



## Advanced Slider Shape Control For PMR

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Product Marketing Manager  
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### Introduction

- **Today's Data Storage industry requires new advancements in Saws and Lapper development to meet:**
- **Smaller Form Factors**
  - PICO / FEMTO
  - PMR / TMR Head designs
- **Slider Shape Control**
  - Row geometry
  - Dicing cut-edge Quality
    - Drive quality / reliability
- **Improving Cost of Ownership**
  - Tool footprint
  - Throughput
  - Yields
  - Automation



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## Topic Overview

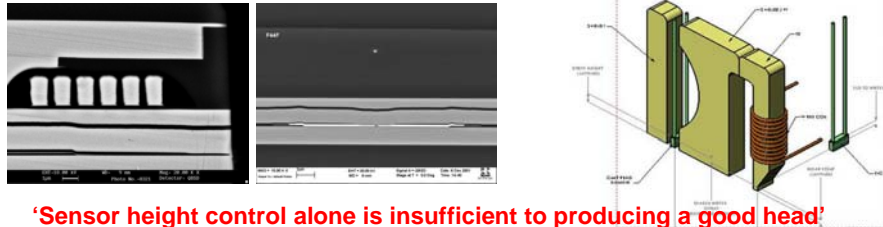
- **Slider Fab Technical Demands**
  - Lappers
  - Saws
- **Current Practices in Industry**
- **Limitations**
- **Summary of Results**
- **Slider Fab Technical Solution**



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## PMR Challenge – Reader/Writer Offset Control



**'Sensor height control alone is insufficient to producing a good head'**

- PMR Head Designs require stripe height, throat height and reader/writer offset control
- Precise angle adjustment requirement based on Writer ELG and Reader ELG

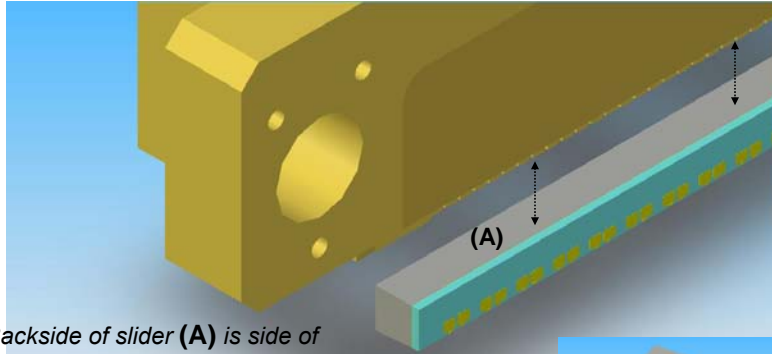
PMR		Height Control		Perpendicularity Control		
Gb/in <sup>2</sup>	GB/P	Stripe Height (nm)	Reader Sigma (nm)	Writer Sigma (nm)	R/W Offset Sigma (nm)	Angle Range (degree)
120	160	150	7.50	20.00	12.00	±0.375
160	240	150	7.50	20.00	9.60	±0.300
200	280	120	6.00	15.00	8.00	±0.250
240	320	70	3.50	10.00	4.80	± 0.150



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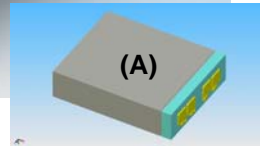
## Critical Parameter to Reader/Writer Offset



Backside of slider (A) is side of row mounted to ELG lapping tool



Wedge angle controls via the ELG lapper has limited precision adjustment capability to lap the ABS perpendicular to the trailing edge

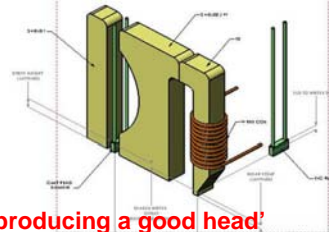
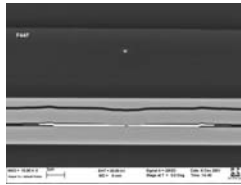
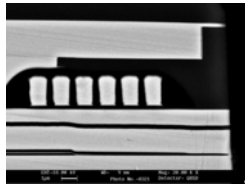


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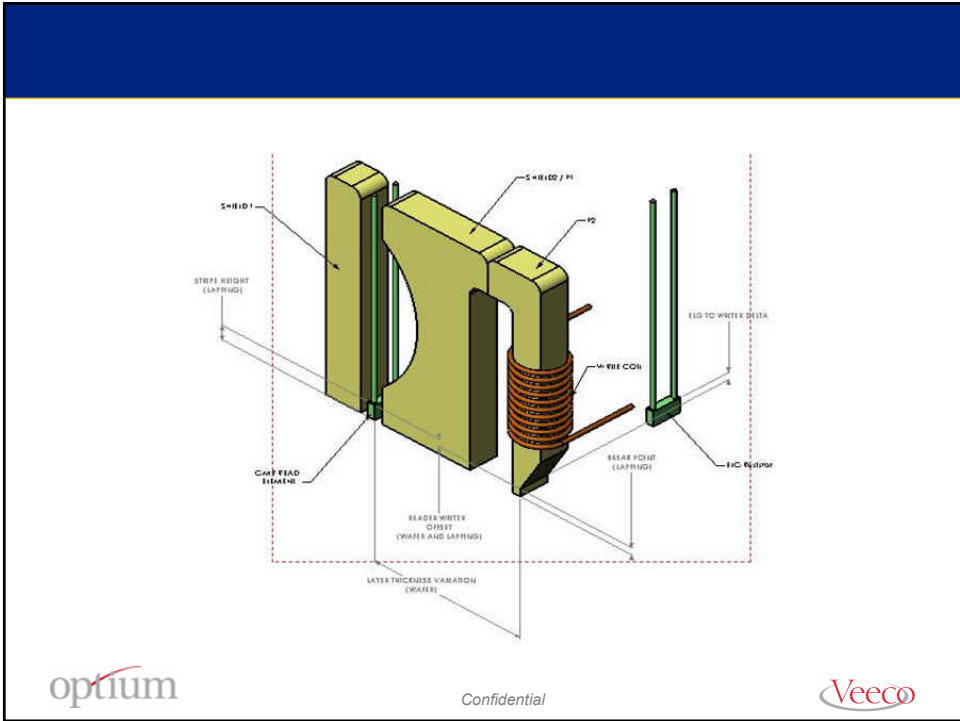
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## Lapper Solution for PMR

$\mu$ -radian Angle Adjustment Control Technology provides **Reader/Writer Offset**

Sensor Height Control Technology provides **Stripe Height Control**

Low lapping pressure improves **Flatness control, Surface Finish, PTR**

**ABS**

$\theta$

Wedge Angle To Control **Parallelism**

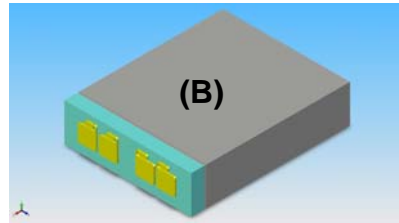
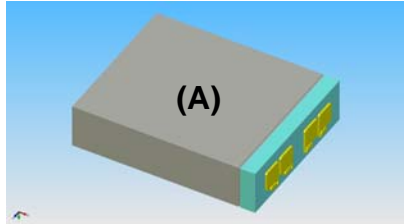
Edge grinding the backside of slider provides the required **Perpendicularity**

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## Saw Contributions to Slider Shape Control



Slider Perpendicularity – begins with side mounted to the lapping tool (A), a critical parameter to controlling reader/writer offset

Slider Parallelism – ELG lapper wedge angle adjusts the ABS side (B) parallel to backside of slider body

Squareness – a square slider minimizes downstream HGA adjustments

Slider Height – reducing slider height 'deviation to target' to  $\leq 1.0 \mu\text{m}$  by edge grinding the backside of the slider control z-height tolerance at slider-suspension

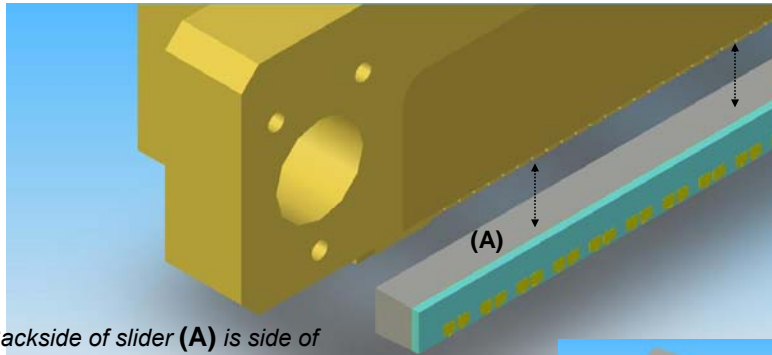
Slider Symmetry – controlling the dicing kerf size ensures outer walls of slider are equidistance from ABS centerline



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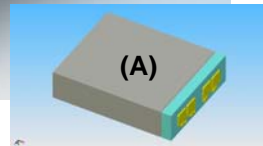
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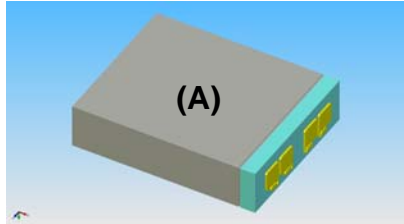
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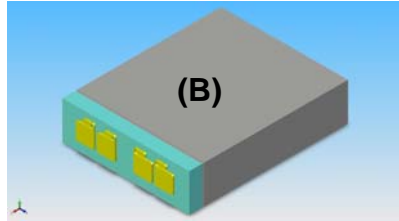
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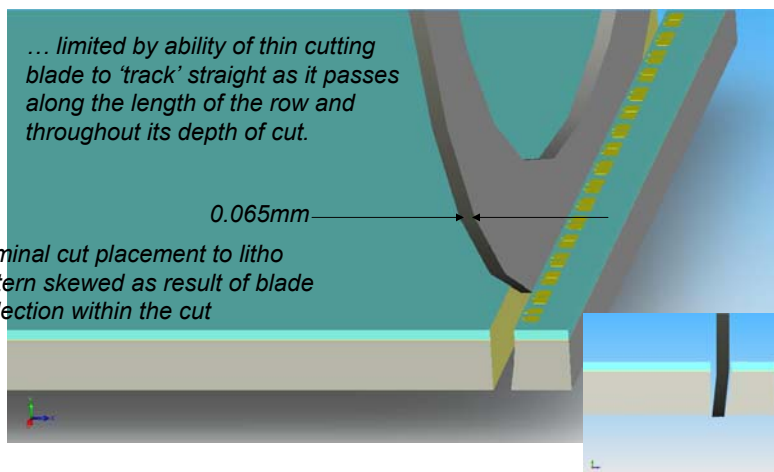
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## Problems at Row Slice

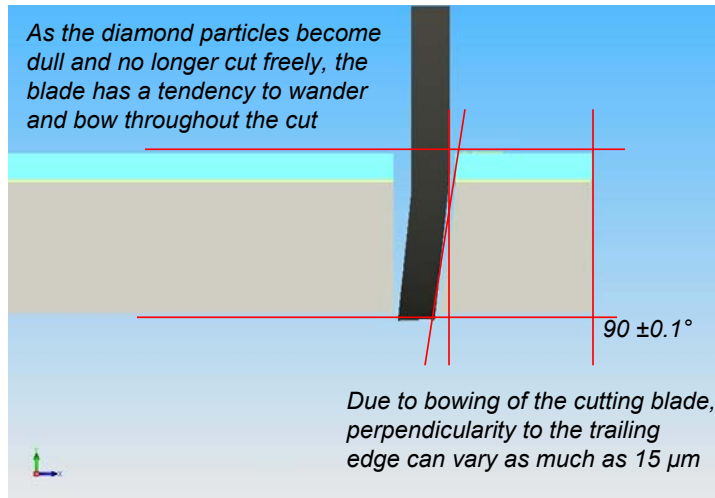


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## Thin Blade Kerf Geometry

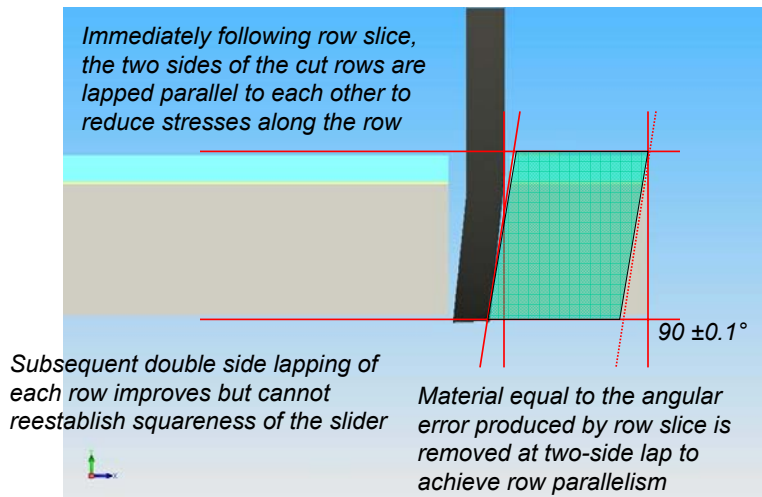


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## Industry-Wide Problem

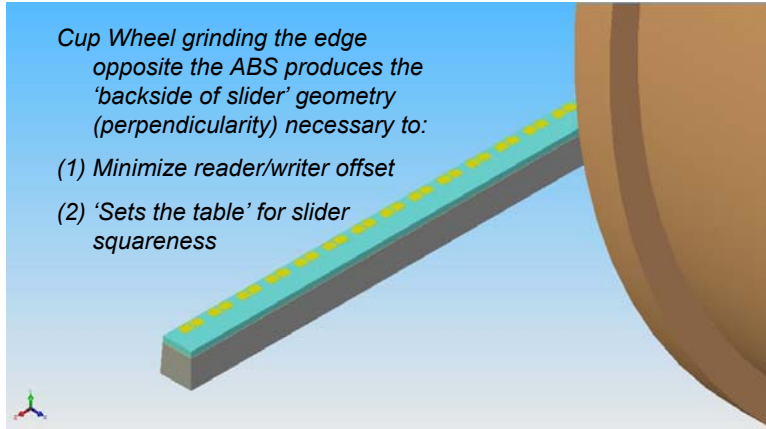


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## "A Better Solution – Cup Wheel Edge Grinding"

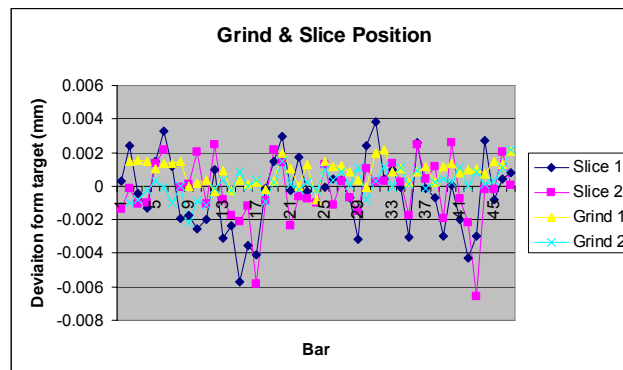


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## Sigma – Slice vs. Grind



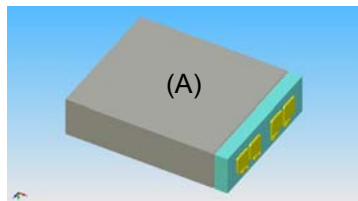
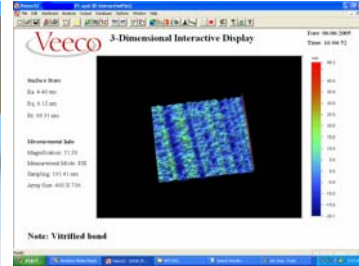
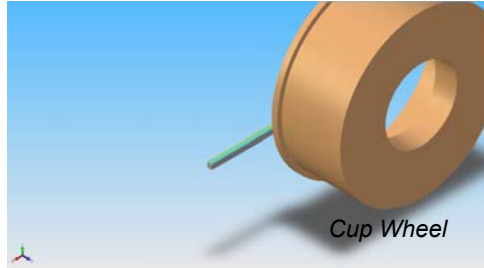
	Slice 1	Slice 2	Grind 1	Grind 2
Ave	-0.00043	0.00036	0.00086	0.00016
Sigma	0.00221	0.00188	0.0007	0.00079

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## Edge Grind Surface Quality



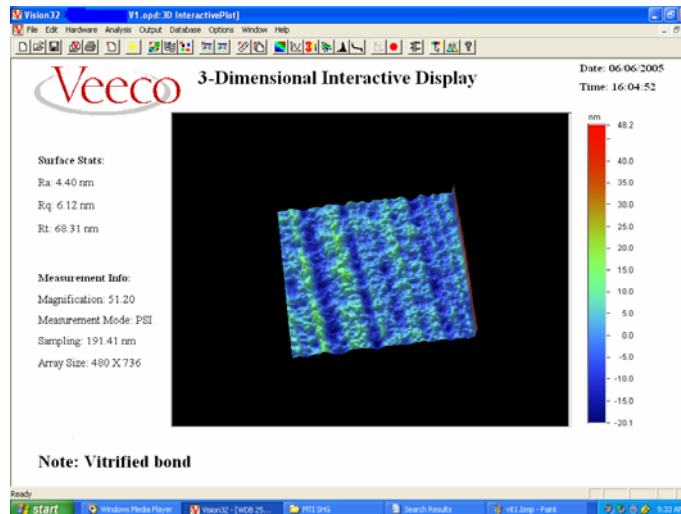
Surface Roughness - Slider Backside (A) Vitrified Bond Grinding Cup Wheel			
	Ra (nm)	Rq (nm)	Rt (nm)
Ave	5.714	7.433	77.390
Sigma	0.727	0.767	11.383
Max	7.094	8.750	122.132
Min	4.012	5.535	58.817

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## Surface Stats – Slider Backside



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## Dicing – Shaping Outer Walls of the Slider Body

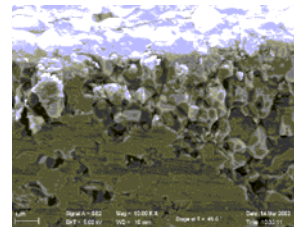
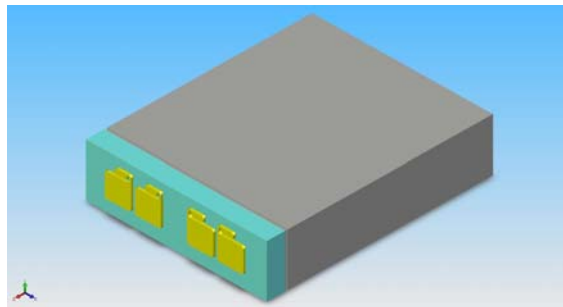


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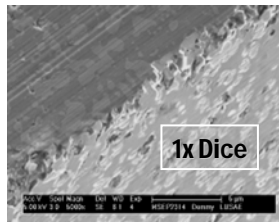
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## “Better dicing procedures means less particles and more reliable drives”

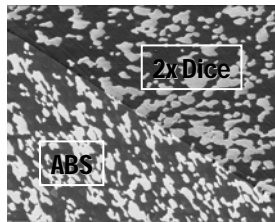


1

**(Photo 1)**  
10.0kx magnification of typical cut edge after 1 pass (1x) dicing step



2



3

**(Photo 2)**  
1<sup>st</sup> pass dice produces chips, pressure ridges, and grain pullouts along edges  
**(Photo 2)**  
2<sup>nd</sup> pass using polish blade eliminates chips, pressure ridges, and grain pullouts.

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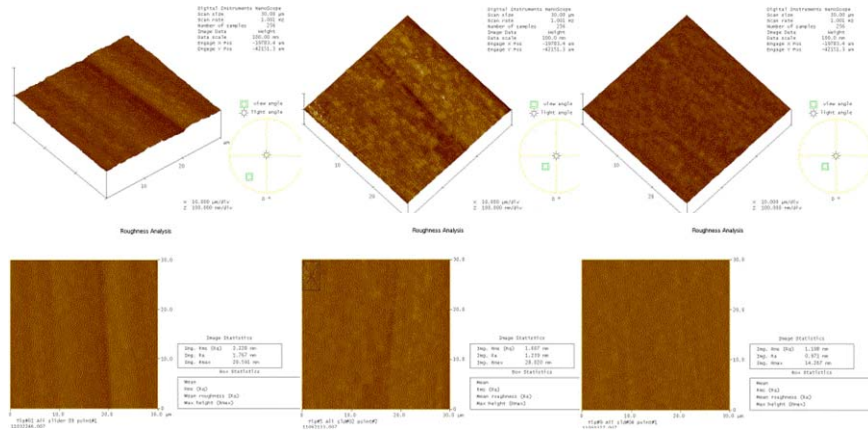
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## 2x Dice Surface Roughness

Ra - 1.77nm

Ra - 1.22nm

Ra - 0.97nm



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## Slice and Grind with Auto Bar Handling System

Video Presentation

## Summary

- **Slice and Grind...**
  - Produces chip-free edges parallel to the litho pattern
  - Controls ABS perpendicularity to trailing edge to  $\leq 4.0 \mu\text{m}$
  - Controls slider height to  $\leq 2.0 \mu\text{m}$
  - Eliminates angular error produced by thin cutting blades
  - Mitigates precise angle adjustments between writer ELG and reader ELG
- **2x Dice...**
  - Particulate control through advances in the dice and polish process significantly improves HDD reliability
- **Auto Bar Handler...**
  - Improves yields while reducing Slider Fab 'cost-of-ownership'
  - Eliminates costly non-value added steps such as parts handling



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