Process Development Center
&
Intelligent Tooling Solutions

The Sharon-Cutwell way to optimize cutting and drilling tools for Aerospace & Defense Drilling and High-Performance Machining industries.

Introductions

Jeff Prom
Owner & President

Scott Prom
Director of Technology & Innovation

Stefan Finster
Sales Manager

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Itinerary

1. Process Development Center (PDC)
2. Intelligent Process Development™
3. Intelligent Tooling™
4. Case Studies
5. Q&A

Process Development Center

Driving Innovation and Process Improvements

What is it?

- It is a testing & development center built with the latest machining, measurement and analysis equipment available and staffed with dedicated personnel.
- (2) dedicated machining centers
  - (1) MQL & (1) High Pressure coolant
- Pro-micron spike® – force measurement and analysis
- Alicona – advanced inspection & wear analysis
- High-speed video - Process visualization
- Other inspection equipment
- Full-time personnel dedicated to PDC

Process Development Center

Driving Innovation and Process Improvements

What is it?

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Process Development Center

Driving Innovation and Process Improvements

Why does it exist?

- To drive innovation and process improvements into our customers applications and processes.
- PDC is a tool to help solve the most challenging hole-making and machining problems in industry.

What is the Need?

- Largely unmet need to solve machining problems and bringing advancements to our customers in a timely manner & in a non-production environment.
- No one is doing this.

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Process Development Center

Driving Innovation and Process Improvements

Methods of Process Development

Common method: *(Limits Advancements)*

- Bring tried and true solutions new projects
- Needed to minimize risk
- New solutions must be tested on the floor
  - Risky - Uncertainty involved
  - Disrupts production
  - Slow process
  - Minimal data-driven decisions

Process Development Center

Driving Innovation and Process Improvements

Methods of Process Development

PDC method: *(Enables Advancements!)*

- Test & Optimize “off-line”
- Data-driven decisions
- Rapid solution iterations
- We can take risks and work through them – “Fail forward”
- Bring “mostly baked” optimized solution to the production spindle

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Driving Innovation and Process Improvements

What do we do in the PDC?

WE LEARN!

- We help solve our Customers problems
- Co-develop solutions & create optimal processes with our Customers
- Develop our own products
- Collaborate with industry partners – to synthesize the worlds best technologies to create unique and transformative solutions

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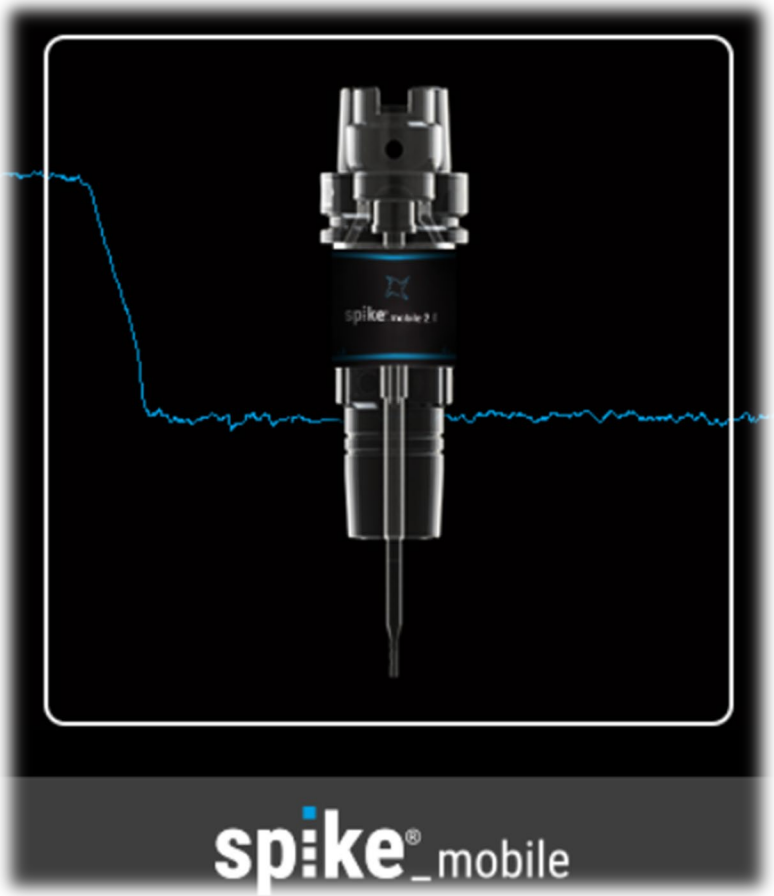
Intelligent Process Development™

Driving Innovation and Process Improvements

What is it?

- Synthesizing all PDC tools and resources and our expertise to create an objective understanding of the drilling process.
- Use that understanding to guide tool geometry and process variation to create desired outcomes.
- Examples
  - Pro-micron spike® – Force measurement and analysis
  - Alicona – Advanced inspection & wear analysis
  - High-speed video - Process visualization

Force Analysis – real time with Pro-Micron spike®



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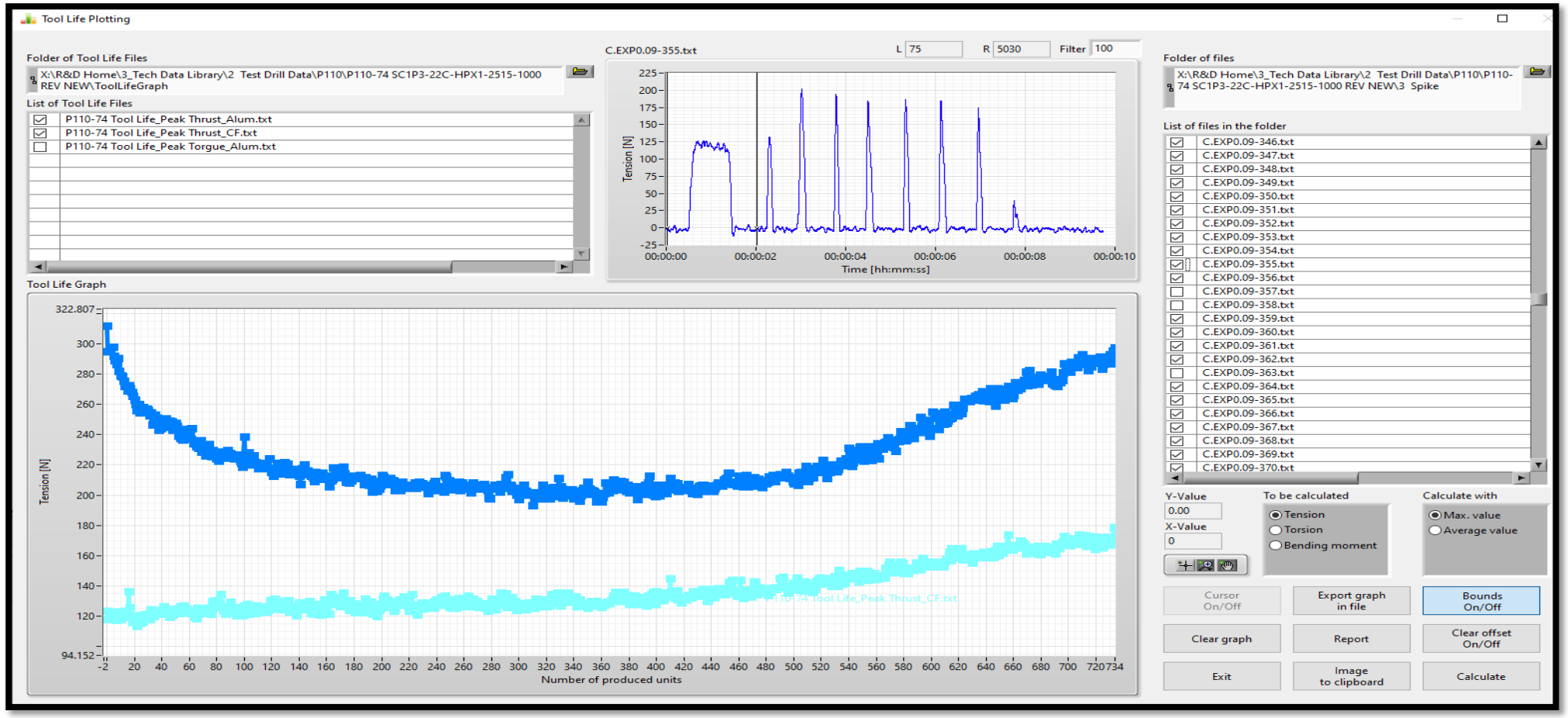
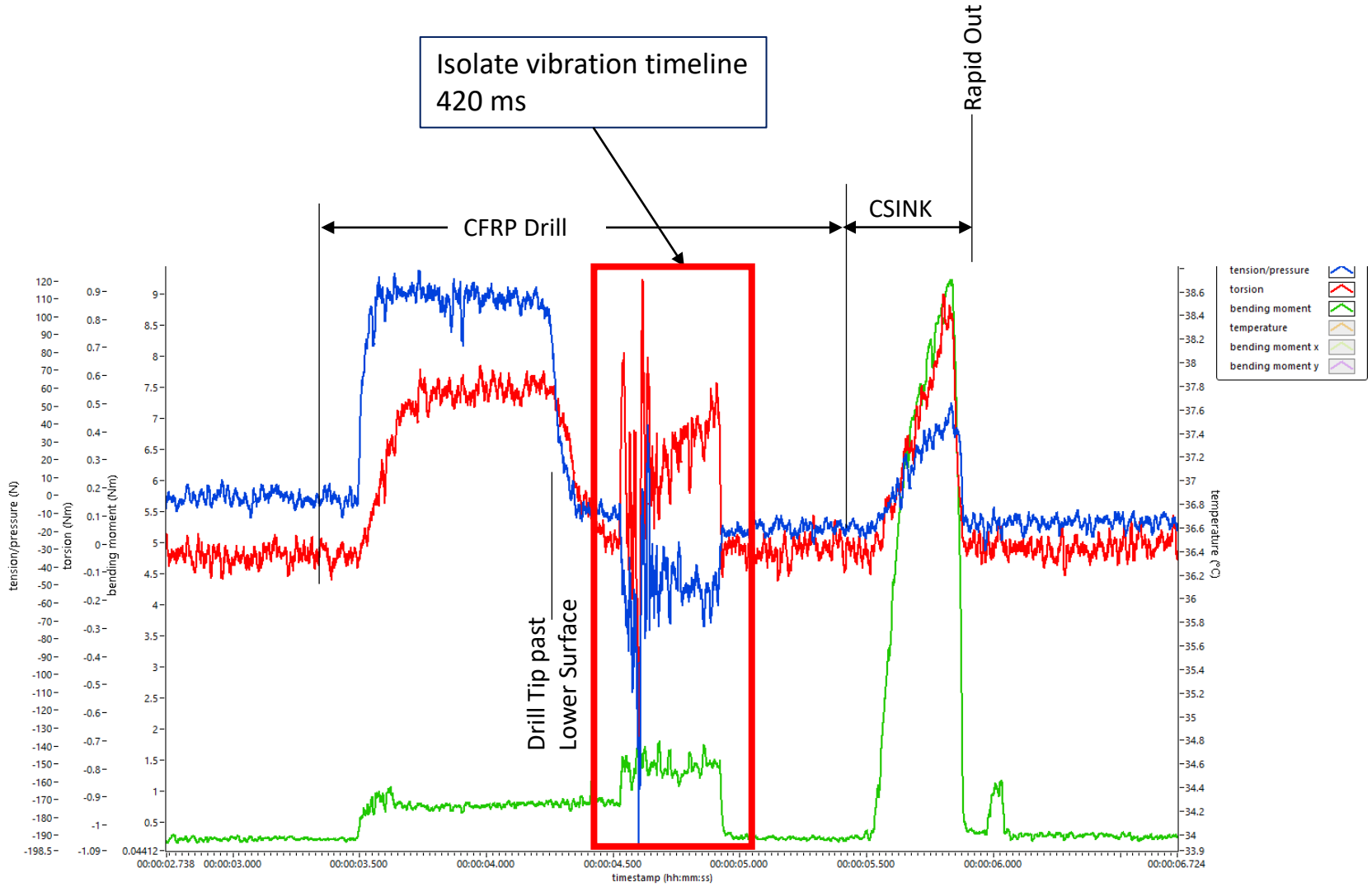
Example: Peak Thrust vs Hole#

Carbon Fiber / Aluminum Stack



Drill/C'sink Process – Drill Vibration Investigation

1 hole – Carbon Fiber



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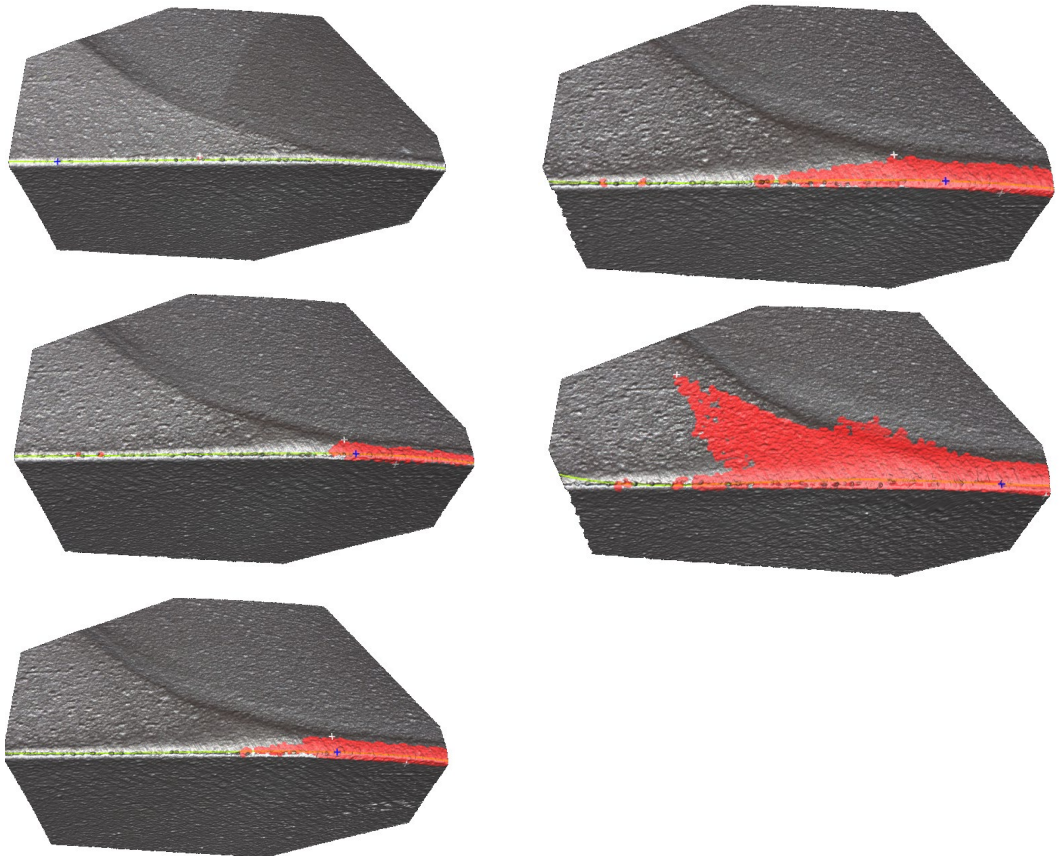
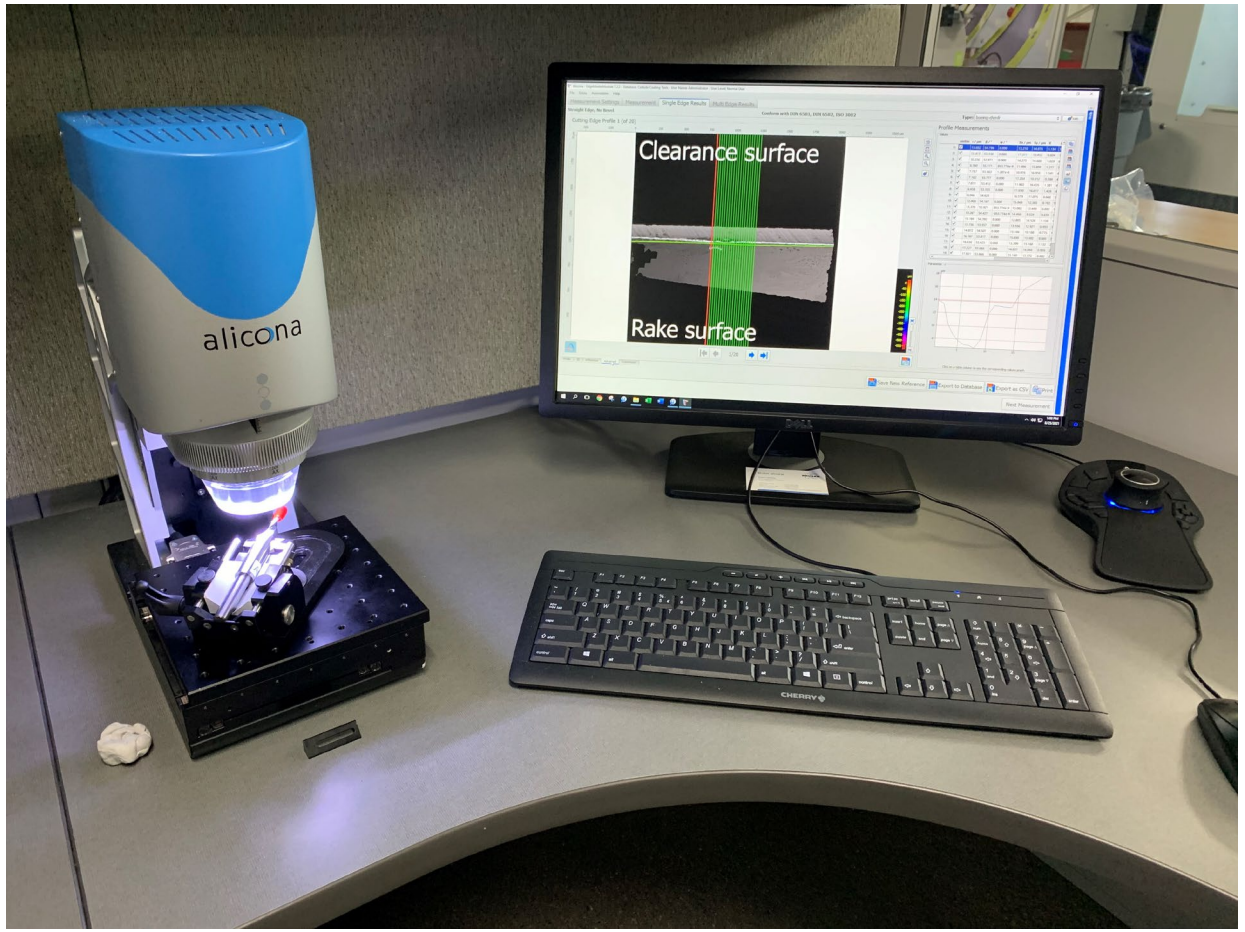
Alicona - Wear Progression Analysis
(Every 100 holes)





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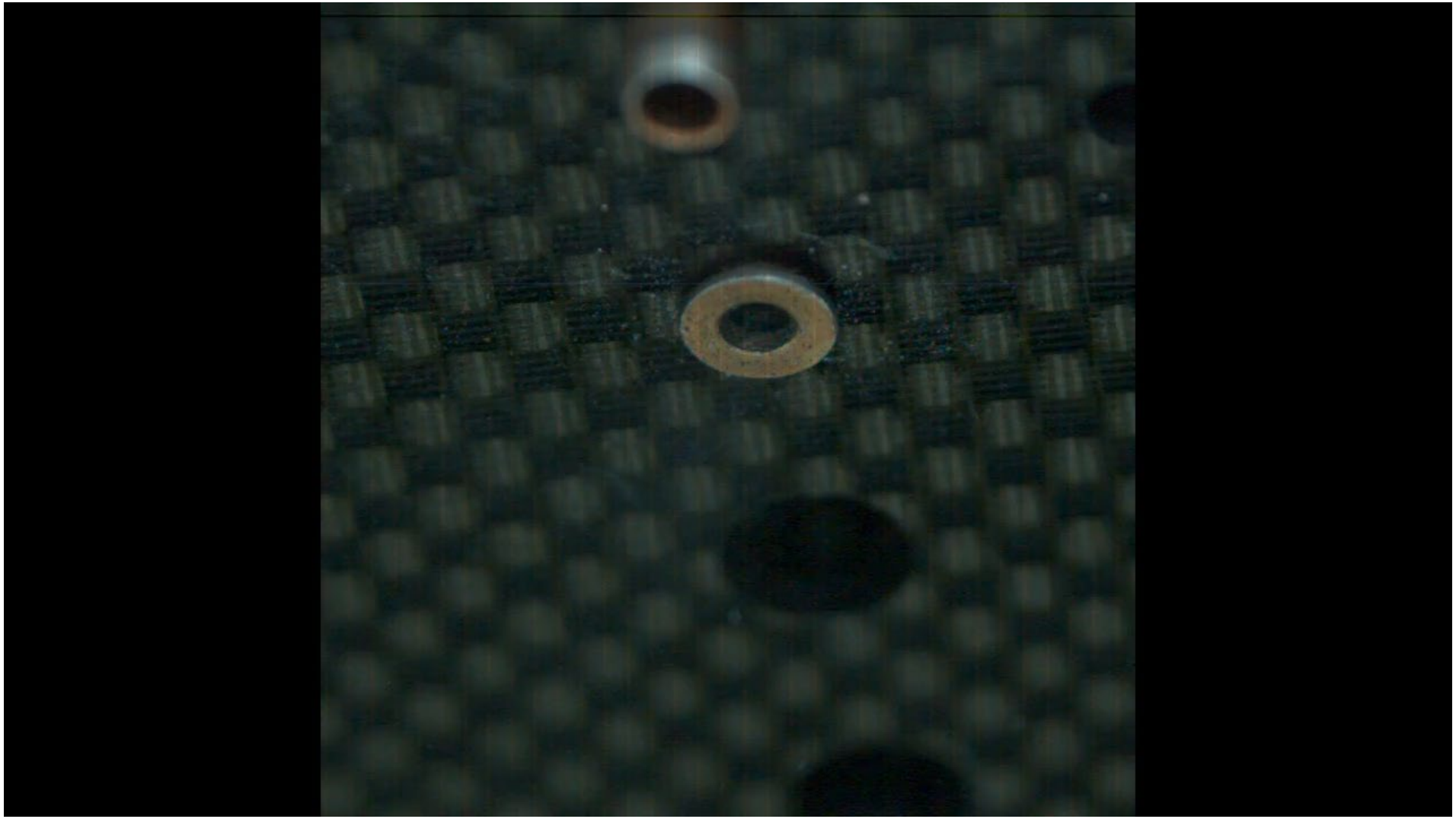
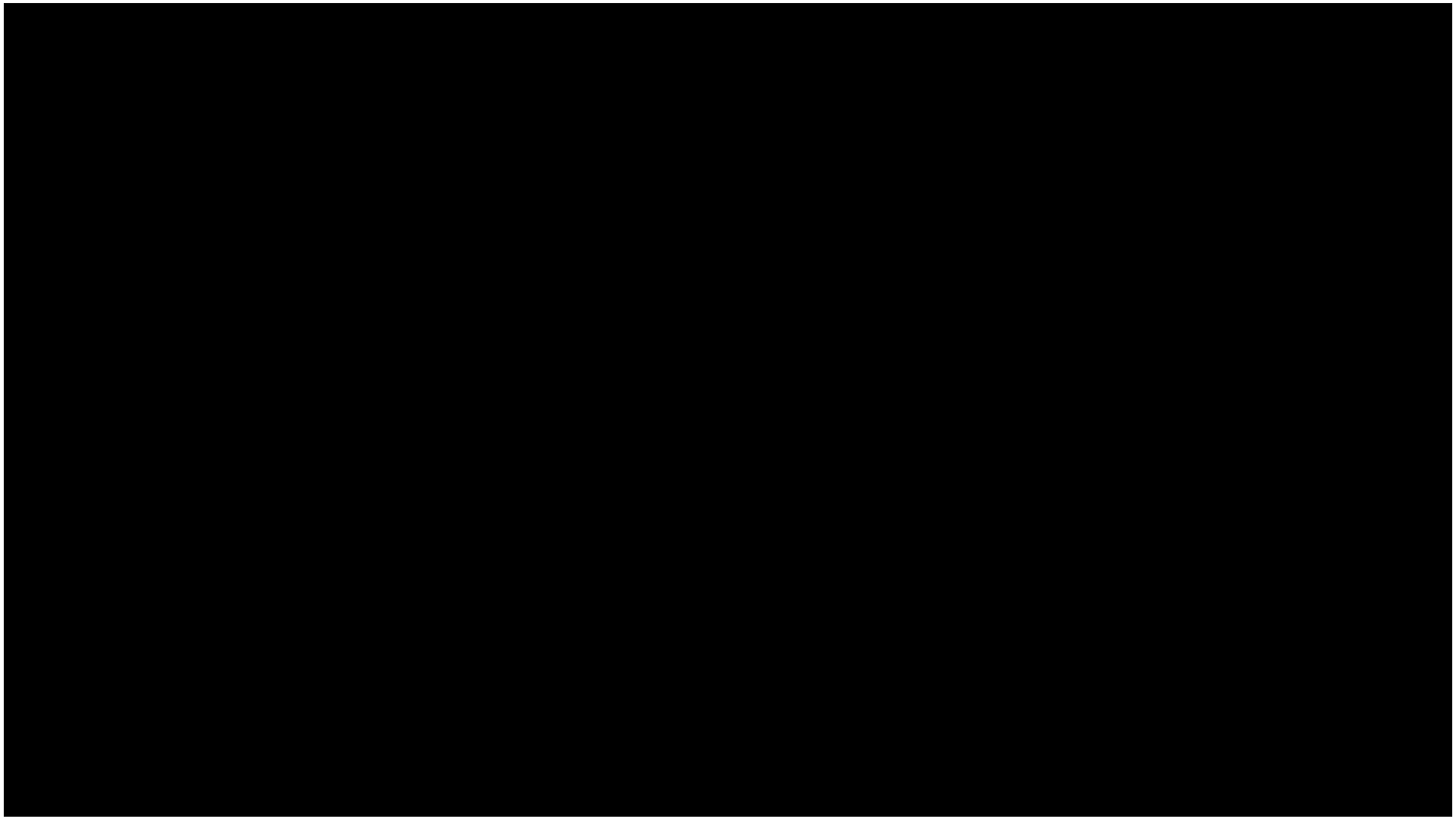
High Speed Video – Tack Drill VAD



High Speed Video – Bend to Break



Intelligent Tooling™

What is it?

- The tool can communicate – in real time – its current health and status.
- Primarily utilizing spike®
- Used during R&D and troubleshooting
  - We're constantly monitoring all force plot data when testing.
  - Observe wear patterns and tool life
  - Informed when end-of-life or abnormal events occur
- Future State – working closely with Pro-micron
  - Create dataset force profiles of known good and normal wear patterns
  - Contrast to datasets of known abnormal conditions
  - Develop algorithms & KPIs to inform machine and operators of worn tools or tool failures
  - **Maximize tool life and minimize scrap!**

Case Study - Automotive

- Big 3 Automotive - Production Problem Solving:
  - Machine axis fault due to heavy thrust – engine block drilling
  - Up to 30% downtime – reduced feed and tool life
  - Asked to solve problem with a better cutting tool

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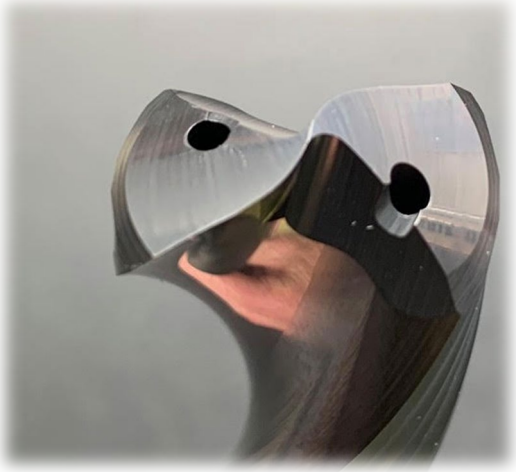
Case Study - Automotive

Intelligent Process Development™

- Project Kick-off 23 Mar 2021
- Baselined existing drill with spike
- Designed several drills of our own and tested

Baseline Drill

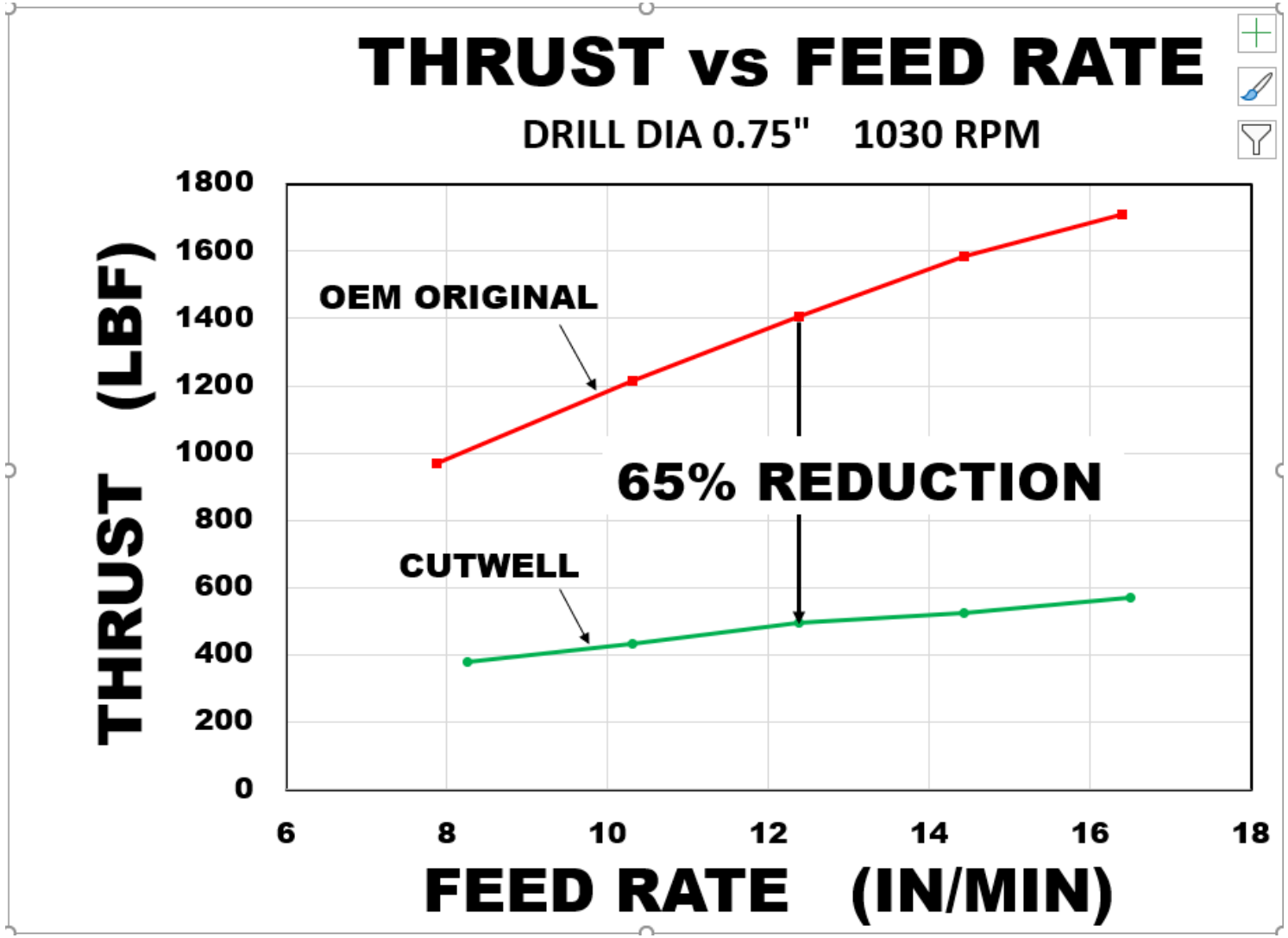
Sharon-Cutwell Drill



Case Study - Automotive

Intelligent Process Development™

- Reduced thrust by 60% - with 50% INCREASED FEED!
- Cutwell testing complete and results presented 6 May 2021 6 weeks!
- Up and running in production!



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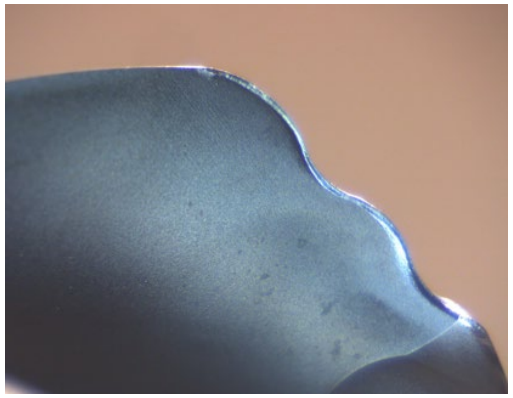
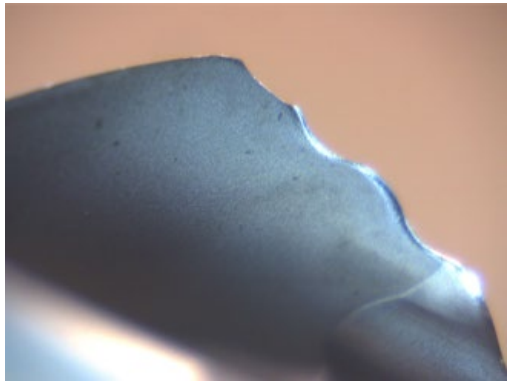
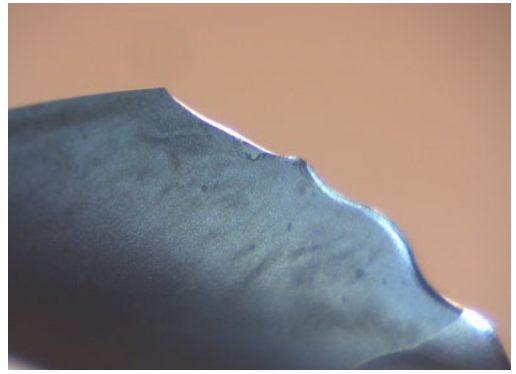
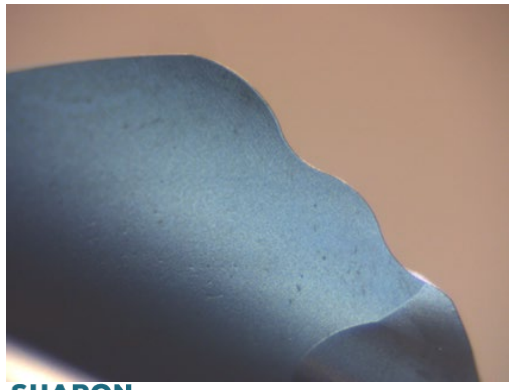
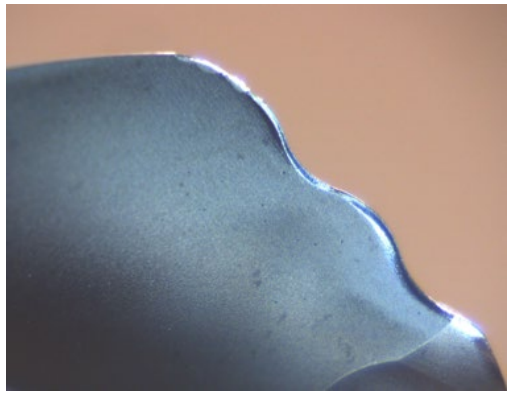
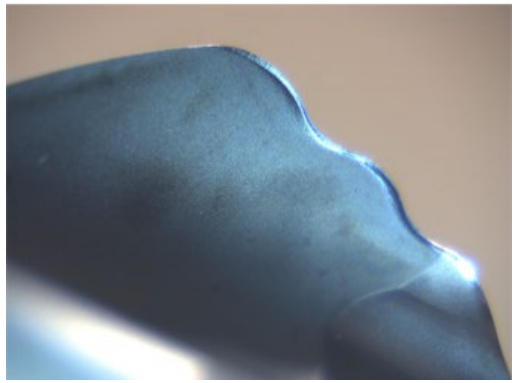
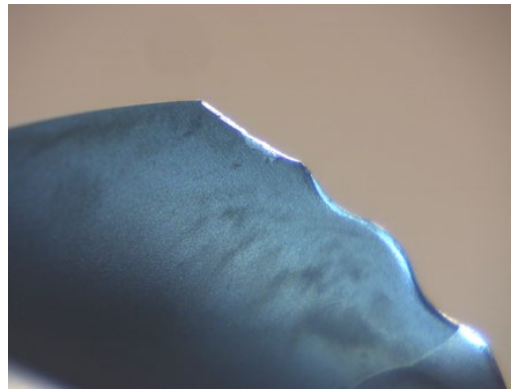
Case Studies – Aerospace
Intelligent Tool Development™

- Cutwell's Wave-Point™ drills are designed & developed specifically for automated drilling in aerospace material stacks
  - P2 – Composite
  - P3 – Composite / Aluminum
  - P4 – Composite / Titanium

High Speed Video – Wave-Point™ Exit

Case Studies – Aerospace 1

Force Comparison – 4 Holes, 4 Drills, CF only

	Drill 1 New Drill	Drill 2 Mid-life	Drill 3 Failure 1	Drill 4 Failure 2
Face 1				
Face 2				

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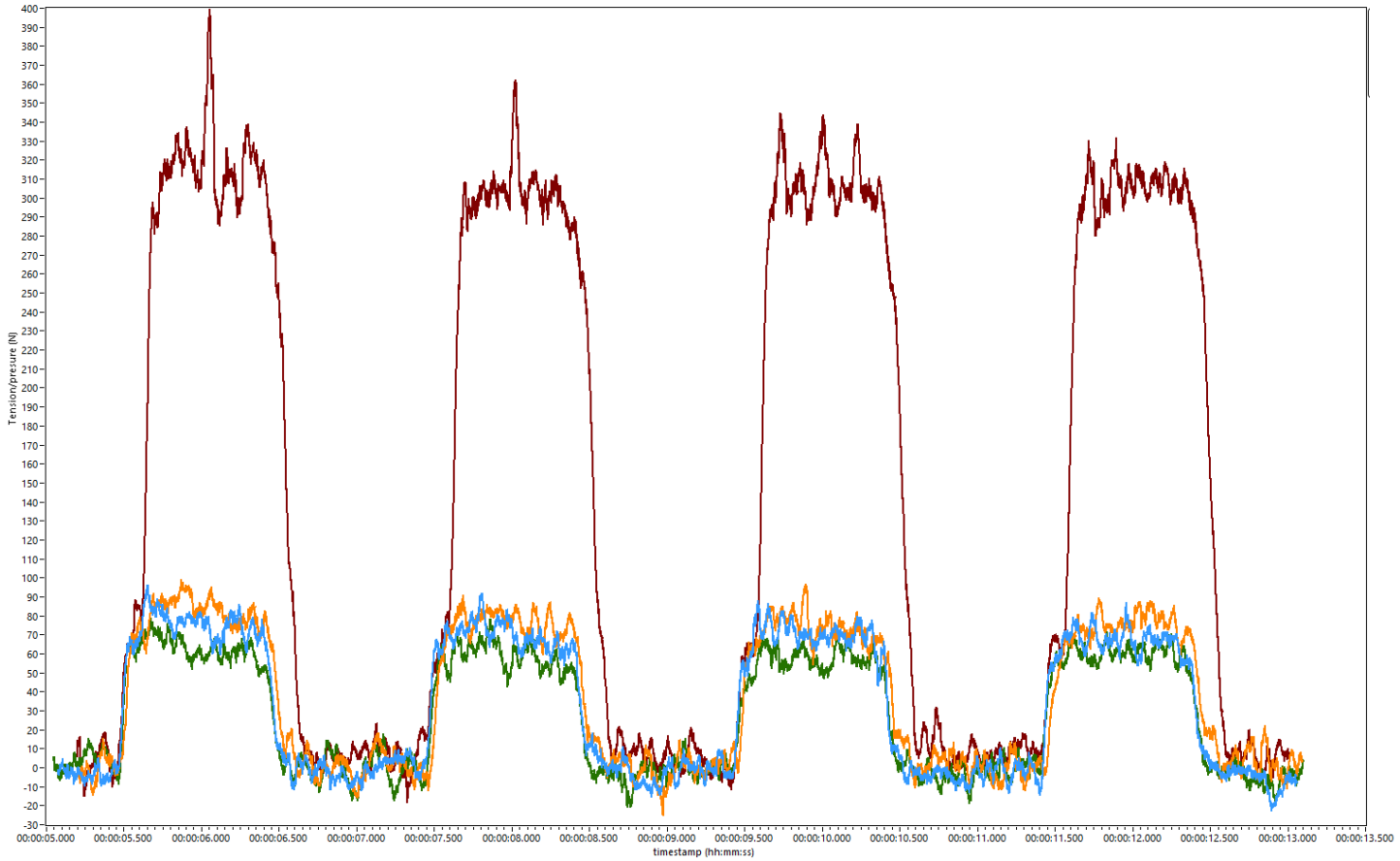
Case Studies – Aerospace 1

Thrust Comparison – 4 Holes, 4 Drills, CF only

Drill 1
Drill 2
Drill 3
Drill 4



- Notable thrust increase on Drill 4

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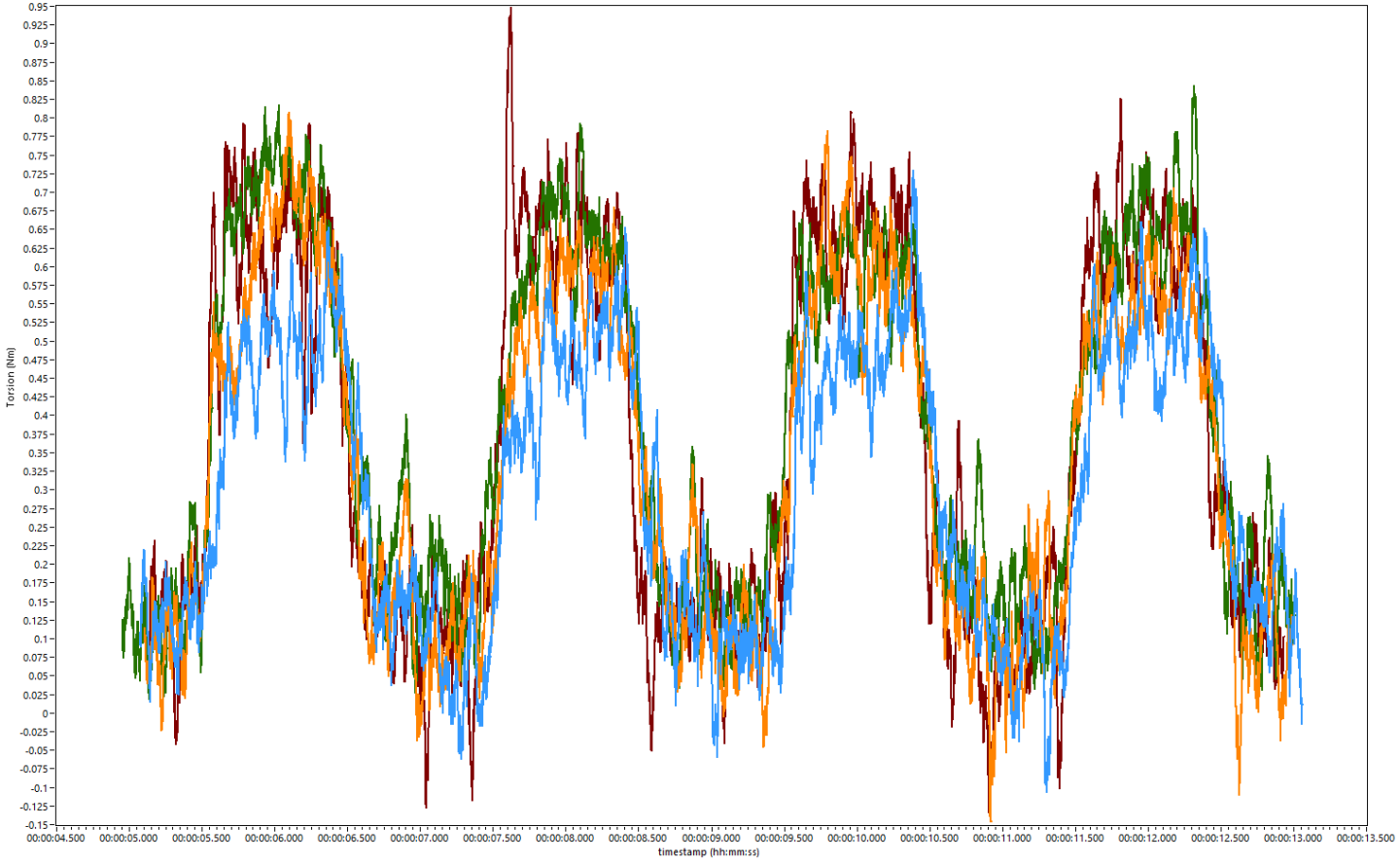
Case Studies – Aerospace 1

Torque Comparison – 4 Holes, 4 Drills, CF only

Drill 1
Drill 2
Drill 3
Drill 4



- Slight increase in torque between Drill 1 and 4

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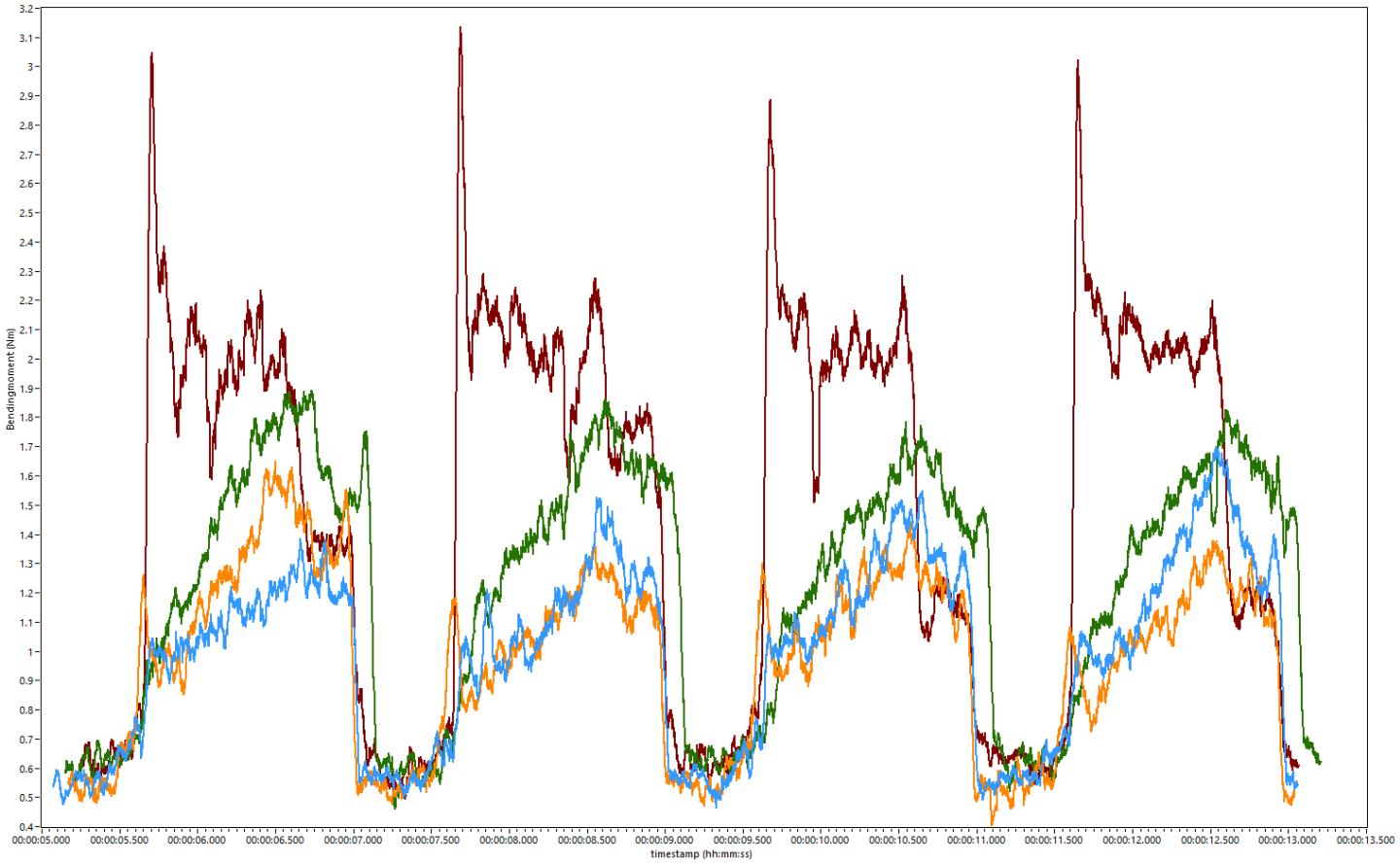
Case Studies – Aerospace 1

Bending Comparison – 4 Holes, 4 Drills, CF only

Drill 1
Drill 2
Drill 3
Drill 4



- Bending increased with drill tip chipping

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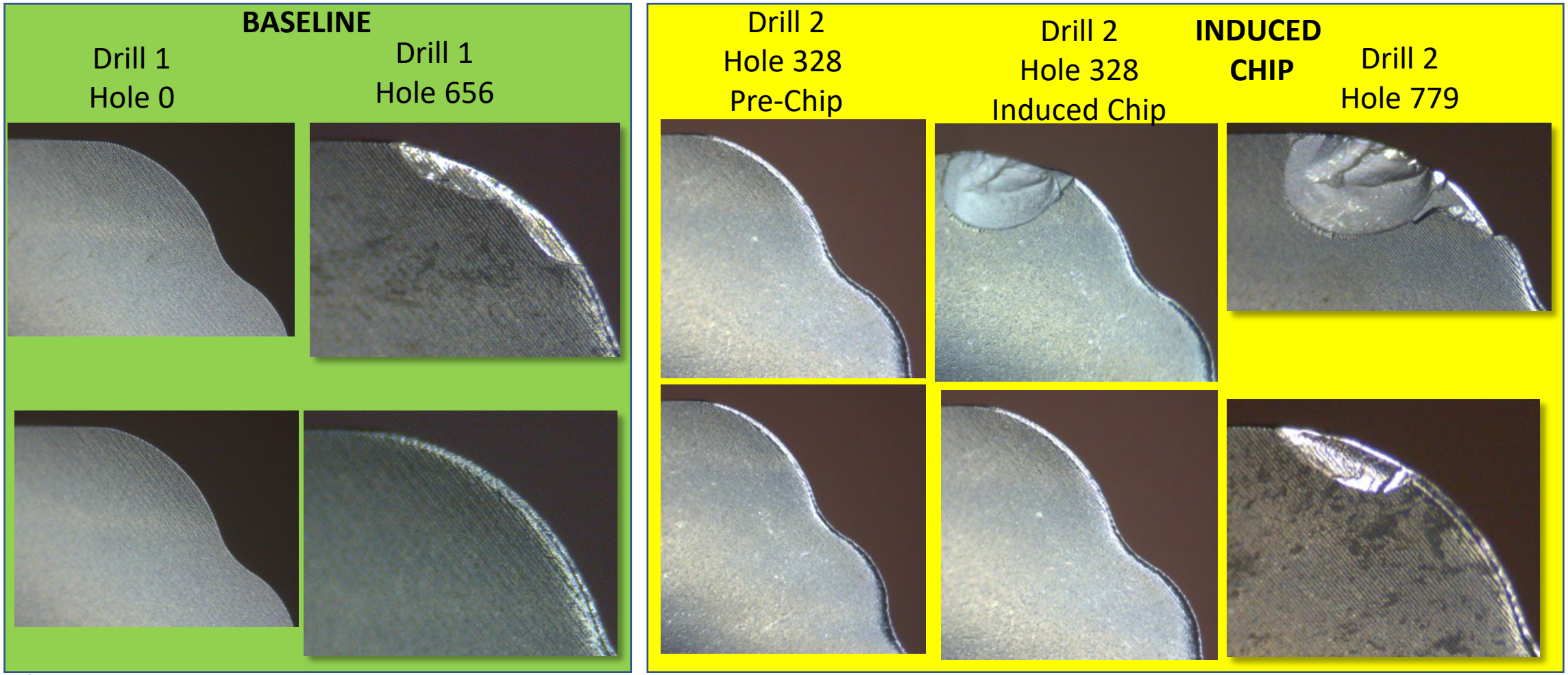
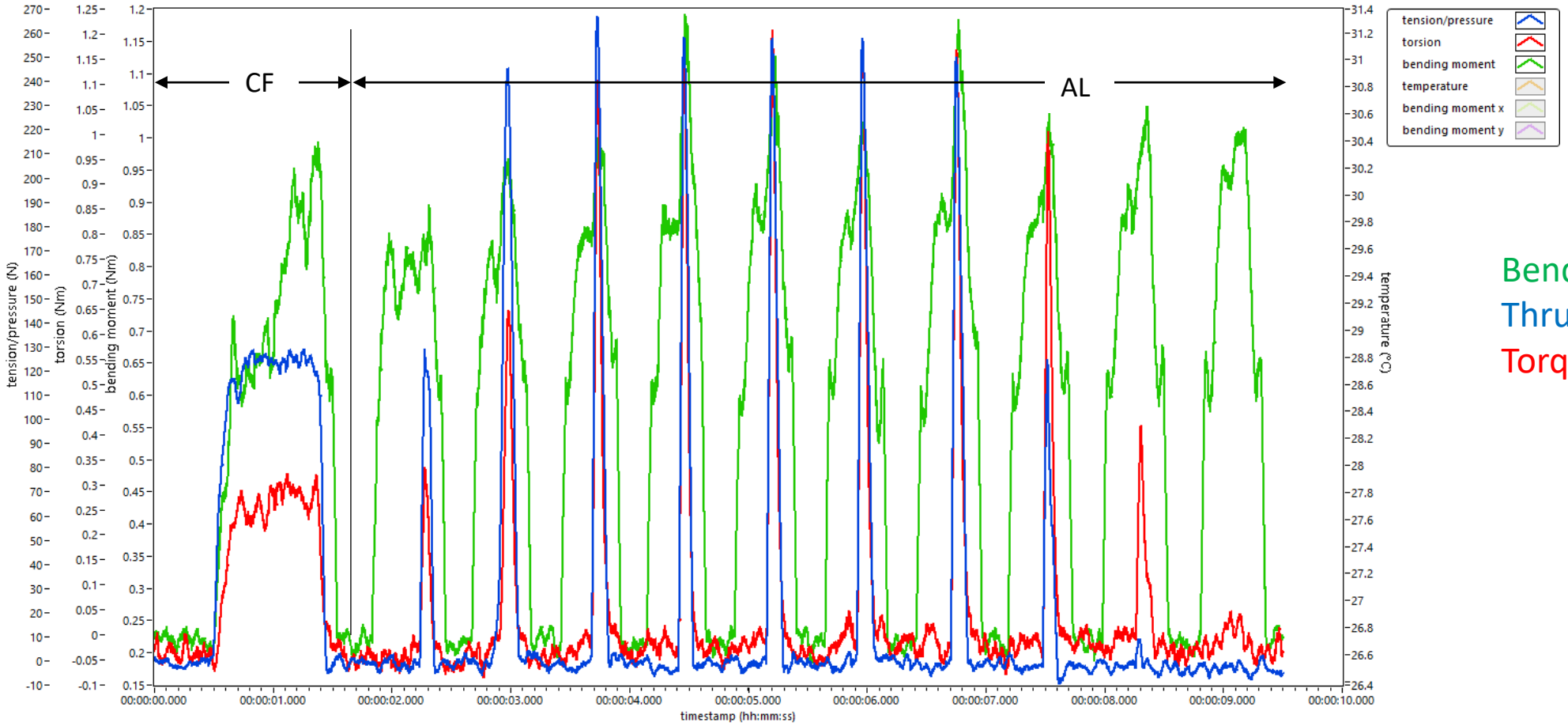
Case Studies – Aerospace 2

Force Comparison – Drill Life, 2 Drills, CF/AL



Case Studies – Aerospace 2

1 hole CF/Al Process, CF continuous, AL 10 Full Retract Pecks



Bending
Thrust
Torque

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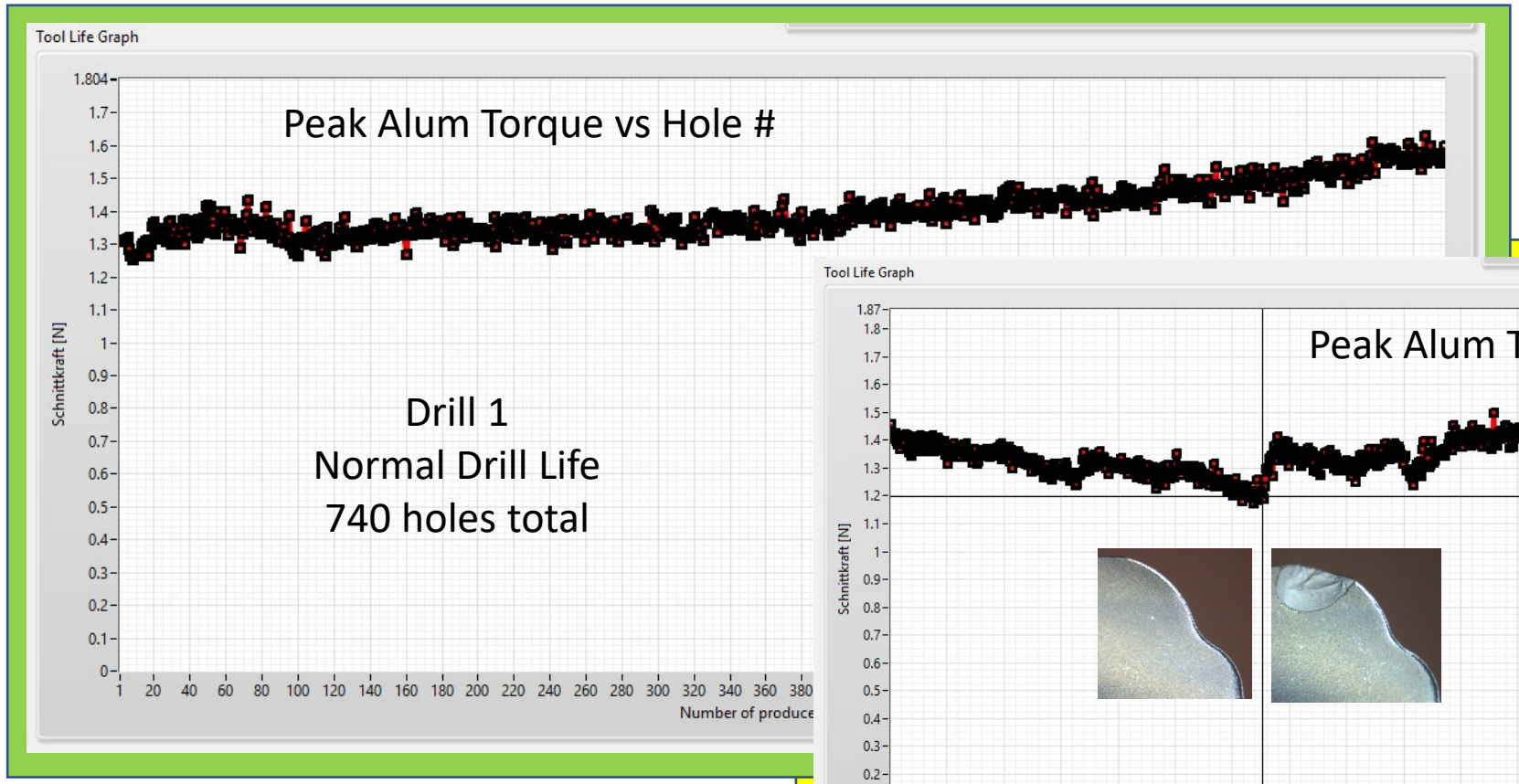
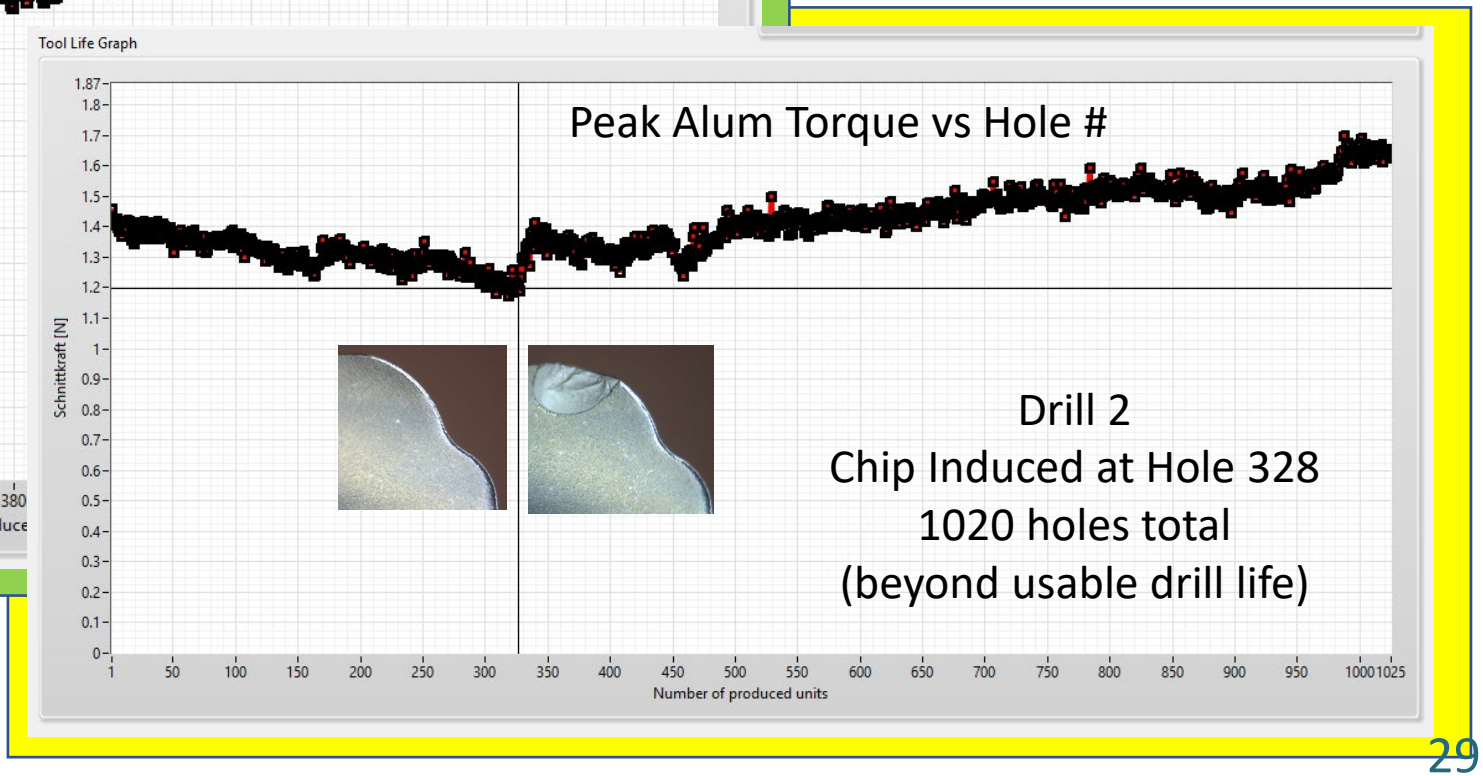
Case Studies – Aerospace 2

Torque vs Hole #, 2 Drills





- Step increase in Torque noted on Drill 2 after induced chip

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Conclusion

Why it's special for Sharon-Cutwell to have a PDC?
What can Sharon-Cutwell PDC do for you?

1. What are your most challenging applications? Let us help you solve them.
2. Validate speeds, feeds and tool life.
3. Let us help **drive innovation** into your processes!

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Thank You.

Any Questions?

Jeff Prom
Owner & President

Scott Prom
Director of Technology & Innovation

Stefan Finster
Sales Manager

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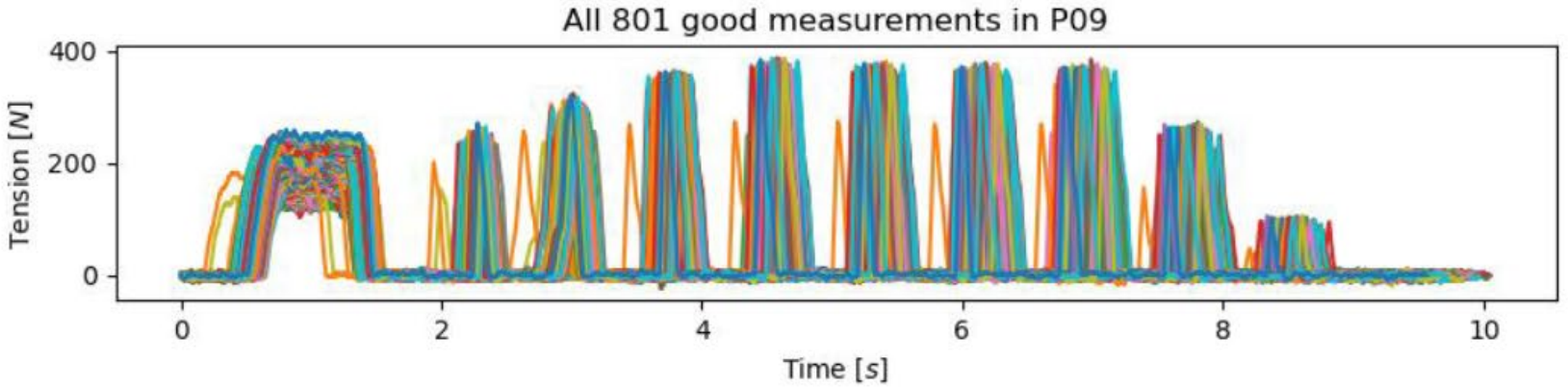
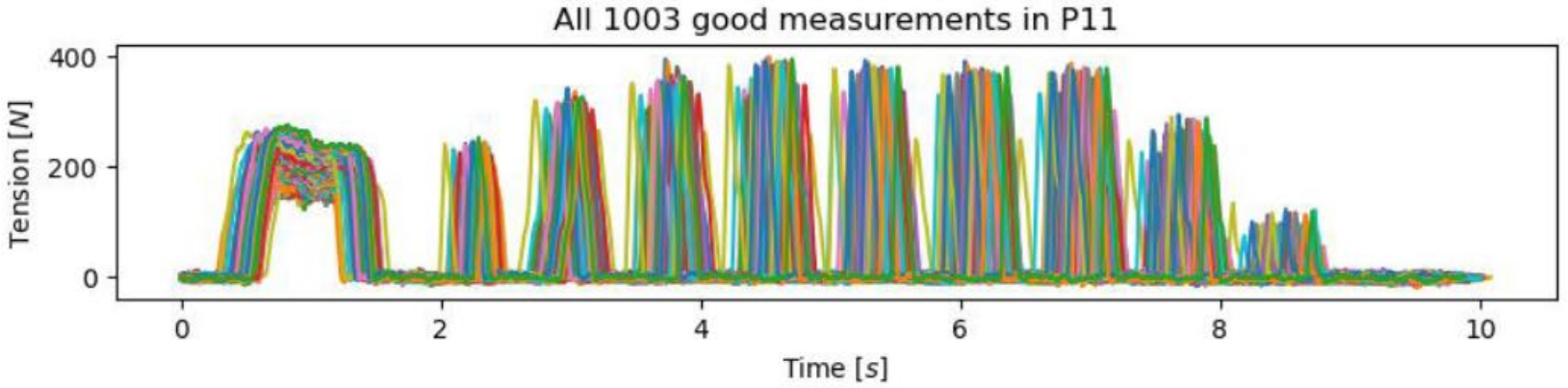
All filtered thrust data of P09 and P11:

P09 & P11 = Thrust history for 2 drill life tests.
Drilling process for CF / Al Stack. Continuous drilling in CF. 9 peck cycles in AL





Data recorded for each hole during tool life. Analysis performed to compare evolution of force vs time.

Tool-health prediction:

HI-value based on CF-Drilling:

- Value between 1 and 0
- 0 means tool is in an critical state
- Normalization of each package is based on first 20 values

Advanced data processing creates metrics to allow comparison of each drill life to the “BASELINE” process.

Algorithms are still under development and will be process specific.