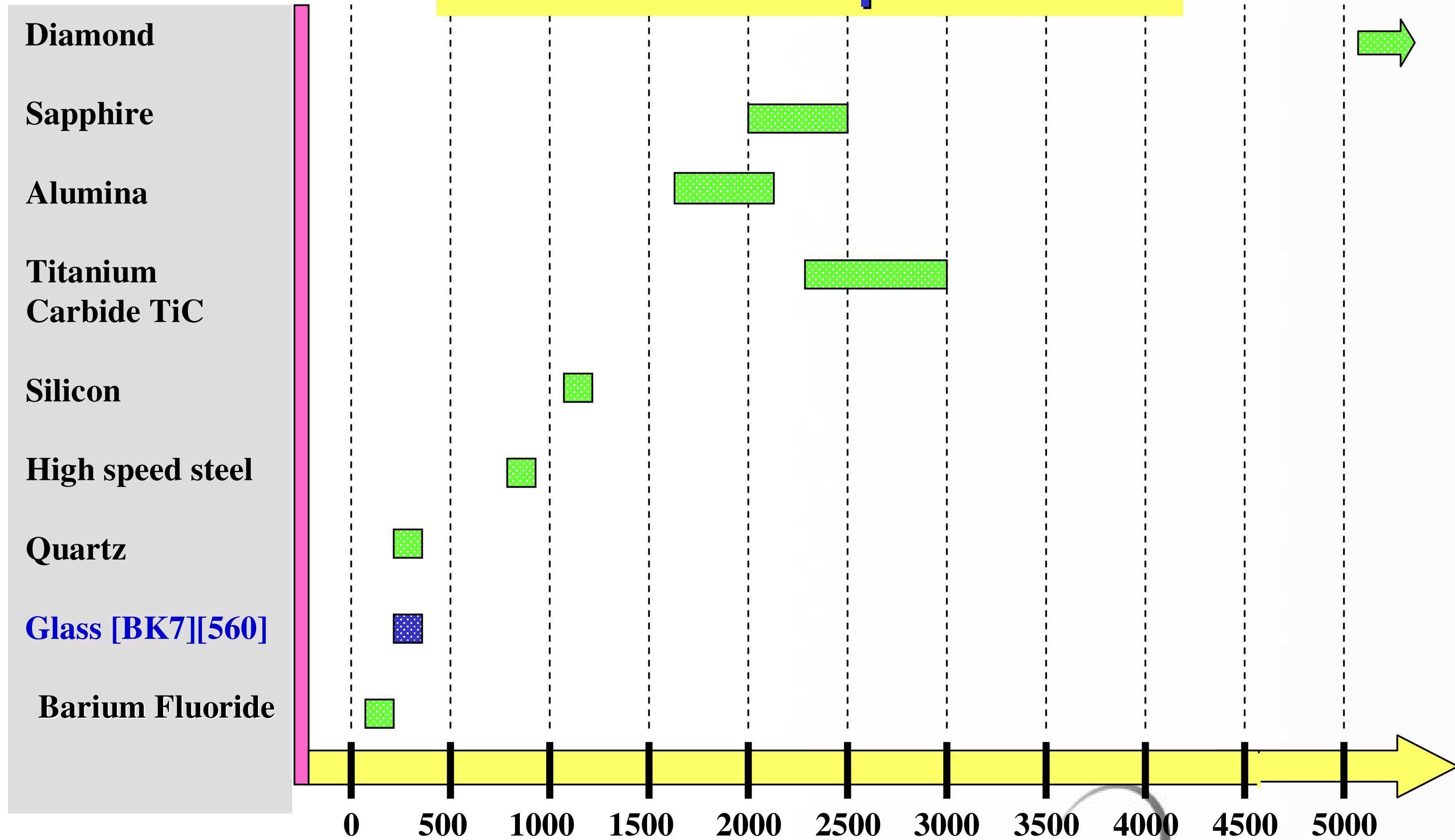
- Feed rate: 2-10 mm/sec
- Spindle speed:
  - 2”: 18-30 krpm
  - 4”: 8-16 krpm

ADT = Dicing
Advanced Dicing Technologies

Dicing Glass Characteristics:

- Brittle material – tends to chip
- Relatively soft material
- Will load during dicing
  - Cut perpendicularity problems
- Problematic mounting - Back side chipping
- Surface finish issues

Dicing Glass & Fiber Optic Applications

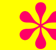


ADT = Dicing
Advanced Dicing Technologies

#

Nickel Binders
Will Overload

Metal Sintered
May Work only
On some thin
Substrates

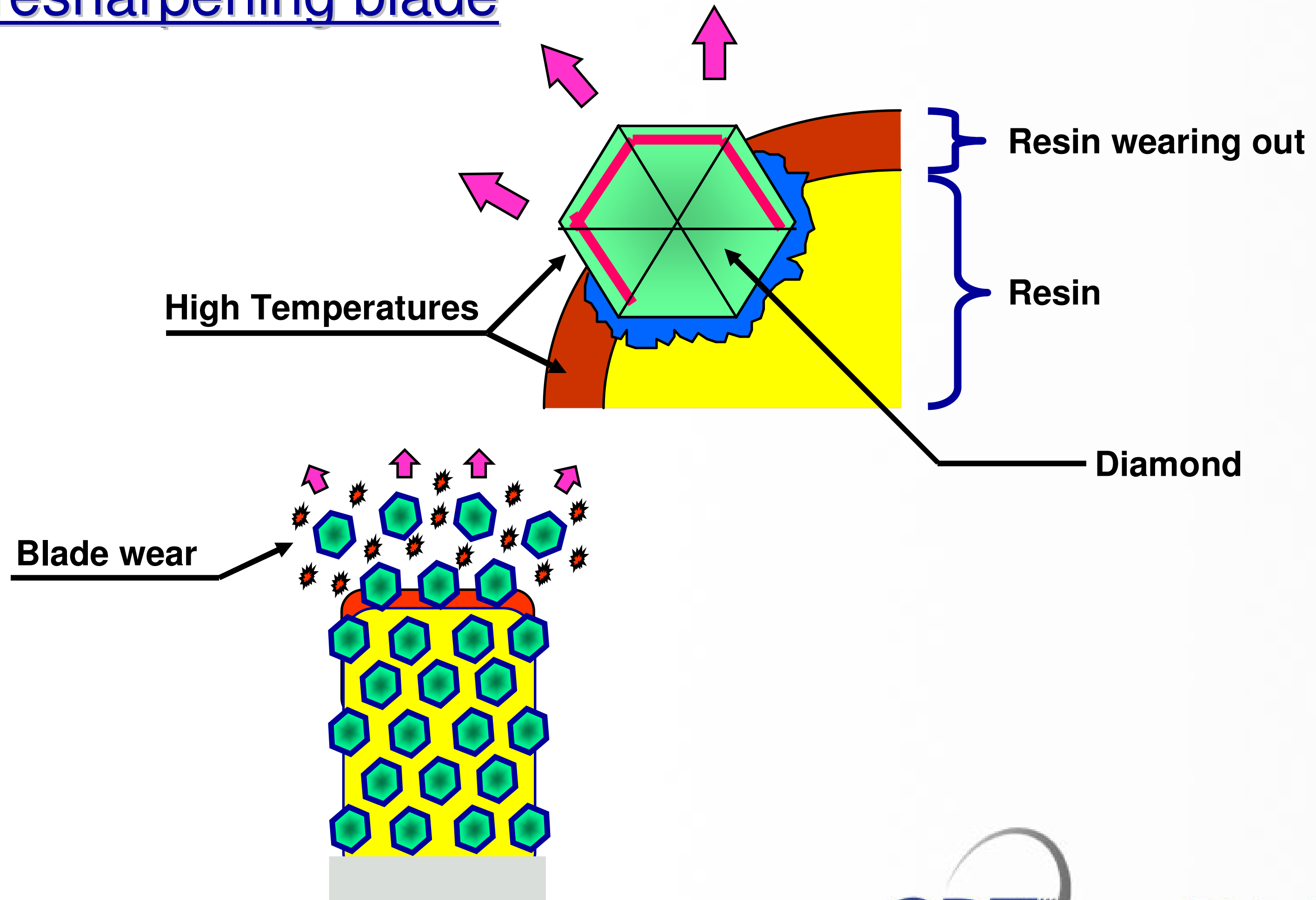


Resinoid Binders
Perform with
Minimum loading
And best cut quality

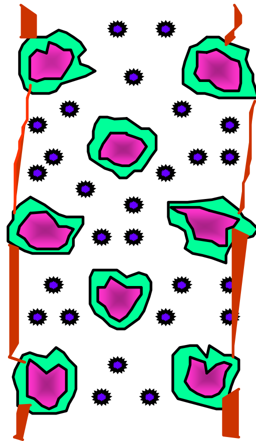
Nickel & M. Sintered Matrices can be used on some special Glass applications

ADT = Dicing
Advanced Dicing Technologies

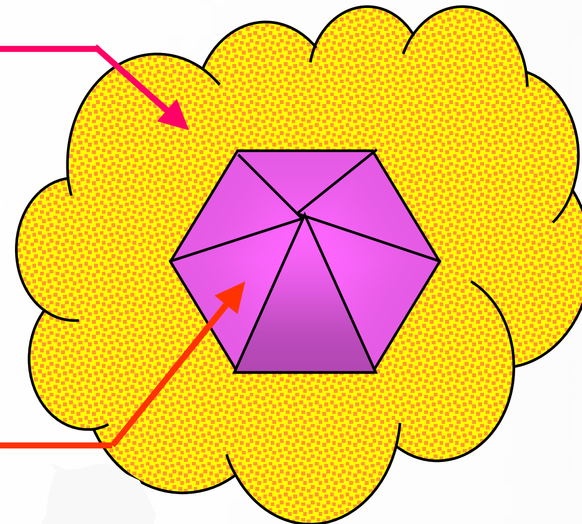
Self resharpening blade



Resinoid - matrix characteristics



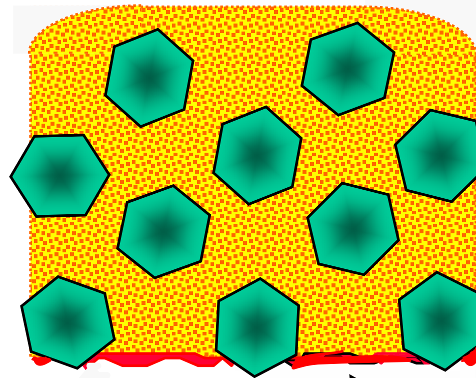
No nickel coating on Diamonds.



- Two stage curing.
- Carbon powder for electrical conductivity.

* **Higher wear.**
* **Finer cut.**

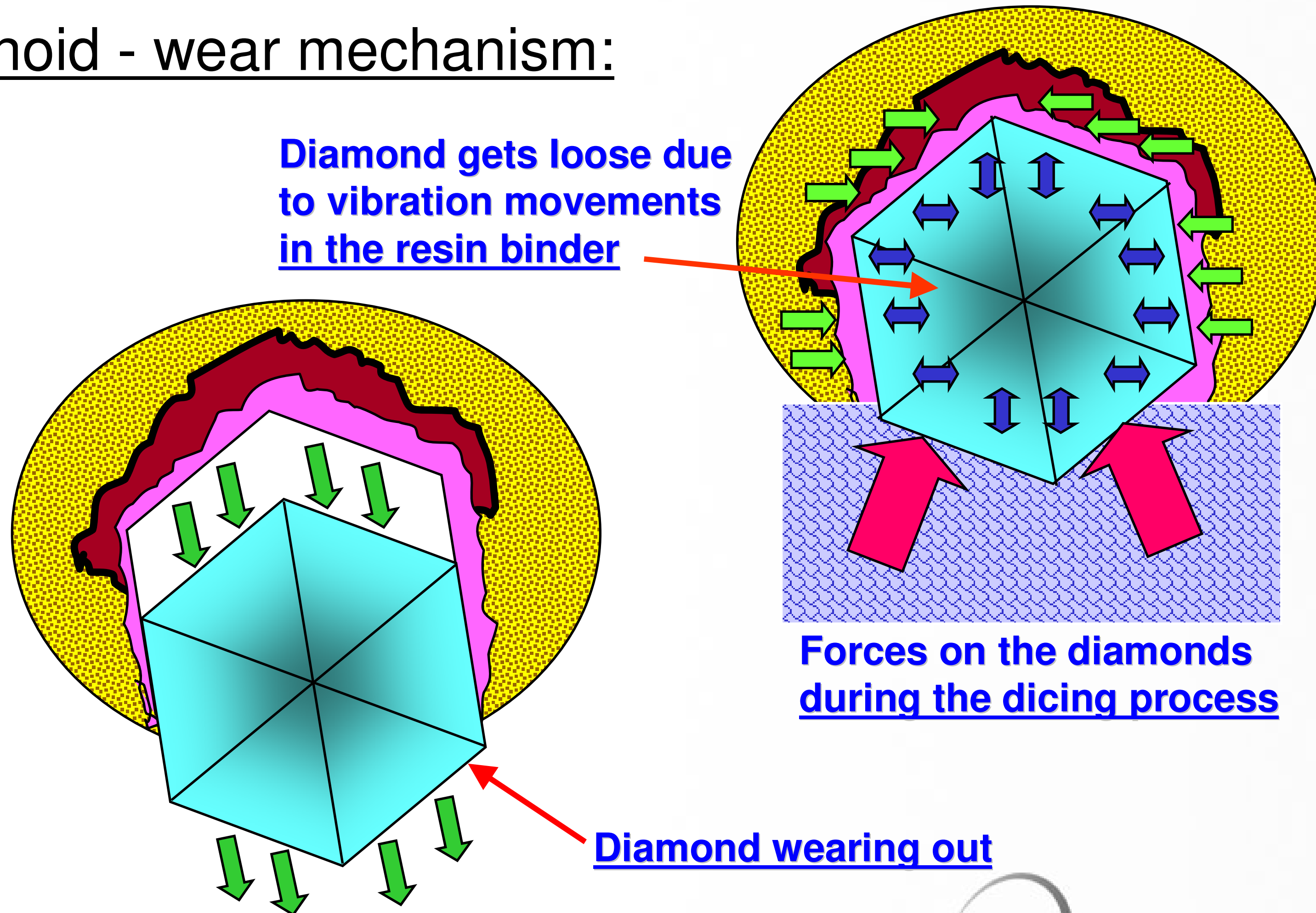
Resinoid - Low diamond %



Powder residue.

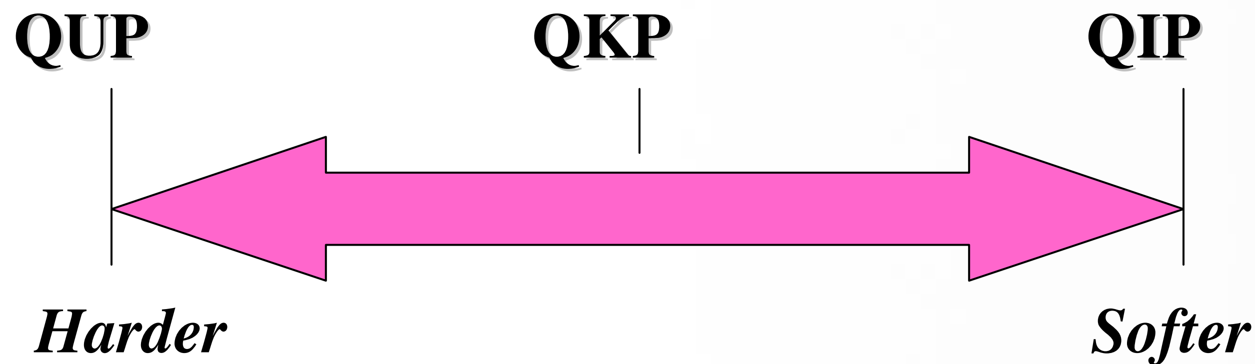
* Less loading.
* Freer dicing.
* Higher wear.
* Better cut quality.

Resinoid - wear mechanism:



Dicing Glass & Fiber Optic Applications

Popular resin binders for dicing glass

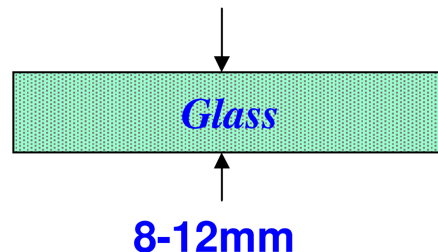


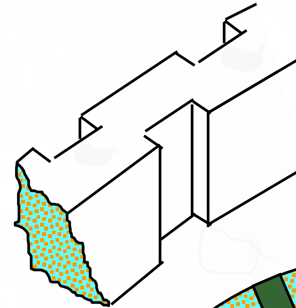
P/N Example – 00777-8045-008-QUP

Diamond grit sizes: - 15 - 45mic. 3 & 6mic. For special communication app.

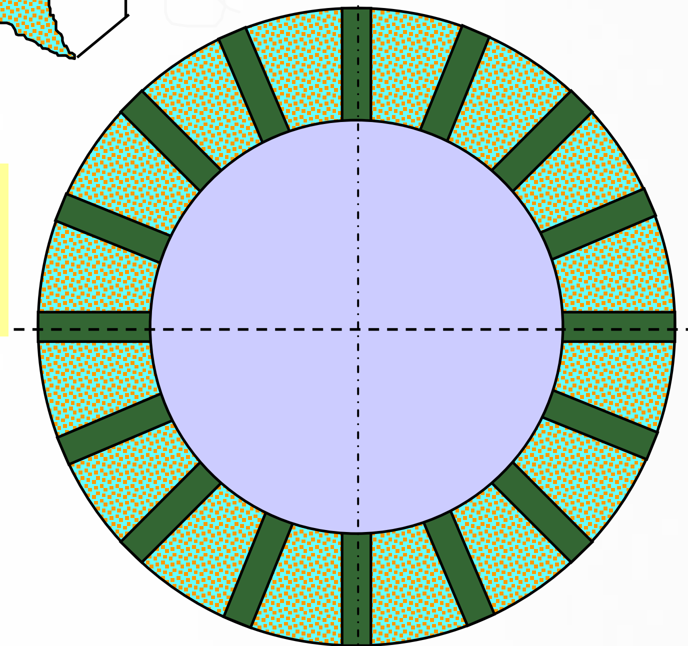
Dicing Glass & Fiber Optic Applications

Thick glass substrates:





-SPG + Larger Diamond grits Up to 88mic.



- **Minimizes loads and wear during the dicing process**
- **Min. thickness .015", in some cases .012"**
- **Can be used with standard flange sets or with high cooling flange sets**

ADT = Dicing
Advanced Dicing Technologies

Dicing Glass & Fiber Optic Applications

Application Test - # 1

Substrate:
Material: Glass - Sio2
Substrate size: - 1”x 1”
Thickness: - 0.2mm [.0078”]

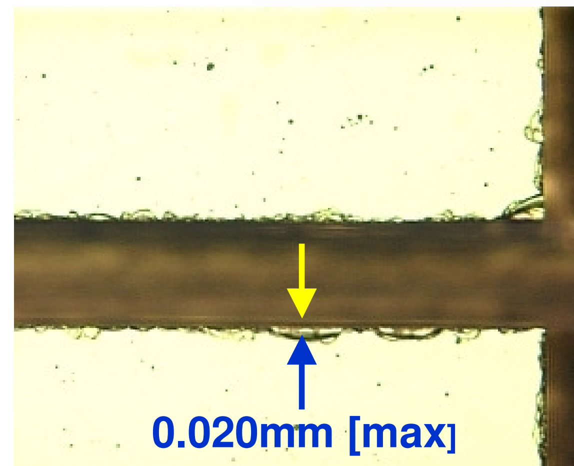
Cutting parameters:
Spindle:- 26Krpm
Feed rate:- 1mm/sec
Cut depth:- .010” [0.25mm/sec]
Coolant:- Tap water 3.5 L / min.

Saw being used: - ADT - 7100 / 2”

Process:
Mounting:- UV Advill D-210
Blade matrix:- ADT Resinoid
Blade O.D.:- 2.188”
Blade thickness:- .006”[.152mm]
Blade exposure:- .033”[0.86mm]
Diamond grit:- 20mic.
Blade P/N:- 777-1020-006-QIP

Cutting results:
Top side chipping - <.00078” [0.020mm]
Cracks - No Cracks
Final Die size:- .0299”x.0275” [0.70x0.76mm]

Application Test - # 1



Application Test - # 2

Substrate:
Material: Glass - BK7 AR coated
Substrate size: - 2” Dia.
Thickness: - 9.65mm

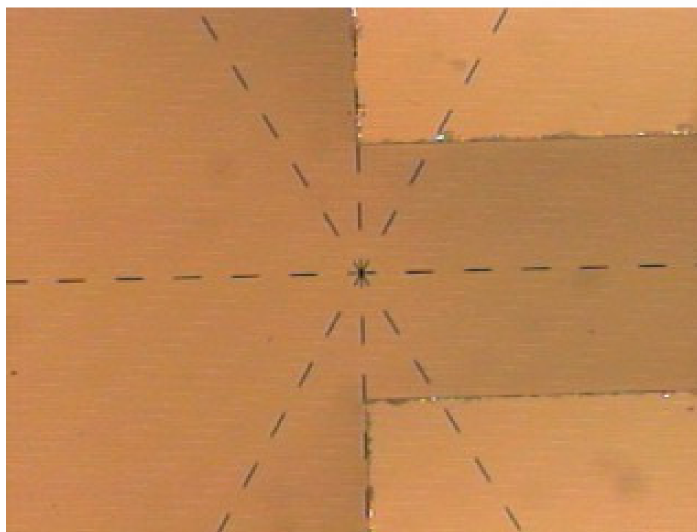
Cutting parameters:
Spindle:- 12Krpm
Feed rate:- 0.5mm/sec
Cut depth:- 10.49mm [.413”]
Coolant:- Tap water 3.5 L / min.

Saw being used: - ADT - 7100 / 4”

Process:
Mounting:- Glass to Glass by wax + Furukawa UV on top to protect the top coating
Blade matrix:- ADT Resinoid
Blade O.D.:- 5”
Blade thickness:- .030”
Blade exposure:- .50”
Diamond grit:- 53mic.
Blade P/N:- 777- 5053- 030-SPG

Cutting results:
Kerf:- 0.776mm [.0305”]
Top side chipping - Ave.0.015mm
Max. 0.35mm
Back side chipping:-
Final Die size:- Ave.0.045mm
Max.0.065mm

Application Test - # 2



Dicing Glass & Fiber Optic Applications

Application Test - # 3 - Fiber optic switch

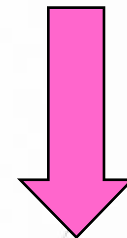
Substrate:
Material: Glass - Plastic Package with glass fibers
Substrate size: - 11.4x7.62mm [.448"x.3"]
Thickness: - 2.5mm [.098"]

Cutting parameters:
Spindle:- 28Krpm
Feed rate:- 1 - 10mm/sec
Cut depth:- 2.7mm [.106"]
Coolant:- Tap water / 3.0L/min

Saw being used: - ADT - 7100 / 4"

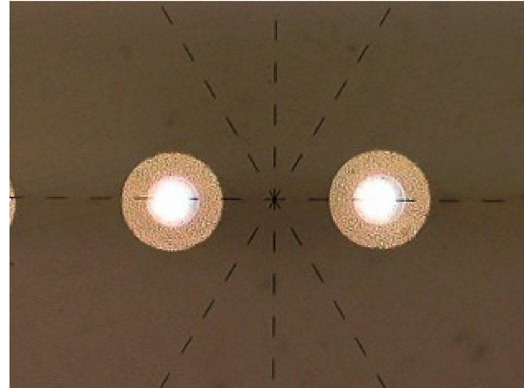
Process:
Mounting:- Mechanical clamping
Blade matrix:- ADT Nickel
Blade O.D.:- 2.188"
Blade thickness:- .007"[Lapped]
Blade exposure:- 3.15mm [.124"]
Diamond grit:- 10mic.
Blade P/N:- 1776-2301-070-BLO
Dressing:- ADT - Sil. Car . 600mesh

Cutting results:
Top side chipping - The best at 1mm /sec with 0.001mm chipping

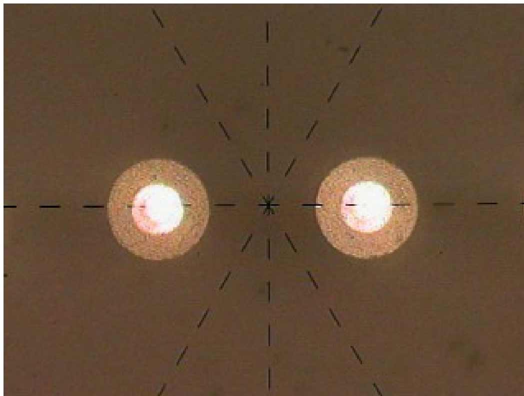


ADT = Dicing
Advanced Dicing Technologies

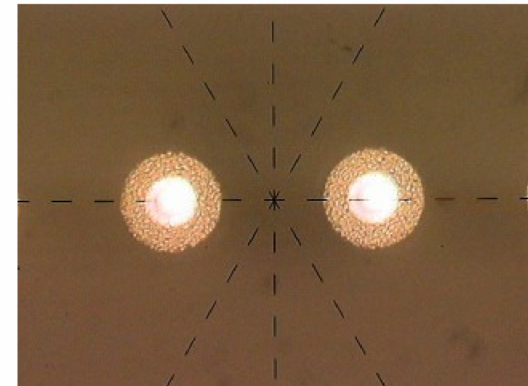
Application Test - # 3



Cross section [100x]
Feed rate 1mm/sec



Cross section [100x]
Feed rate 5mm/sec



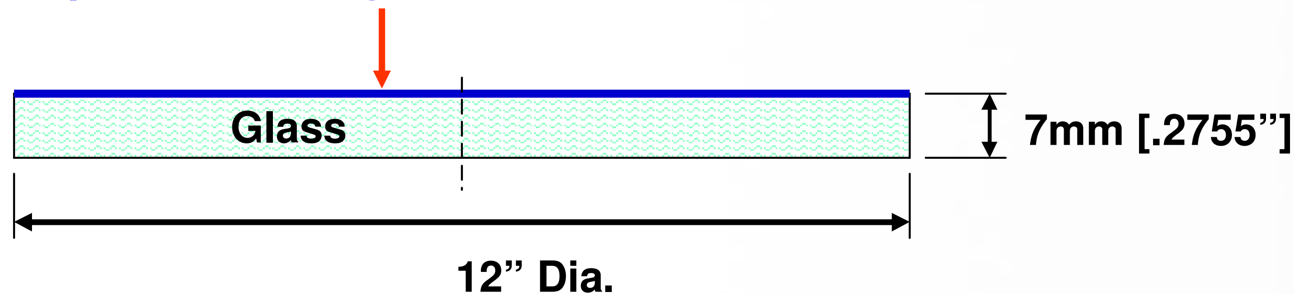
Cross section [100x]
Feed rate 10 mm/sec

Application Test - # 4

Saw being used: - ADT - 7100 / 4”

Substrate:
Material: Round Glass
Substrate size: - 12” Dia.
Thickness: - 7mm .2755”]
Special coating:- 0.030mm [.0012”]

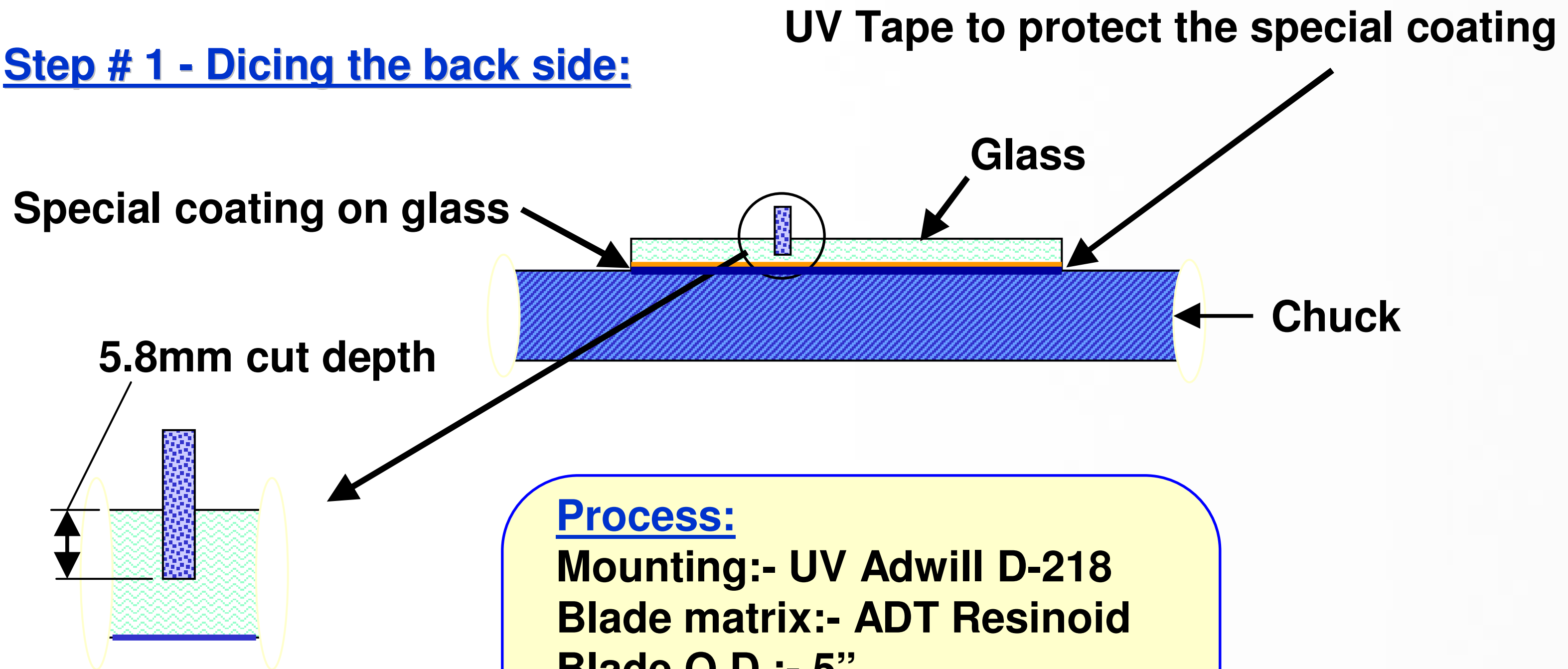
Customer request:
Dice in 2x passes



Dicing Glass & Fiber Optic Applications

Application Test - # 4

Step # 1 - Dicing the back side:



Process:
Mounting:- UV Adwill D-218
Blade matrix:- ADT Resinoid
Blade O.D.:- 5"
Blade thickness:- .025"
Blade exposure:- .350"
Diamond grit:- 53mic.
Blade P/N:- 777- 5053- 025-SPG

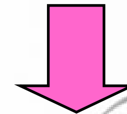
ADT = Dicing
Advanced Dicing Technologies

Application Test - # 4

Saw being used: - ADT - 7100 / 4”

Cutting parameters:
Spindle:- 12Krpm
Feed rate:- 1mm/sec
Cut depth:- 5.8mm [.228”]
Coolant:- Over 3 Liters / min.

Cutting results:
Kerf:- 0.670mm [.0263”]
Top side chipping:
Average < 0.030mm [.0012”]
Max. 0.079mm [.0031”]
Cracks - No cracks



Application Test - # 4

Step # 2 - Dicing the remaining thickness
Top coating up

Top Coating

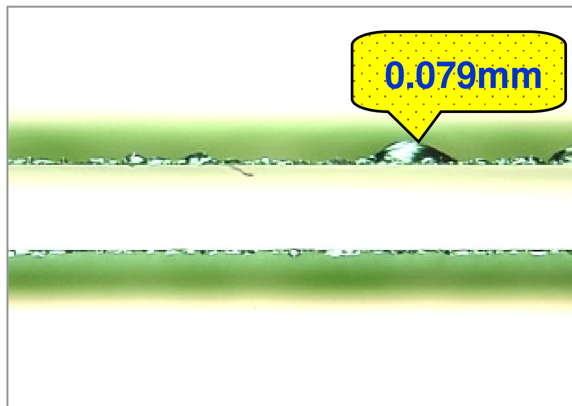
Lapped

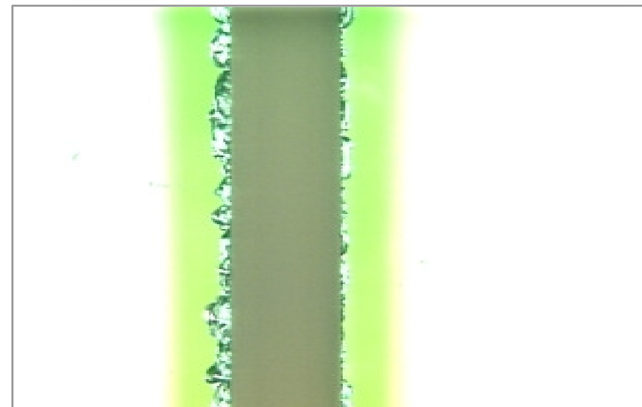
Saw being used: - ADT - 7100 / 4"

Process:
Mounting:- UV Adwill D-218
Blade matrix:- ADT Resinoid
Blade O.D.:- 5"
Blade thickness:- .010"
Blade exposure:- 2.54mm [.100"]
Diamond grit:- 53mic.
Blade P/N:- 777- 5053- 010

Cutting parameters:
Spindle:- 12Krpm
Feed rate:- 3mm/sec
Cut depth:- The remaining 1.2mm [.047"]
Coolant:- Tap water > 3 L./ min.

Application Test - # 4





Dicing Glass & Fiber Optic Applications

Application Test - # 5

Substrate:
Material: Glass
Substrate size: - 100 x 100mm [3.93" x 3.93"].
Thickness: - 2mm - [.0787"]

Cutting parameters:
Spindle:- 12Krpm
Feed rate:- 3mm/sec
Cut depth:- 2.05mm [.0807"]
Coolant:- Tap water 3 L/min.

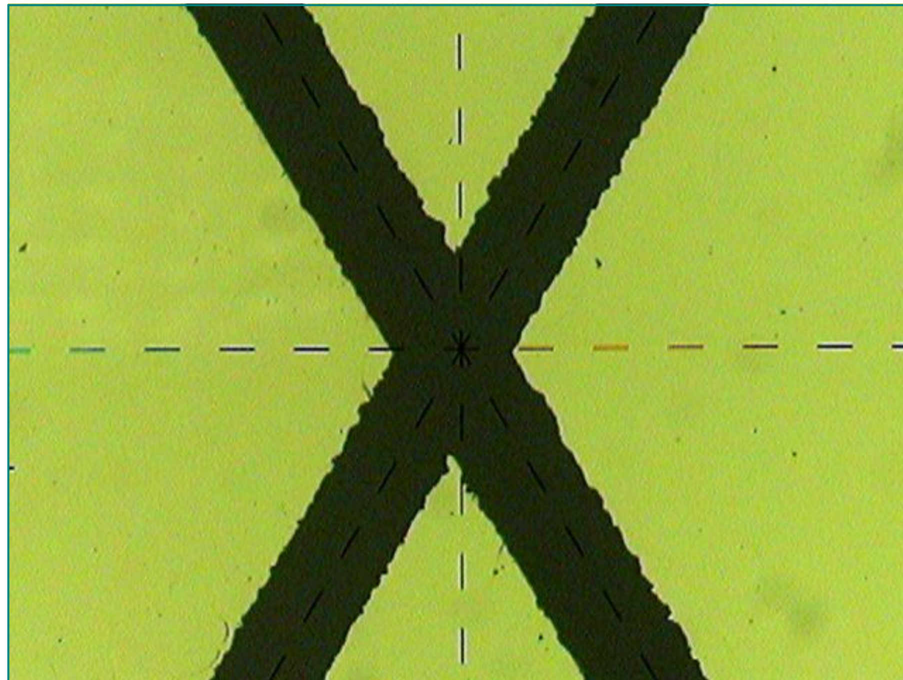
Saw being used: - ADT - 7100 / 4"

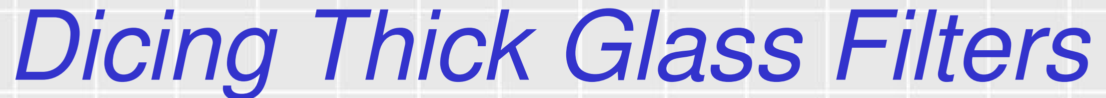
Process:
Mounting:- UV tape
Blade matrix:- ADT Resinoid
Blade O.D.:- 4.6"
Blade thickness:- .008"
Blade exposure:- .150"
Diamond grit:- 30mic.
Blade P/N:- 777- 6030- 008-QUP

Cutting results:
Kerf:- 0.2mm [.008"]
Top side chipping - Ave.0.015mm [.0006"]
Cracks:- No Cracks
Final Die size:- 12.4 x 12.4mm
[Hex cut] [.488" x .488"]

ADT = Dicing
Advanced Dicing Technologies

Application Test - # 5





Application Test - # 6

Substrate:
Material: Glass filters
Substrate size: - 50x 50mm [2" x 2"].
Thickness: - 6mm - [.236"]

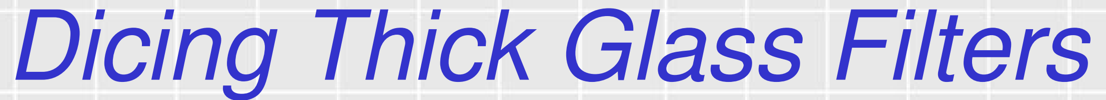
Saw being used: - ADT - 7100 / 4"

Process:
Mounting:- Wax on glass
Blade matrix:- ADT Sintered/ENGS- I06
Blade O.D.:- 4.6"
Blade thickness:- .020"
Blade exposure:- 7.65mm
Diamond grit:- 80mic.
Blade P/N:- 4B777-ENGS-I06

Cutting parameters:
Spindle:- 7.5Krpm
Feed rate:- 0.5-1mm/sec
Cut depth:- 2 steps,
#1- 2mm no. #2- 4.25mm
0.25mm into the base glass
Coolant:- Tap water with Universal Photonics Blue cool coolant additive at a 0.5%.
Cooling nozzle – 2.5mm x 2.5l/min.

Customer spec:
Top & back side chipping:- <.500mm
Perpendicularity (degree):- +/- 0.33
Kerf:- Not critical / it is trimming only

ADT = Dicing
Advanced Dicing Technologies



Dicing Thick Glass Filters

Dressing:	New Blade	* On line dressing
Dressing media	Silicon carbide 320 mesh P/N-00767-0320-002	Silicon carbide 320 mesh P/N-00767-0320-002
Spindle speed	7500rpm	7500rpm
Feed rate	5mm/sec	5mm/sec
No. of cuts	5	5
Cut depth Into the board	0.6mm	1mm

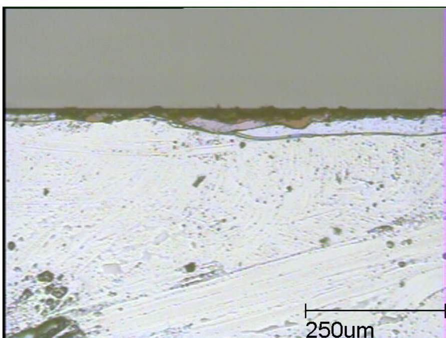
* On line dressing was performed after 10x cuts

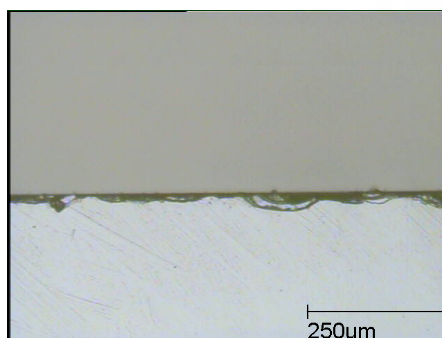
ADT = Dicing
Advanced Dicing Technologies

Dicing Thick Glass Filters

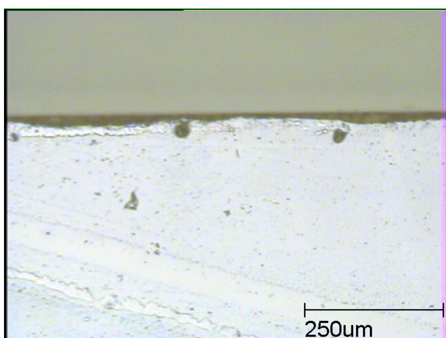
Dicing result:
Top & back side chipping

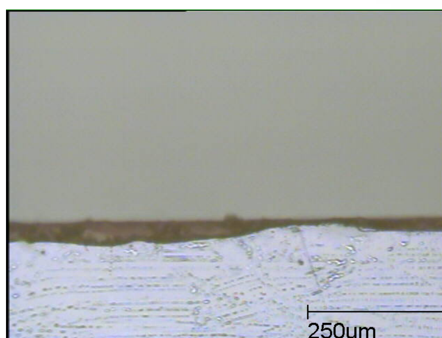
	Top side chipping [µm]	Back side chipping [µm]
	75	45
	62	29
	63	30
	50	39
	48	47
	47	40
	83	35
	44	53
	69	55
	50	57
Minimum	44	29
Maximum	83	57
Average	59.1	43.0
Stdev	13.4	10.1





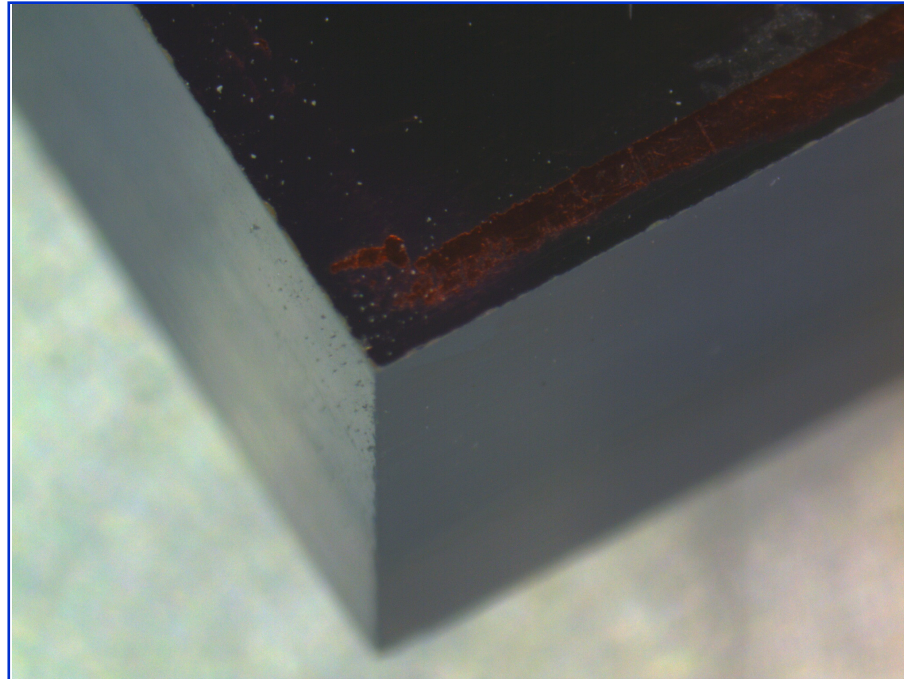
Top side chipping





Back side chipping

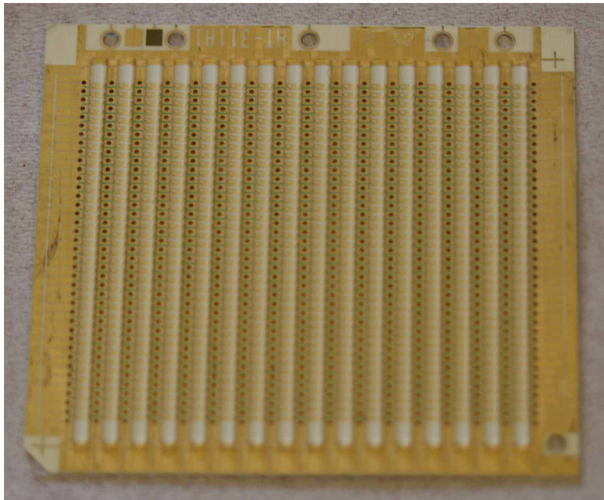
ADT = Dicing
Advanced Dicing Technologies

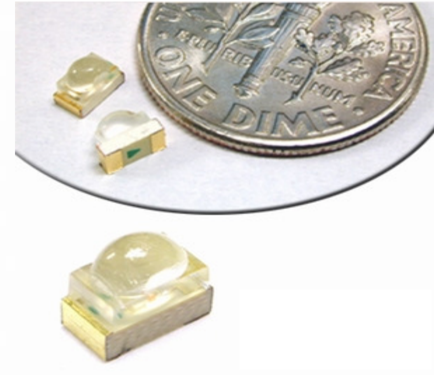


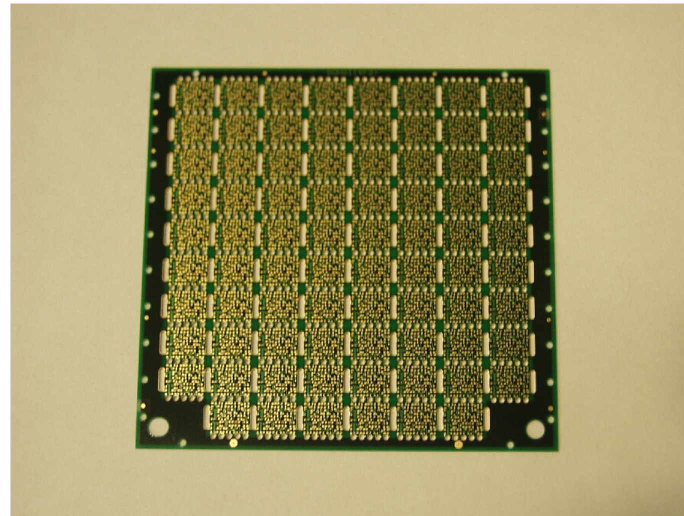
Scale 1:8

ADT = Dicing
Advanced Dicing Technologies

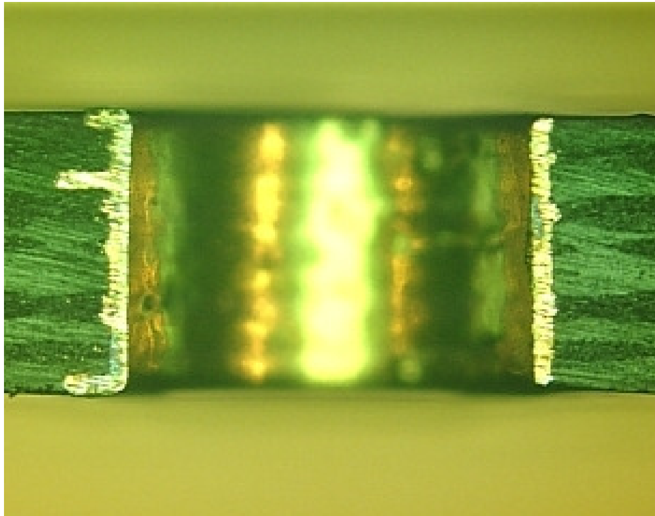
PCB – LED package



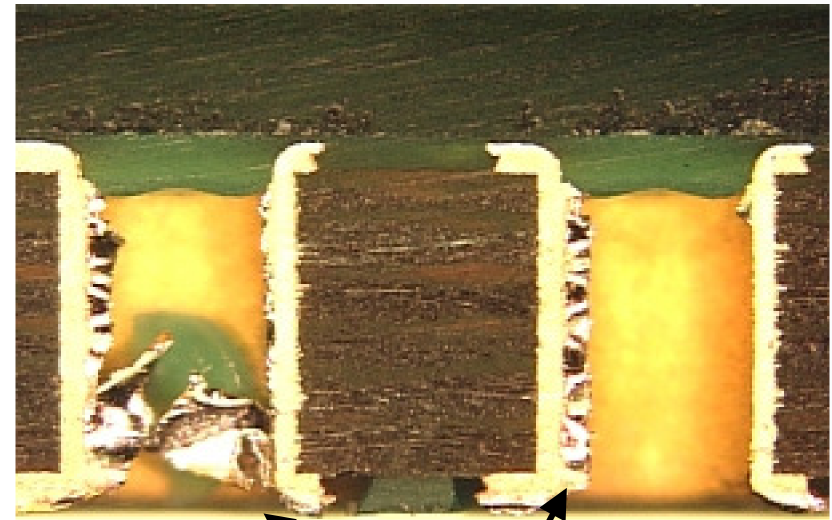




PCB – LED package **Cut Quality**



Good cut quality

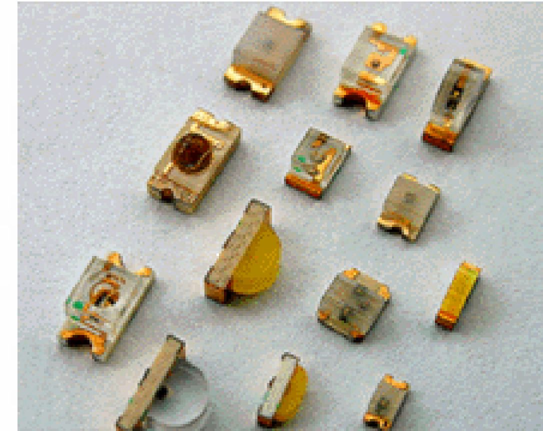


Burrs

PCB – LED package

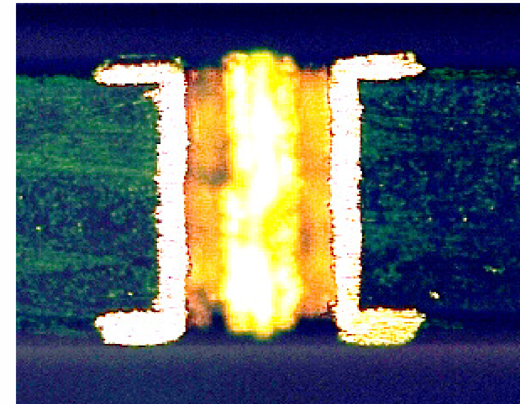
-Blade Characteristics

- 2” Nickel serrated “T”,”V”,”Z”
- Diamond grit size: 10,13,17 microns
- Thickness: 0.003”- 0.008”



-Cutting Parameters

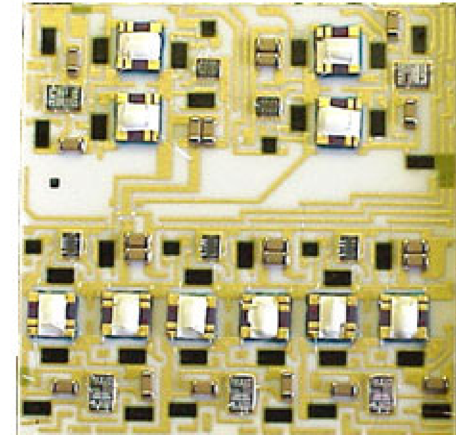
- Feed rate: 50 -150 mm/sec
- Spindle speed:
  - 2”: 25-30 krpm
  - 4”: 12-20 krpm



Alumina - Hybrids

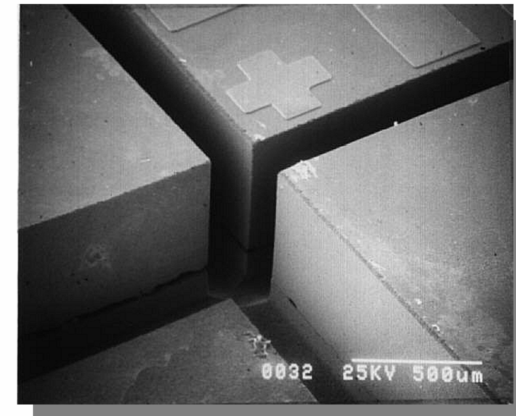
-Blade Characteristics

- 2”, 4” Resin types “K” & “R”
- Diamond grit size: 45 - 88 microns
- Thickness: .006”-.012” (0.15mm – 0.3mm)



-Cutting Parameters

- Feed rate: 4-20 mm/sec
- Spindle speed:
  - 2”: 20-30 krpm
  - 4”: 10-16 krpm



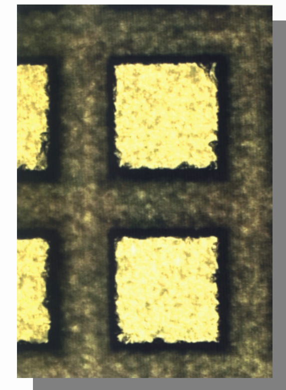
Quartz - SAW Filters

-Blade Characteristics

- 2”, 4” Resin type “Q” & “K”
- Diamond grit size: 25 - 53 microns
- Thickness: 0.006”-0.012” (0.15mm – 0.3mm)

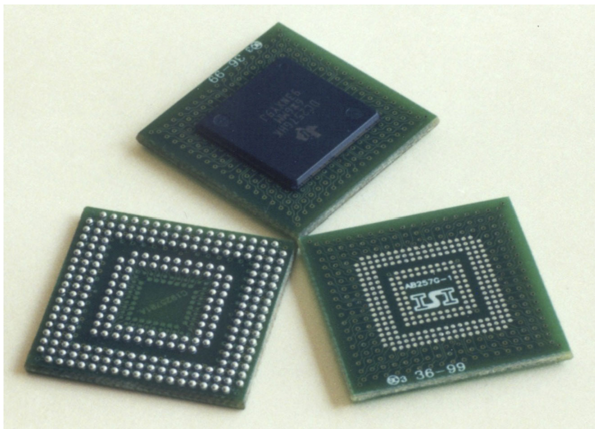
-Cutting Parameters

- Feed rate: 2-10 mm/sec
- Spindle speed:
  - 2”: 18-30 krpm
  - 4”: 8-16 krpm



BGA

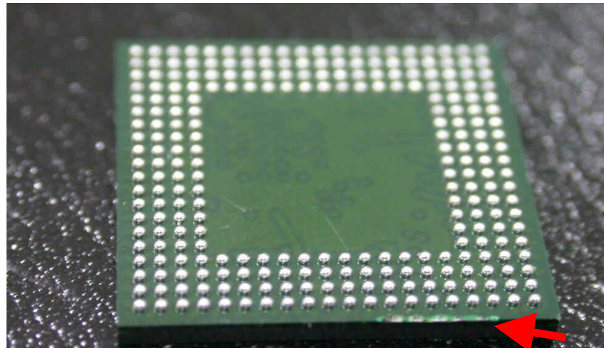
- Small package with large number of communication ports
- Good heat conducting due to large contact surface
- Operate in low electrical current and high frequencies.
- Easy handling with ball shaped and not pins

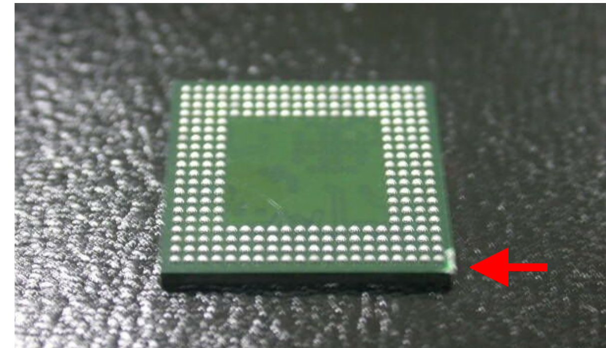


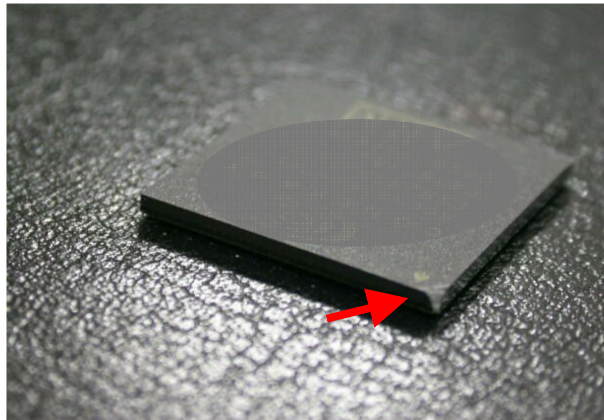
- Notebook computers
- Personal Digital Assistants (PDAs)
- Mobile telephones
- High density disk drives
- Camcorders
- Digital cameras

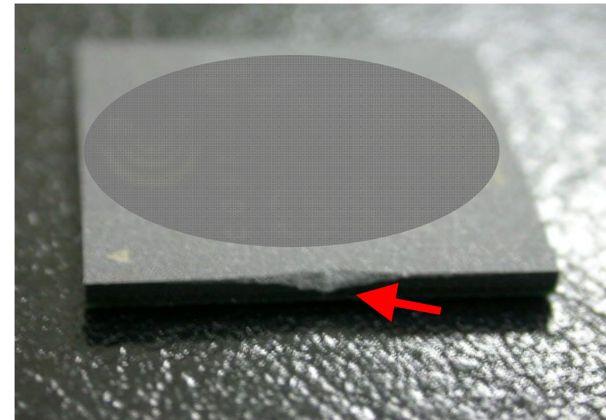
BGA

Quality Criteria



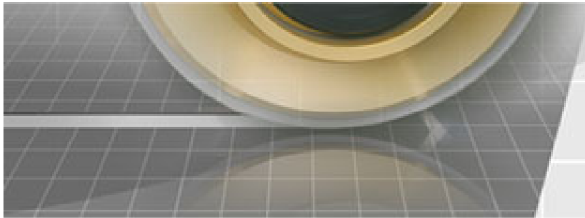






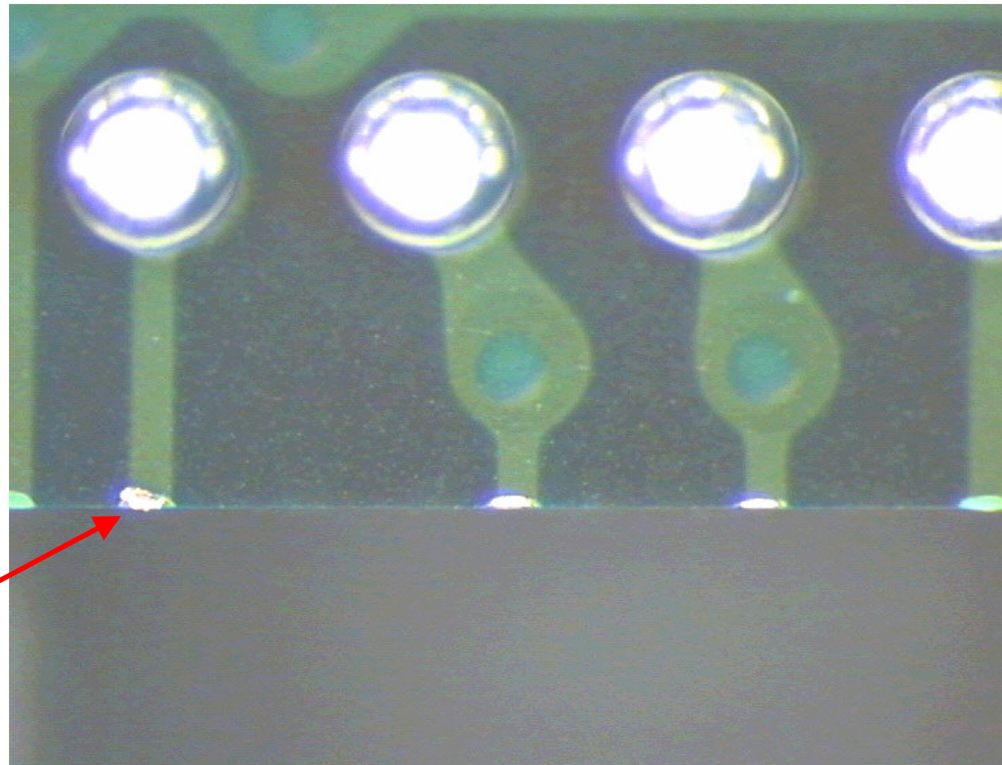
Chipping

copper traces



BGA

Quality Criteria

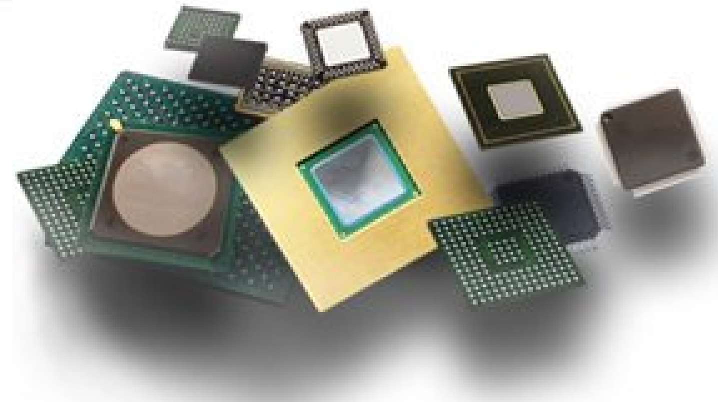


Top View

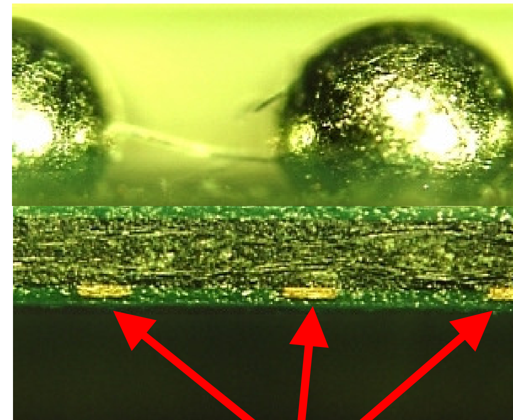
copper traces

ADT = Dicing
Advanced Dicing Technologies

BGA Quality Criteria



Package Size

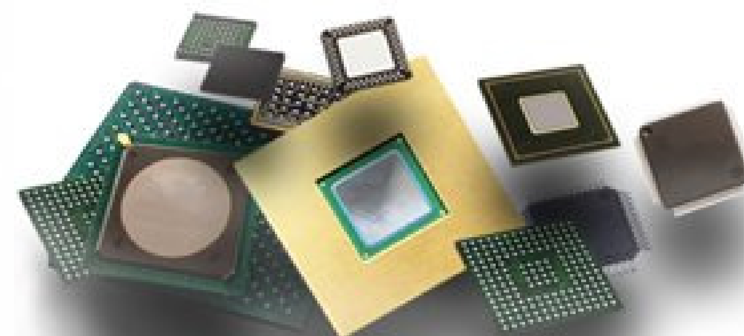


Copper tracers short

copper traces

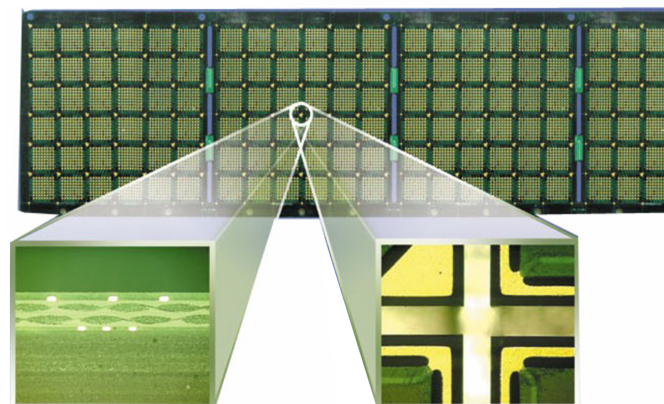
BGA

Quality Criteria



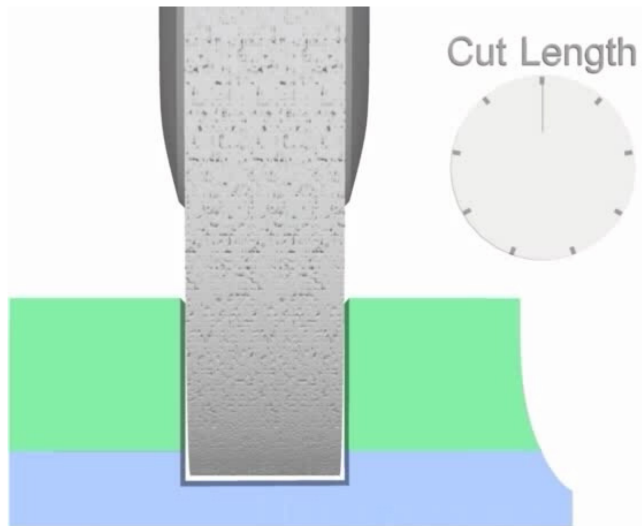
Market Requirements

- Chipping: < 50 mm
- Burrs: < 50 mm
- No copper trace shorts
- Package size: Nominal +/- 50 mm
- Package symmetry: <100 mm



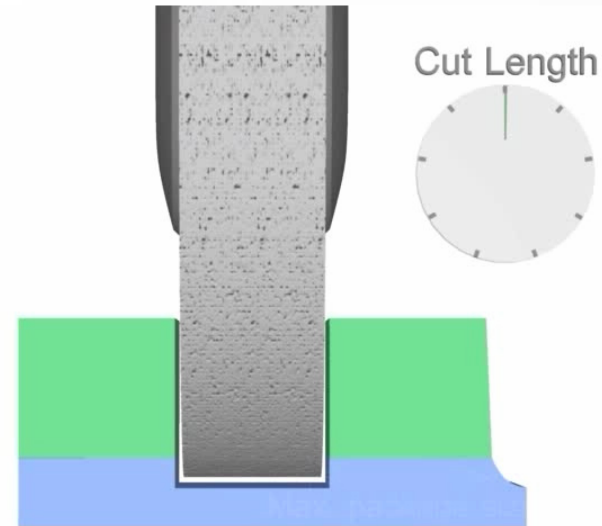
BGA Wear Mechanism effect

Hard Blade



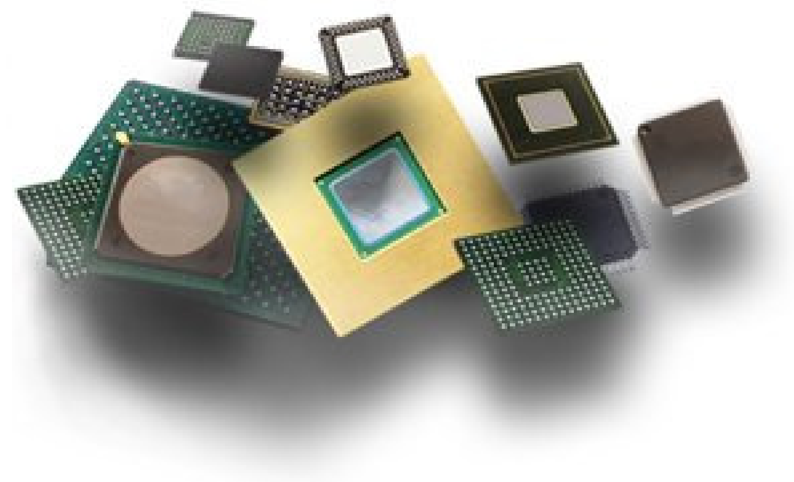
- Low radial wear
- Blade thickness is reduced faster
- Shorter blade life - package size

Soft Blade



- Higher radial wear
- Blade thickness is reduced slower
- Longer blade life - package size

BGA



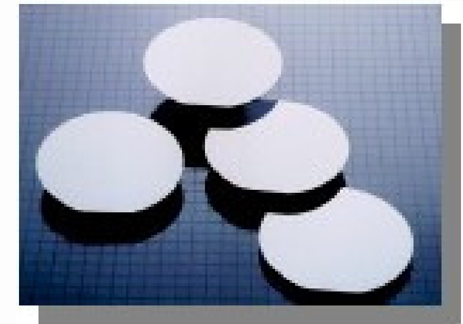
-Blade Characteristics

- 2”- 3” - 4” Metal Sintered blade
- Diamond grit size: 30-50 microns
- Thickness: 0.008”- 0.014” (0.2mm – 0.350mm)

-Cutting Parameters

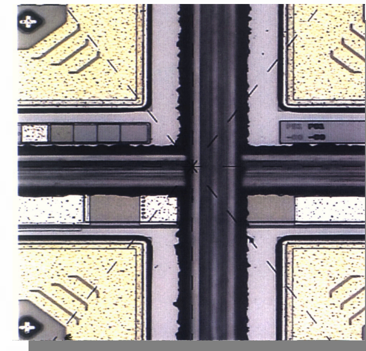
- Feed rate: 75-250 mm/sec
- Spindle speed:
  - 2”: 30 -45 krpm
  - 3”: 20 -30 krpm

Silicon – Low cost Semiconductor Devices



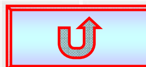
–Blade Characteristics

- Nickel - Hub / Hub less
- Diamond grit: 2/4 up to 4/8 microns
- Thickness: 0.0008”-0.0014” (0.02mm – 0.035mm)



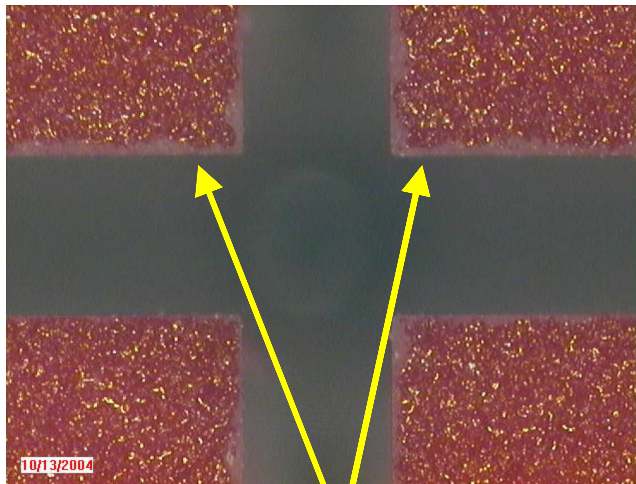
–Cutting Parameters

- Feed rate: 1- 3 inch/sec
- Spindle speed: 30 - 50 krpm

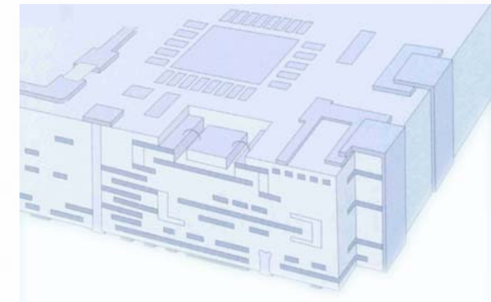


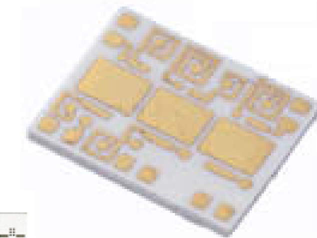
LTCC

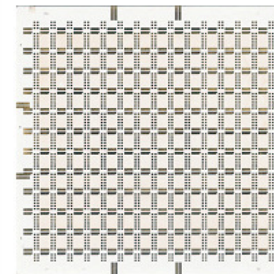
Quality Criteria



Chipping 30µ - 50µ

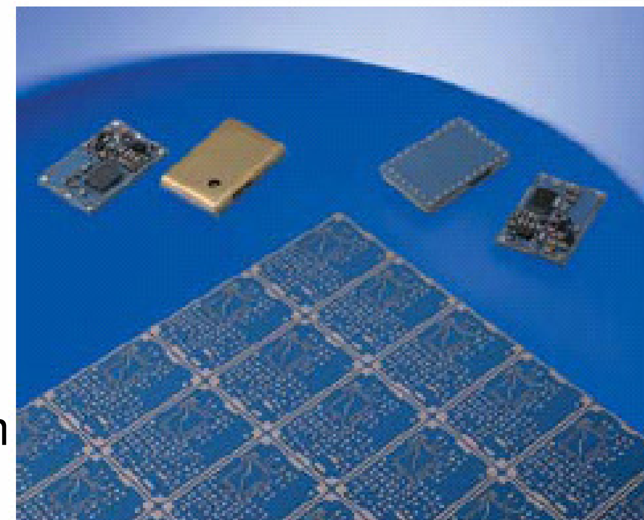






LTCC

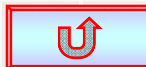
-Blade Characteristics



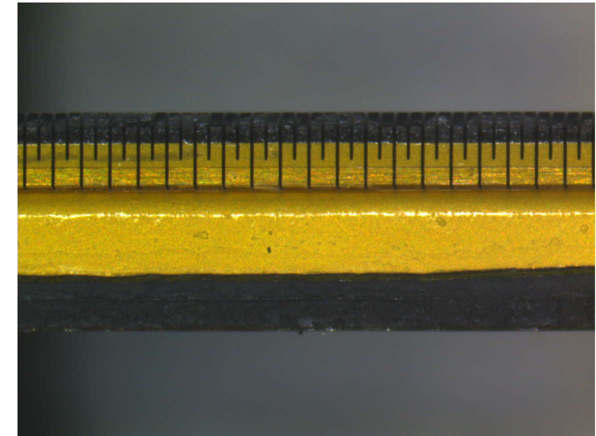
- 2” Sintered & Resinoid type “Q” & “K”
- Diamond grit size:
  - Sintered: 20-35 microns
  - Resinoid: 15-30 microns
- Thickness: 0.008”-0.020” (0.2mm – 0.5mm

-Cutting Parameters

- Feed rate: 5-25 mm/sec
- Spindle speed: 20-30 krpm

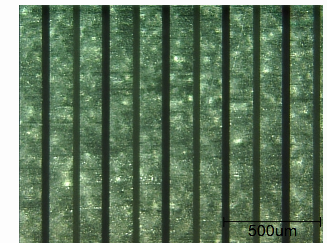


PZT – Ultrasound Sensors



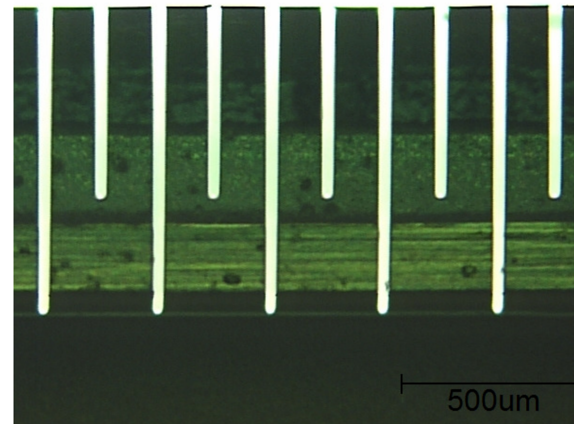
Blade Characteristics

- 2” Nickel - Hub less (Some hub blades)
- Diamond grit size: 3-6 up to 10 microns
- Thickness: 0.0008”-0.004” (0.02mm – 0.1mm)



Cutting Parameters

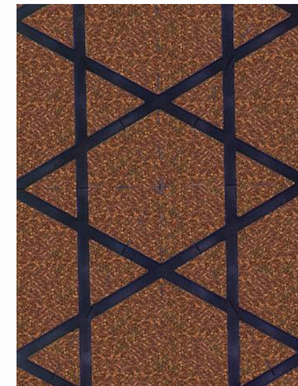
- Feed rate: 1-6 mm/sec
- Spindle speed: 10-30 krpm



Ink Jet Print Heads

Blade Characteristics

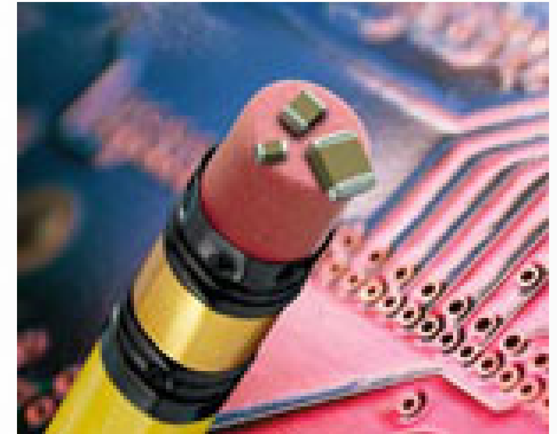
- 2" Nickel - Hub / Hub less
- Diamond grit size: 2/4 – 10 microns
- Thickness: 0.0008"-0.004" (0.02mm – 0.1mm)



Cutting Parameters

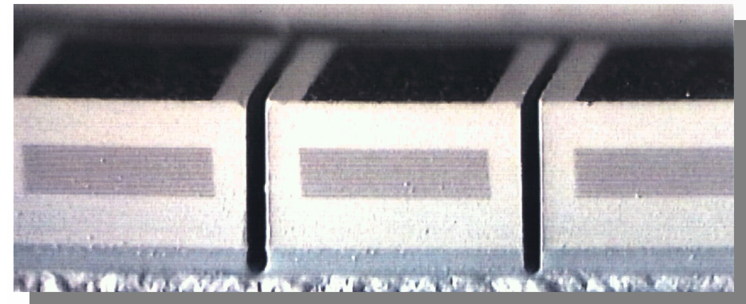
- Feed rate: 1 -10 mm/sec
- Spindle speed: 25 - 35 krpm

Multi Layer Ceramic Capacitors



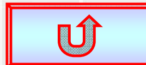
-Blade Characteristics

- 4” Nickel & Nickel Steel Core
- Diamond grit size: 30 - 70 microns
- Thickness: 0.006”-0.014” (0.15mm – 0.35mm)



-Cutting Parameters

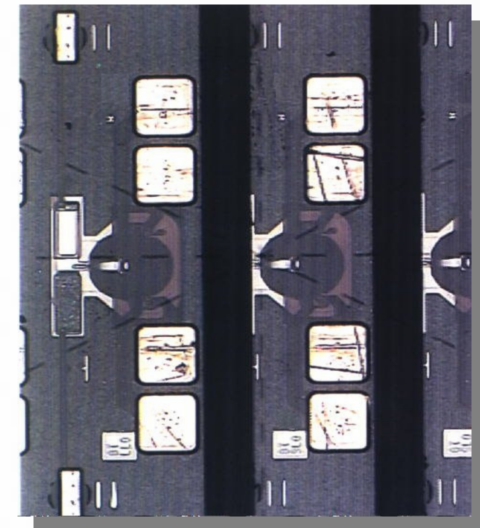
- Feed rate: 50 - 250 mm/sec
- Spindle speed: 12-18 krpm



Altec –AlTiCO3 - Magnetic Heads

-Blade Characteristics

- 4” Sintered , Nickel
- Diamond grit size:
  - Sintered: 10-20 microns
  - Nickel: 2/4 - 15 microns
- Thickness: 0.003”-0.010” (0.075mm – 0.25mm)



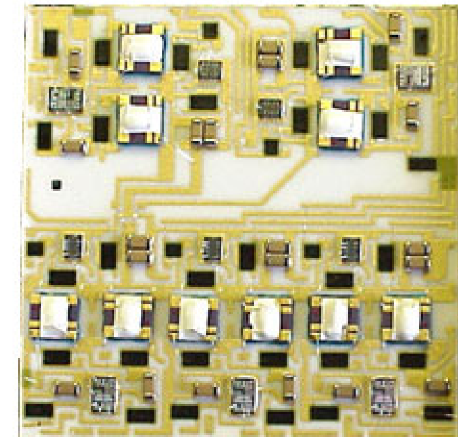
-Cutting Parameters

- Feed rate:
  - Slicing: 1-5 mm/sec
  - Parting 1-10 mm/sec
- Spindle speed: 8-12 krpm.

Alumina - Hybrids

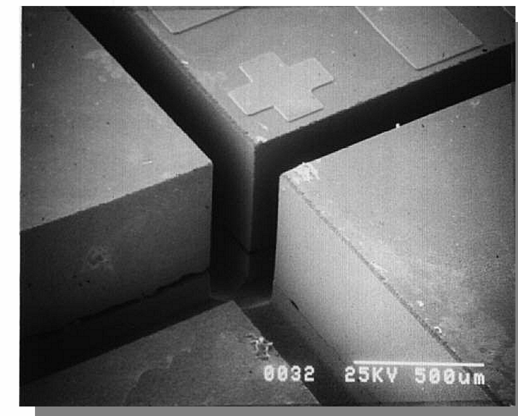
-Blade Characteristics

- 2”, 4” Resin types “K” & “R”
- Diamond grit size: 45 - 88 microns
- Thickness: 0.006”-0.012” (0.15mm – 0.3mm)



-Cutting Parameters

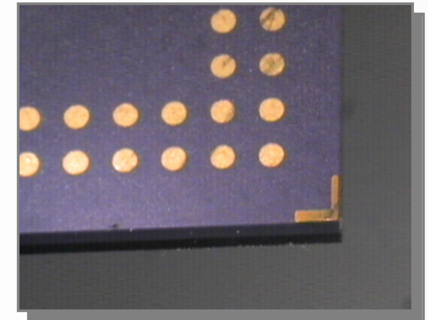
- Feed rate: 4-20 mm/sec
- Spindle speed:
  - 2”: 20-30 krpm
  - 4”: 10-16 krpm



Ceramic BGA

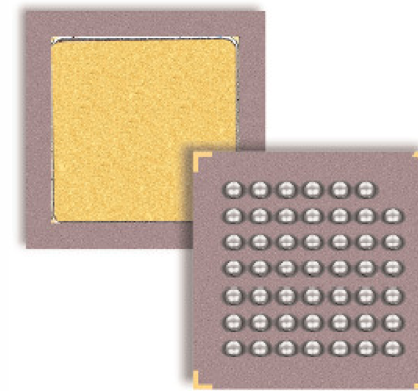
-Blade Characteristics

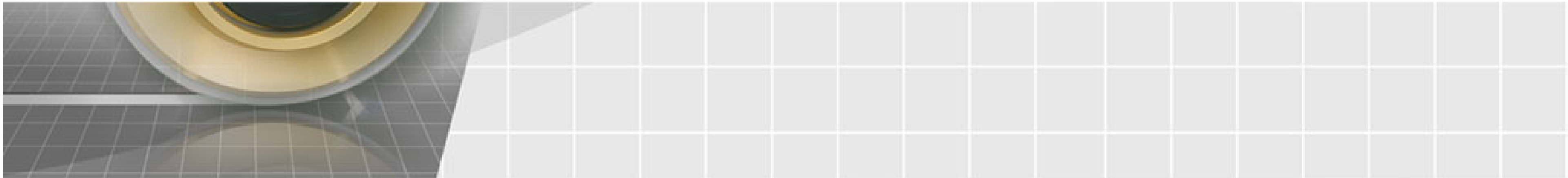
- 2”- 3”- 4” Resin types “K” & “R”
- Diamond grit size: 45, 53, 63 microns
- Thickness: 0.008”-0.020” (0.2mm – 0.5mm)



-Cutting Parameters

- Feed rate: 4-20 mm/sec
- Spindle speed:
  - 2”: 30-40 krpm
  - 3”: 18-25 krpm
  - 4”: 10-16 krpm

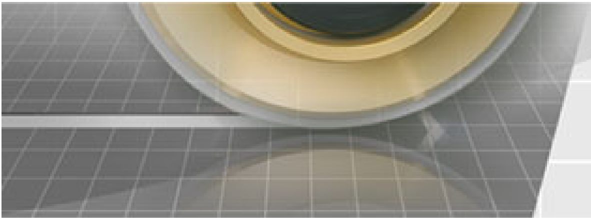


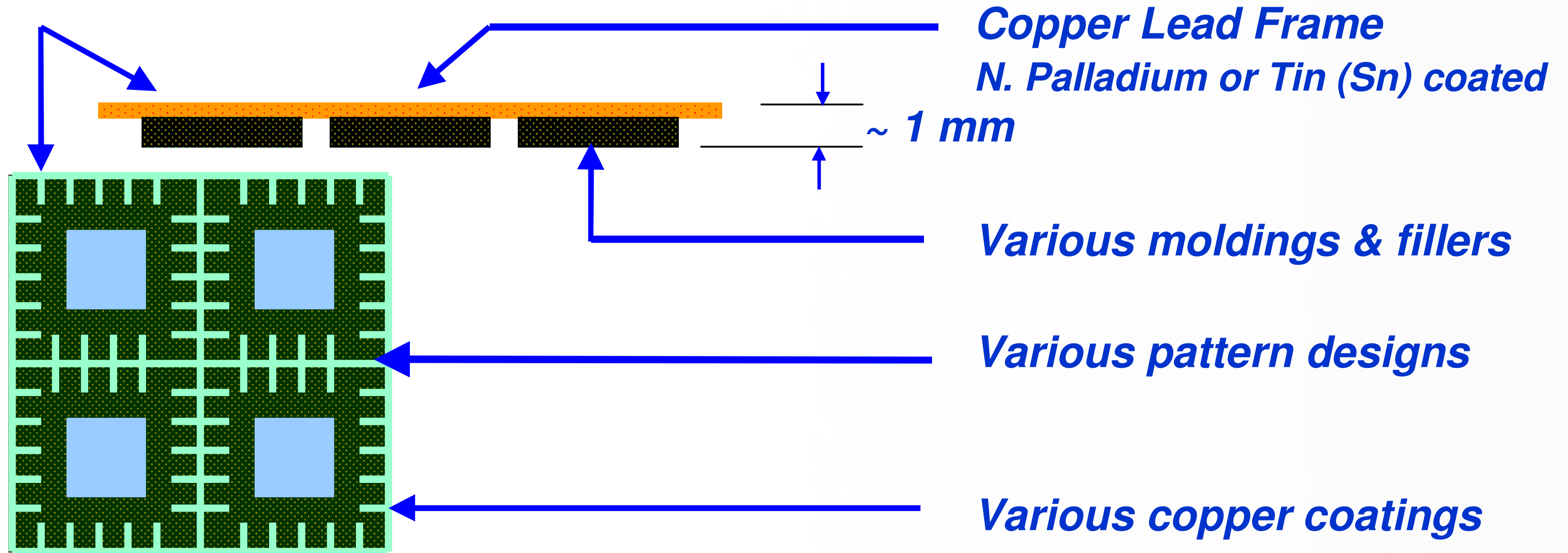


QFN SINGULATION

- Package foundries are demanding process solutions to reduce Cost of Ownership, while maintaining product Quality

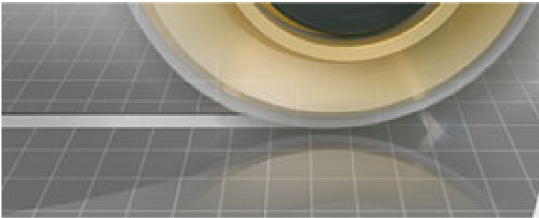
QFN Singulation





Composite Materials

ADT = Dicing
Advanced Dicing Technologies



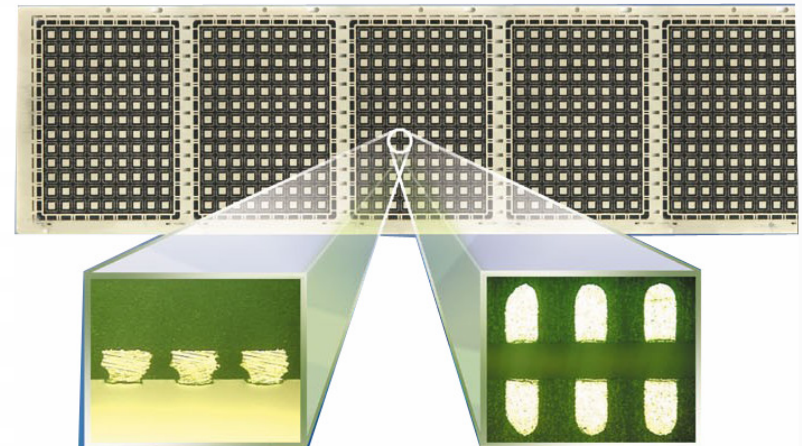
QFN Singulation

Plastic Deformation

QFN Families

Three main family types:

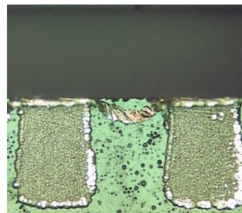
- Power - Largest thickness 1.5-2.5mm (~ 500 mic. copper lead thickness)
- Standard - HE (Half Etched) - 0.8-1.2mm (up to 200 mic. copper lead thickness)
- Thin – 0.4- 0.6mm (up to 150 mic. copper lead thickness)



Two different Types of Coating:

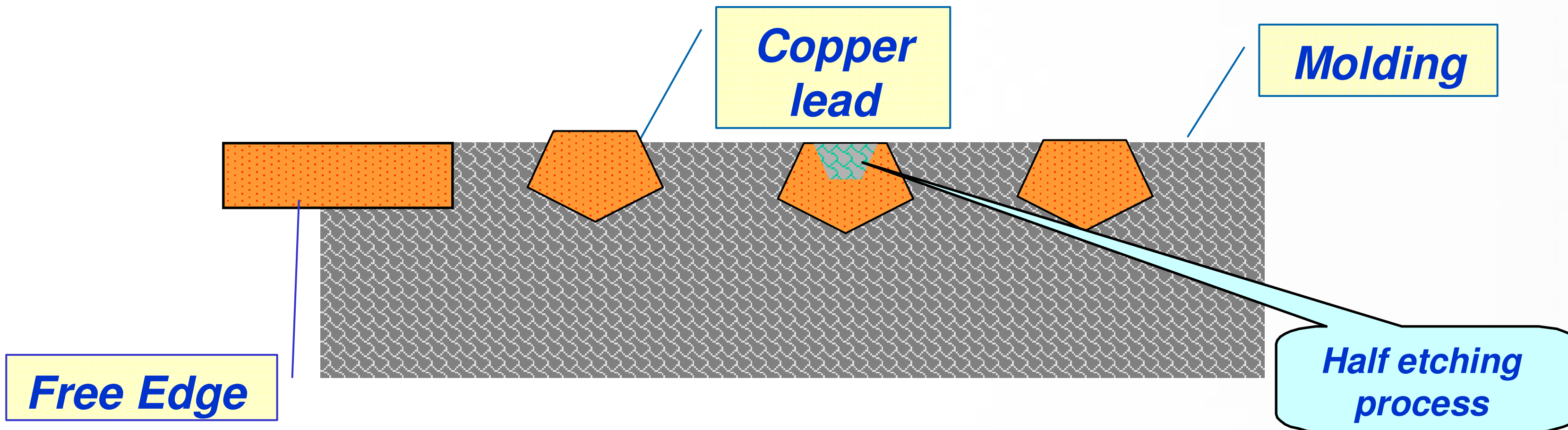
- Tin (Sn) – causing melting
- Ni/Pd – larger "Y" burrs

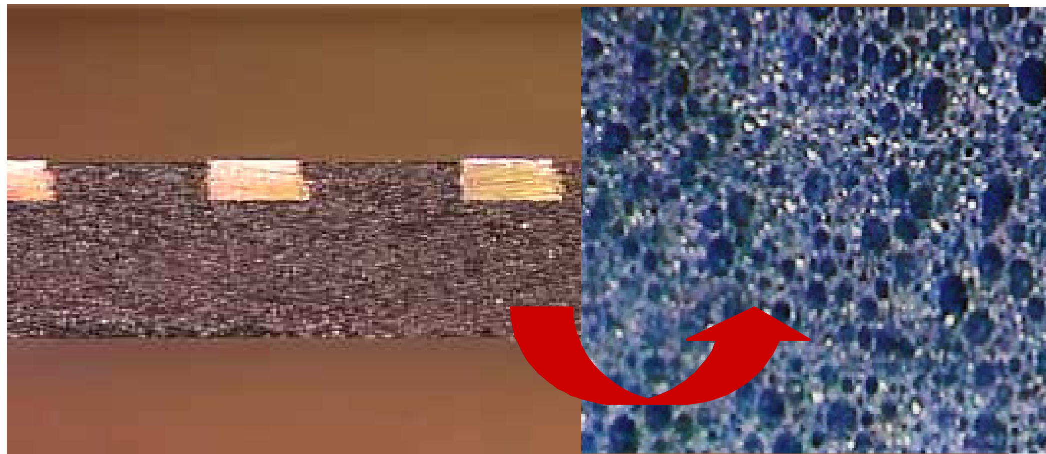
SN coating melting



ADT = Dicing
Advanced Dicing Technologies

QFN Singulation



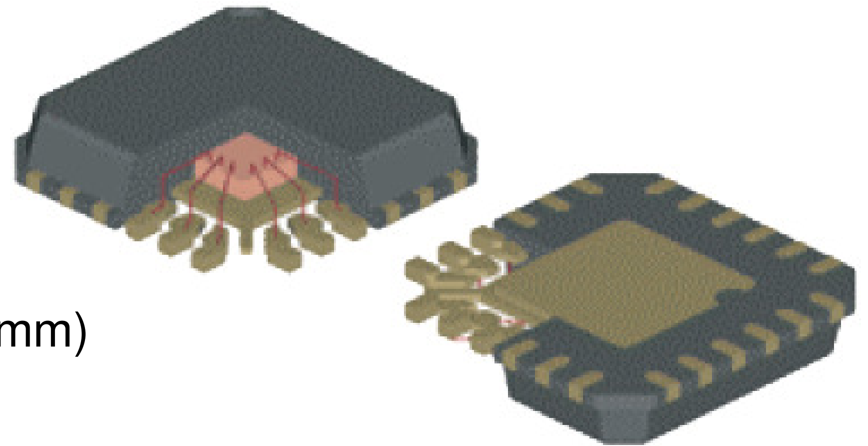


Composite material

ADT = Dicing
Advanced Dicing Technologies

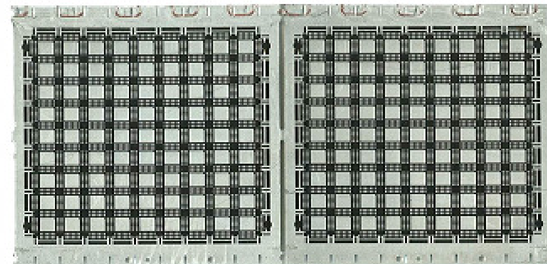
QFN - Blade and Cutting Parameters

-Blade Characteristics



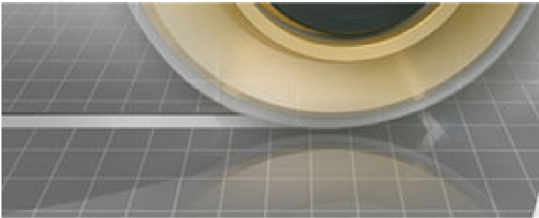
- 2"- 3" - 4" Resinoid types "E" & **"T"**
- Diamond grit size: 45 - 105 microns
- Thickness: .008"- .020" (0.2mm – 0.5mm)

-Cutting Parameters

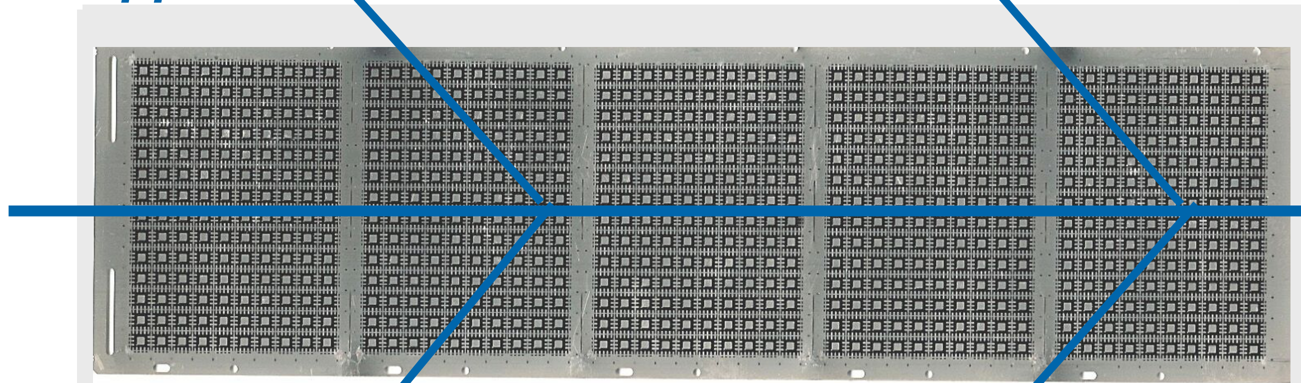


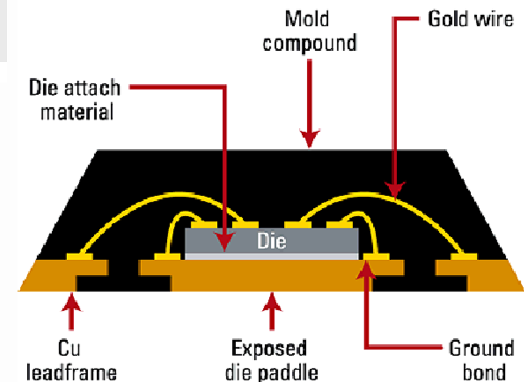
- Feed rate:
  - Half Etched: 30 -100 mm/sec
  - Full Copper: 10 - 40 mm/sec
- Spindle speed:
  - 2": 25-30 krpm
  - 3": 15-25 krpm

ADT = Dicing
Advanced Dicing Technologies



QFN Singulation





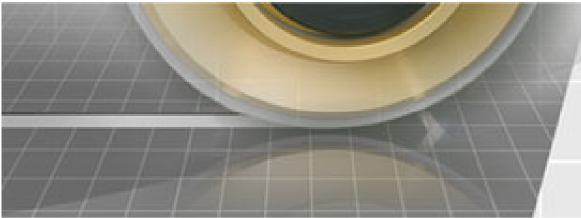
Factors affecting the cutting results

ADT = Dicing
Advanced Dicing Technologies

Characteristic	Current Status
Blade life	500 - 1500 meter
Feed rate	30 – 100 mm/sec
Coolant	D.I. & Additive & Chiller

Market Status

ADT = Dicing
Advanced Dicing Technologies



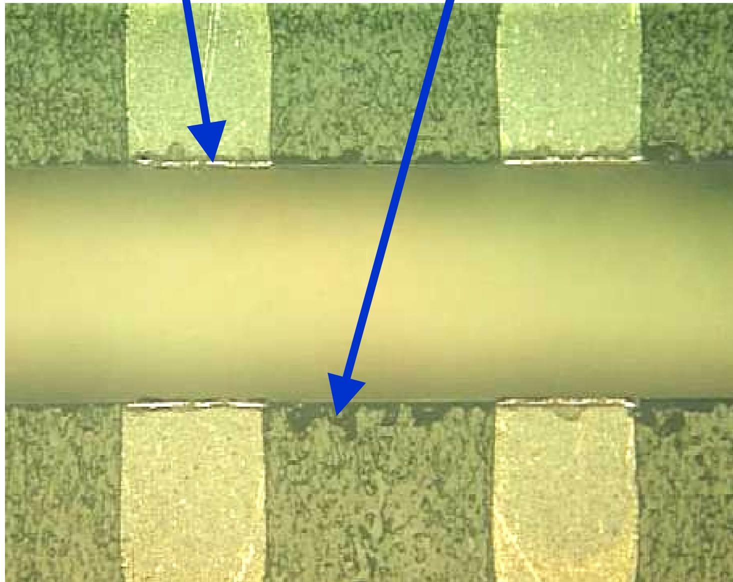
QFN Singulation

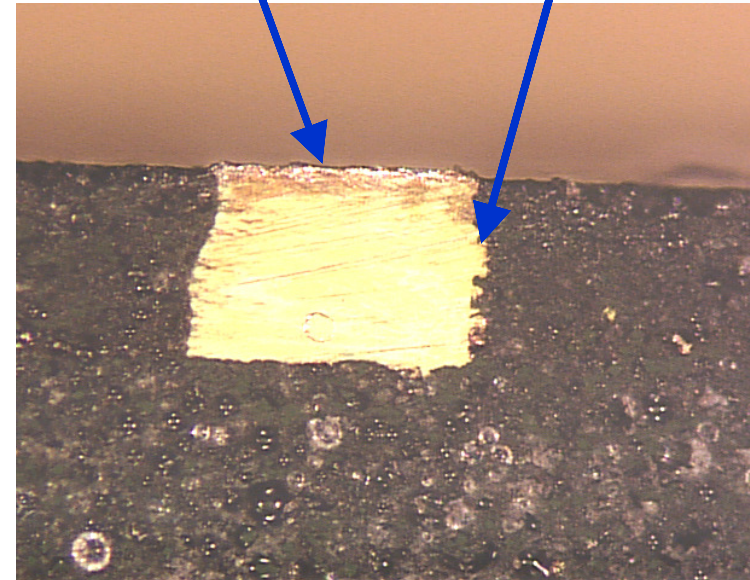
Side Burrs

Molding Chipping

Top Burrs

Smearing

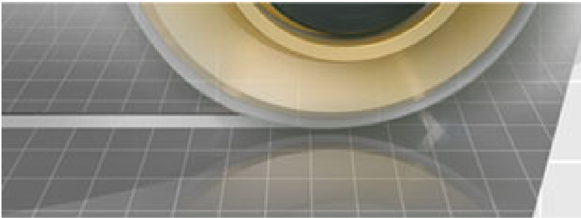




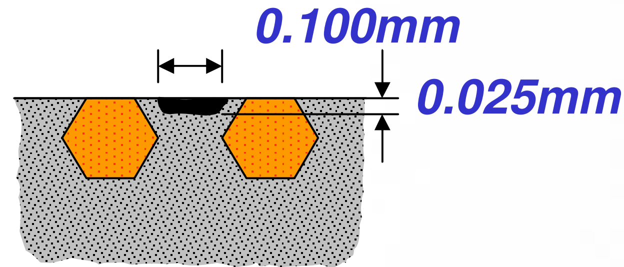
Quality Criteria

ADT = Dicing

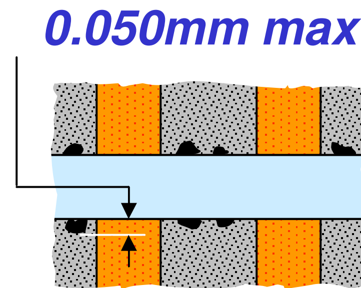
Advanced Dicing Technologies



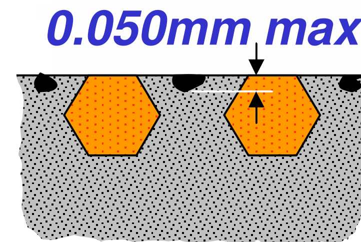
QFN Singulation



Continuous chipping



Top view



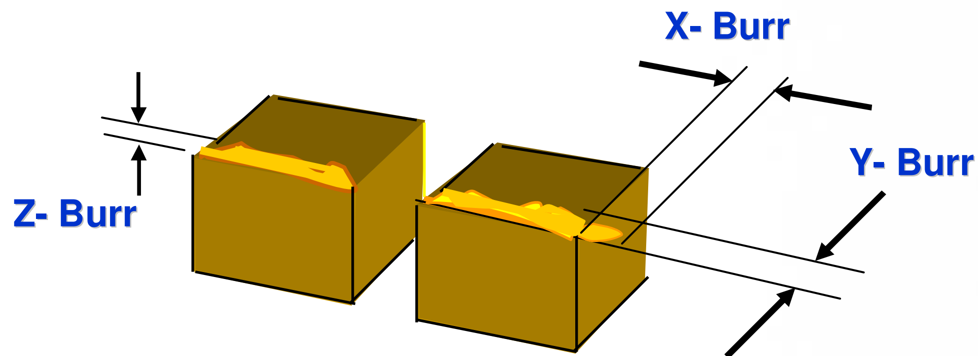
Cross section

❖ *Specification limits may vary between end-users*

Chipping Specification

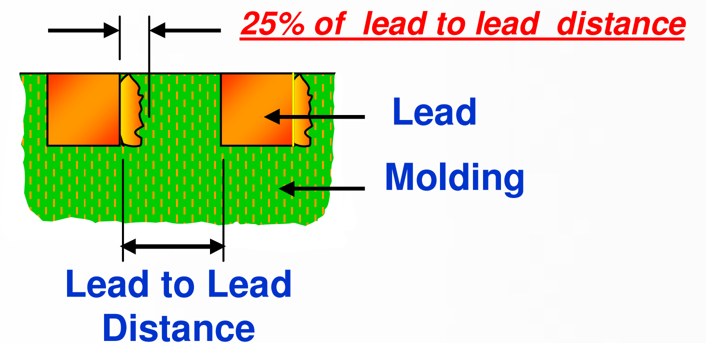
ADT = Dicing
Advanced Dicing Technologies

QFN Singulation



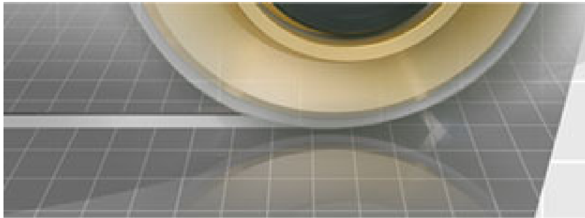
Burr & Smearing Geometry

Copper Smearing

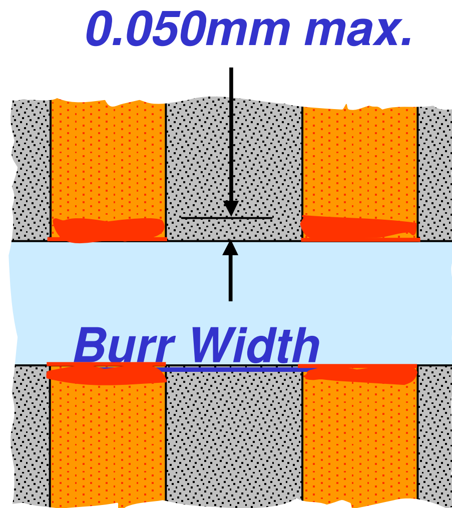


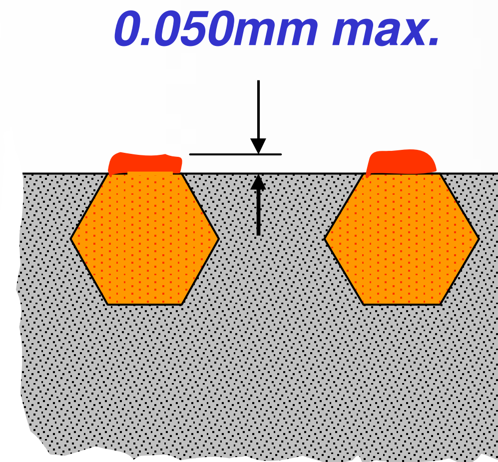
Cross Section

ADT = Dicing
Advanced Dicing Technologies



QFN Singulation





Burr height

Top view

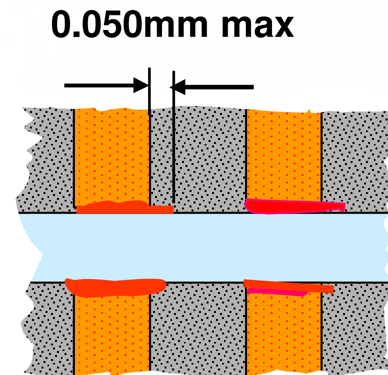
Cross section

❖ *Specification limits may vary between end-users*

Burrs Specification

ADT = Dicing
Advanced Dicing Technologies

- X- Burr - 0.050mm max.



Top view

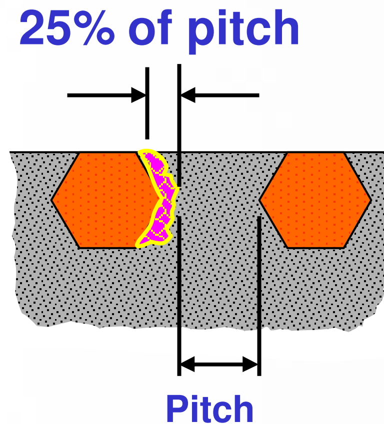
- **No Lead Delaminating.**
- **No Lead Removal.**

- ***Specification limits may vary between end-users***

X - Burrs Specification

General Rules

- Smearing < 25 % of lead pitch
- No lead de-lamination
- No lead removal



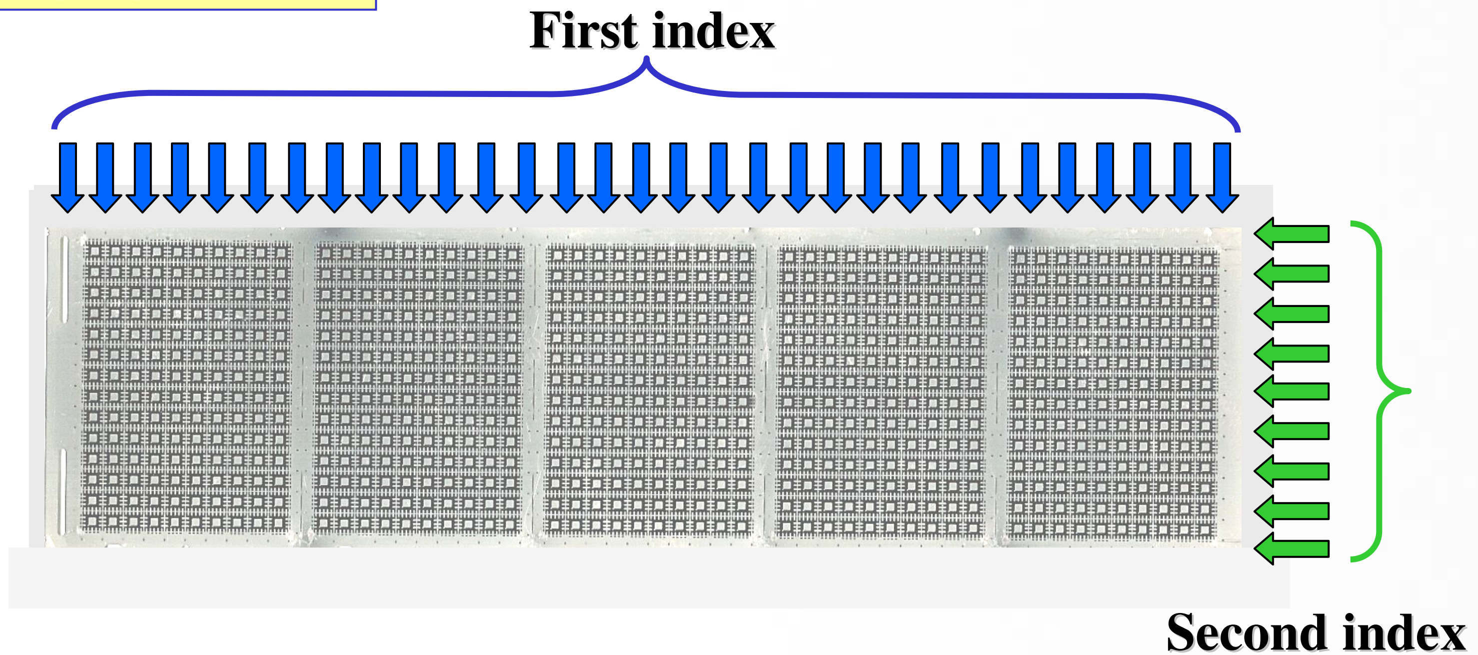
Cross section

- Specification limits may vary between end-users

Smearing Specification

QFN Singulation

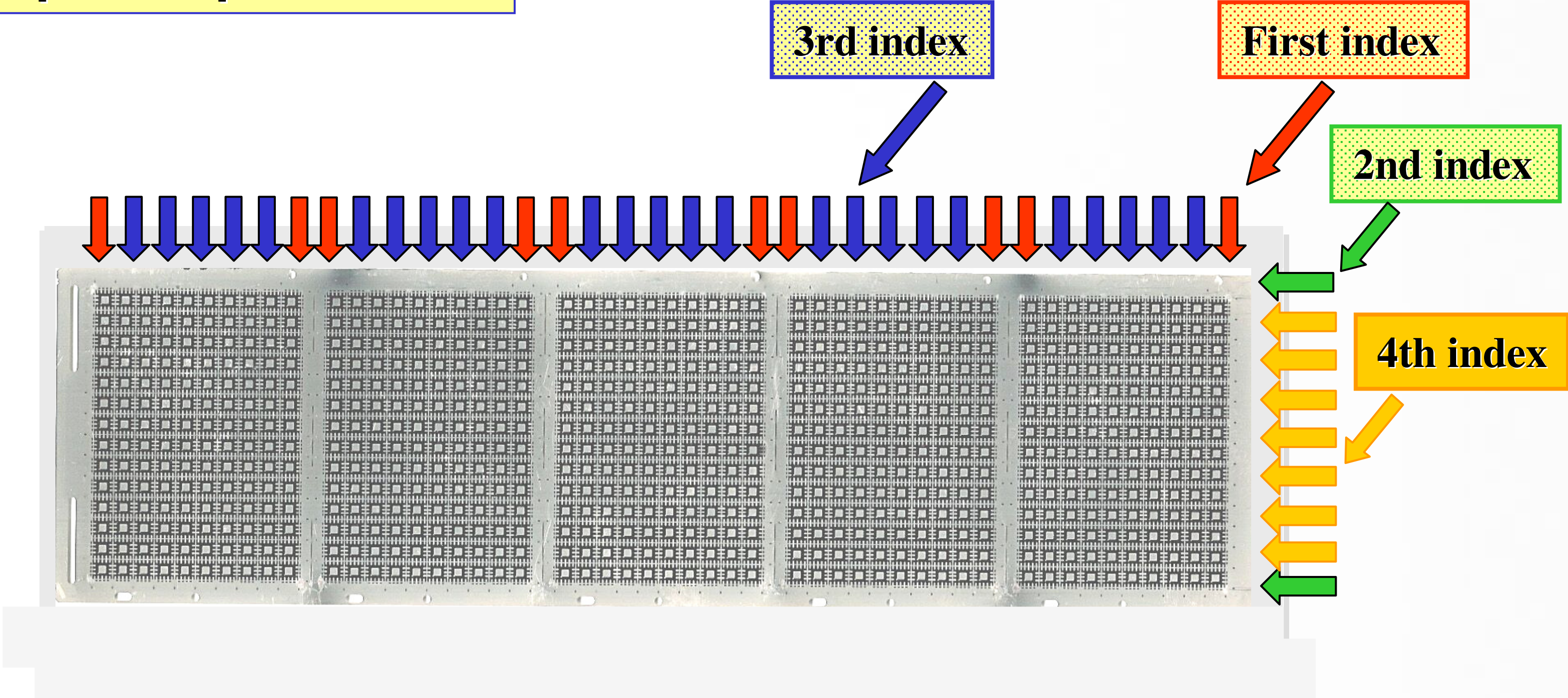
Tape process:



Dicing sequence to minimize load

QFN Singulation

Tapeless process:



Dicing sequence to minimize load

ADT = Dicing
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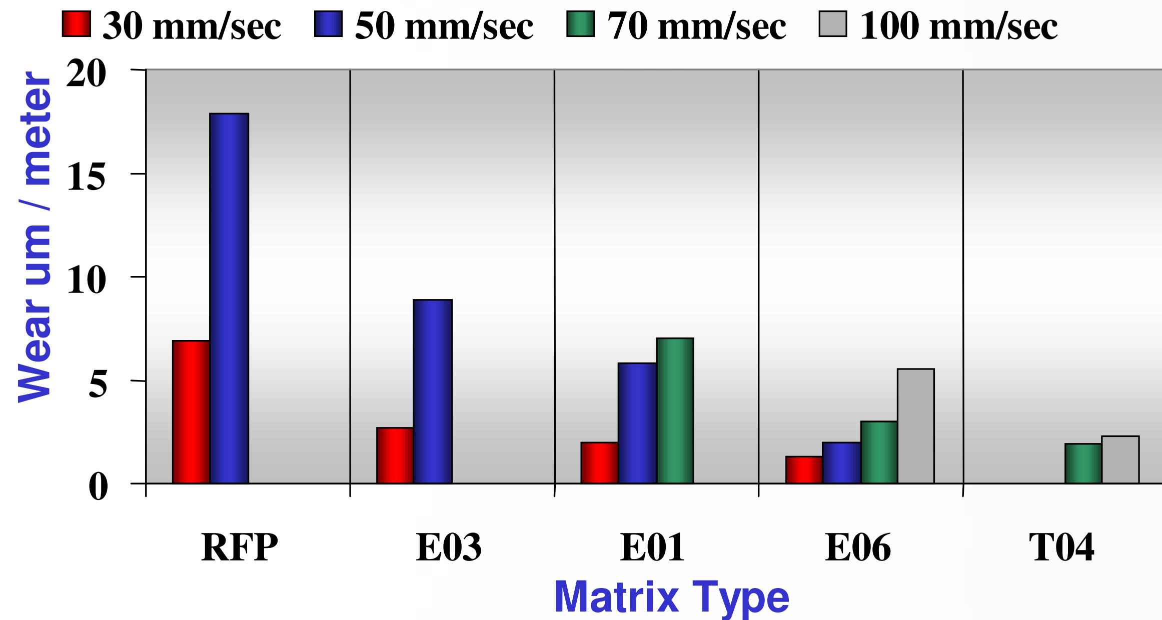
"E" & "T" Type Resin Blades for QFN

- Best Cost of Ownership
- Better blade life (Exceeding 1000 m)
- Above average cut quality
- Better throughput



1998 → 2009

ADT = Dicing
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Blade Selection & Process Parameters

Recommended Values

Product	Material	Blade Type	Blade O.D	Matrix	Diamond size mic	Spindle Speed KRPM	Feed Rate mm/s	Feed Rate Inch/s
PBGA	Epoxy & Molding	Sintered / Nickel	2" 3"	Tape: hard Tape-less: Soft	30, 40, 50	2": 30-45 3": 20-30	75-200	3-8
CBGA	Alumina & Molding	Resin	2" 4"	KUP, RUP	45, 53, 63	2": 30-40 4": 12-16	4-20	0.15-0.8
QFN	Copper & Molding	Resin	2" 3"	"E" type	45 - 105	2": 25-30 3": 15-25	10-80	0.4-3.1
PCB	FR4 / Epoxy & Copper	Nickel	2" 4"	"T" , "V" , "Z"	10 , 13 , 17	2": 25-30 4": 12-20	50-150	2-6
Ceramic Packages	Alumina	Resin	2" 4"	KUP , RUP	45, 53, 63, 88	20-30 10-16	4-20	0.15-0.8
Multi Layer Capacitor	Green Ceramic	Nickel / Nickel Steel Core	4"	Hard	30, 50, 70	12-18	50-250	2-10

Blade Selection & Process Parameters

Recommended Values (cont.)

Product	Material	Blade Type	Blade O.D	Matrix	Diamond size mic	Spindle Speed KRPM	Feed Rate	
							mm/s	Inch/s
Ultrasound Sensors / Ink Jet Print Head	PZT	Nickel	2"	Medium - Hard	2-4, 4-8, 10	25-35	0.5-10	0.02-0.4
IC	Silicon	Nickel	2"	Medium - Hard	2-4, 4-6, 4-8	30-50	25-75	1-3
Active Devices (Discrete)	GaAs	Nickel	2"	Medium - Hard	1-3, 2-4	30-50	2.5-25	0.1-1
Optical and Electro-Optics components	Sapphire	Resin	2" 4"	QIP , QKP , QUP	45, 53, 63	14-25 8-10	1-10	0.04-0.4
Fiber Optics components	Quartz	Resin	2" 4"	QIP , QKP , QUP	25, 30, 45, 53	18-30 8-16	2-15	0.1-0.6
Fiber Optics components	Glass / Fused Silica	Resin	2" 4"	QIP , QKP , QUP	15 - 53	18-30 8-16	2-10	0.1-0.4
Fiber Optics components	Si On Glass	Resin	2"	QIP , QKP , QUP	2-4, 3-6, 9, 15, 25	20-30	0.5-2.5	0.02-0.1
SAW Devices	Quartz	Resin	2" 4"	"Q" Type, KUP	25, 30, 45, 53	18-30 8-16	2-10	0.1-0.4
SAW Devices	LiNbO3 ; LiTaO3	Nickel / Resin	2"	"Q" Type, KUP	Nickel: 4-8 Resin: 9,15,20,30	18-30	2-10	0.1-0.4

Recommended Values (cont.)

Product	Material	Blade Type	Blade O.D	Matrix	Diamond size mic	Spindle Speed KRPM	Feed Rate mm/s	Feed Rate Inch/s
Tape Head	Ferrite	Resin / Nickel	2"	Nickel: Med - Hard ; Resin: QUP,KUP,RUP	Nickel: 3-6, 4-8, 10, 17 Resin: 9, 15, 20, 30	25-35	2-10	0.1-0.4
Magnetic Heads	TiC	Sintered / Nickel	4"	Medium - Hard	Sintered: 10,17,20	Slicing: 8-12	1-5	0.04-0.2
					Nickel: 2-4,3-6,10,15	Parting: 8-12	1-10	0.04-0.4
Passive & Active Devices	LTCC	Sintered / Resin	2"	Sintered: Various Resin "Q" & "K" types	Sintered: 20,25,30,35 ; Resin: 15,20,25,30	20-30	5 - 25	0.2 - 1
SAW Devices, RF	HTCC	Sintered / Resin	2"	Sintered: Soft Resin "Q" & "K" types	Sintered: 30,35,40,45 ; Resin: 20 - 45	20-30	10 - 30	0.4 - 1.2

Blade Selection

Resin matrix types

Cut Quality (←) · Blade life (→)

Resin type													
Q	QIP	QKP	QUP										
K		KIP	KKP	KUP									
R					RUP	RFP							
E									E03	E01	E06		
T												T04	T06
C							C03	C02					

Cut Quality (↑) · Blade life (↓)

Blade life

ADT = Dicing
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