NUCOR AND PRIMETALS: BUILDING THE FUTURE OF ROLL MILL SAFETY AND TECHNOLOGY TOGETHER

IRD FALL 2022

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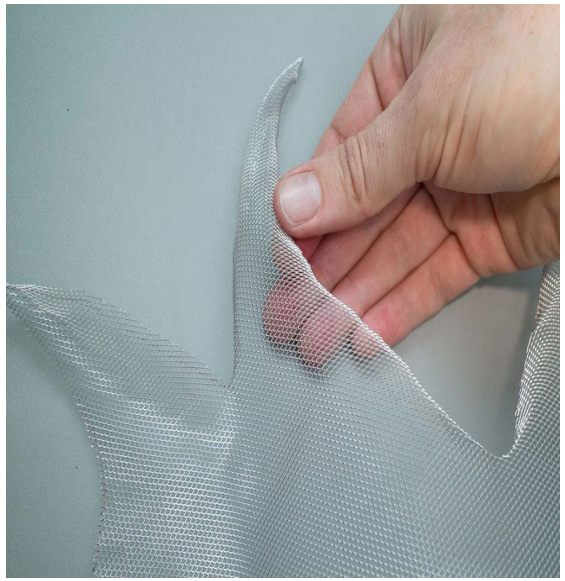
Nucor Steel Connecticut Plant History

- 1984 – Connecticut Steel Corporation was formed
- 1984 - Mesh Plant was started
- 1988 – Roll Mill started up in the fall
- 1990 - Started Ocean State Steel in Rhode Island – Producing Billets
- 1991 – Abandoned Ocean State Steel
- 2000 – Add on new Mesh Plant
- 2006 – NUCOR Purchases Connecticut Steel Corporation
- 2013 – New Furnace, 2 Cantilever Stands, & Reform Area Installed
- 2022 – Smart Tech Trials

Roll Mill Product End Use



❖SMS Reheat Pusher Furnace – 70 TPH

❖2 – SMS CL700 Cantilever Stands

- ❖ Turntable from Furnace Roll Conveyor into the Roll Mill

- **Roughing Mill**

❖ **2 – 1950 Mesta Stands**

❖ **3 – 1940's Morgan Stands – With Fabric Bearings**

❖10 - 1940's Morgan Stands – With Fabric Bearings

- **Intermediate Mill**

Primetals Technologies Overview

Local History

- **1888** Morgan Construction Company founded in Worcester, MA
- **1931** Developed the MORGOIL® oil film bearing
- **1963** Developed the No-Twist® finishing mill
- **2008** Morgan Construction Company merges into Siemens VAI
- **2015** Siemens enters a joint venture with Mitsubishi Heavy Industries (MHI) to form Primetals Technologies
- **2020** MHI and partners take sole ownership of Primetals Technologies

✓ **Revolutionized the wire rod industry with the introduction of the No-Twist® Mill, Stelmor® conveyor, Reducing/Sizing Mill, etc.**

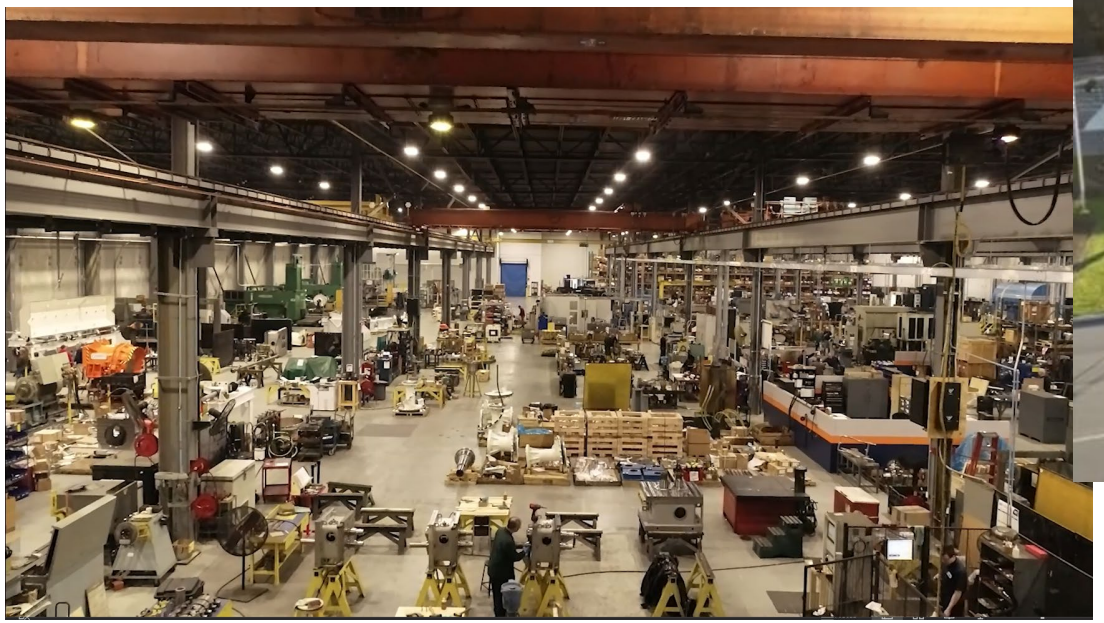
✓ **Over 450 Long Rolling continuous mills worldwide**

✓ **MORGOIL® bearings in 1561 Flat mills**

✓ **Recognized as the world leader in metal rolling technology**

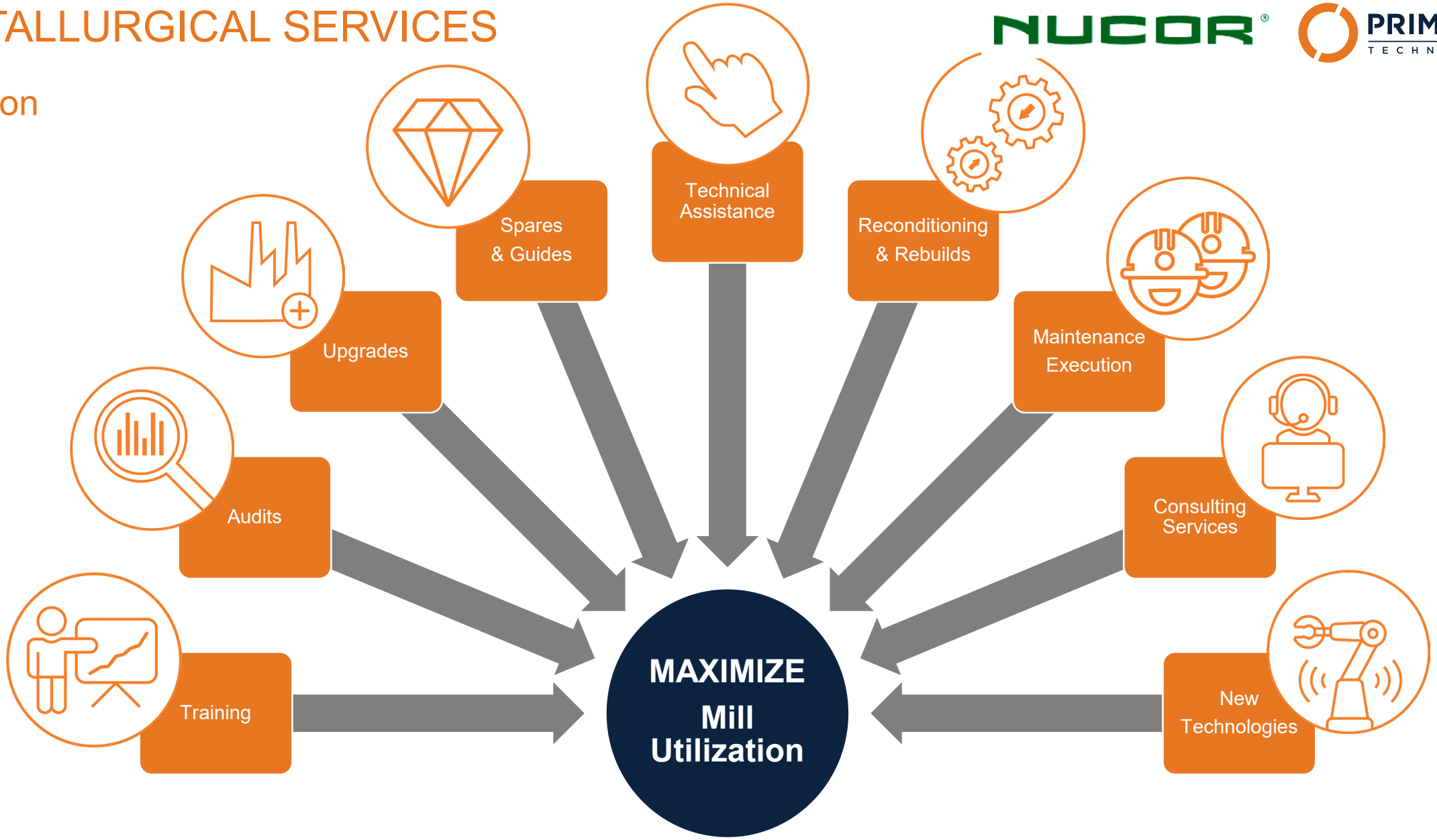
Primetals Technologies – Sutton, MA

- New facility opened in 2020
- 183,000sqft
- Machining, assembly, reconditioning, & warehousing – 143,000sqft.
- Offices with engineering, sales, purchasing, etc – 40,000sqft.
- ~300 employees



METALLURGICAL SERVICES

Mission



Digitalization at Primetals Technologies

Primetals Technologies is building towards a digital future.

Smart plants of the future are built on developments of today:

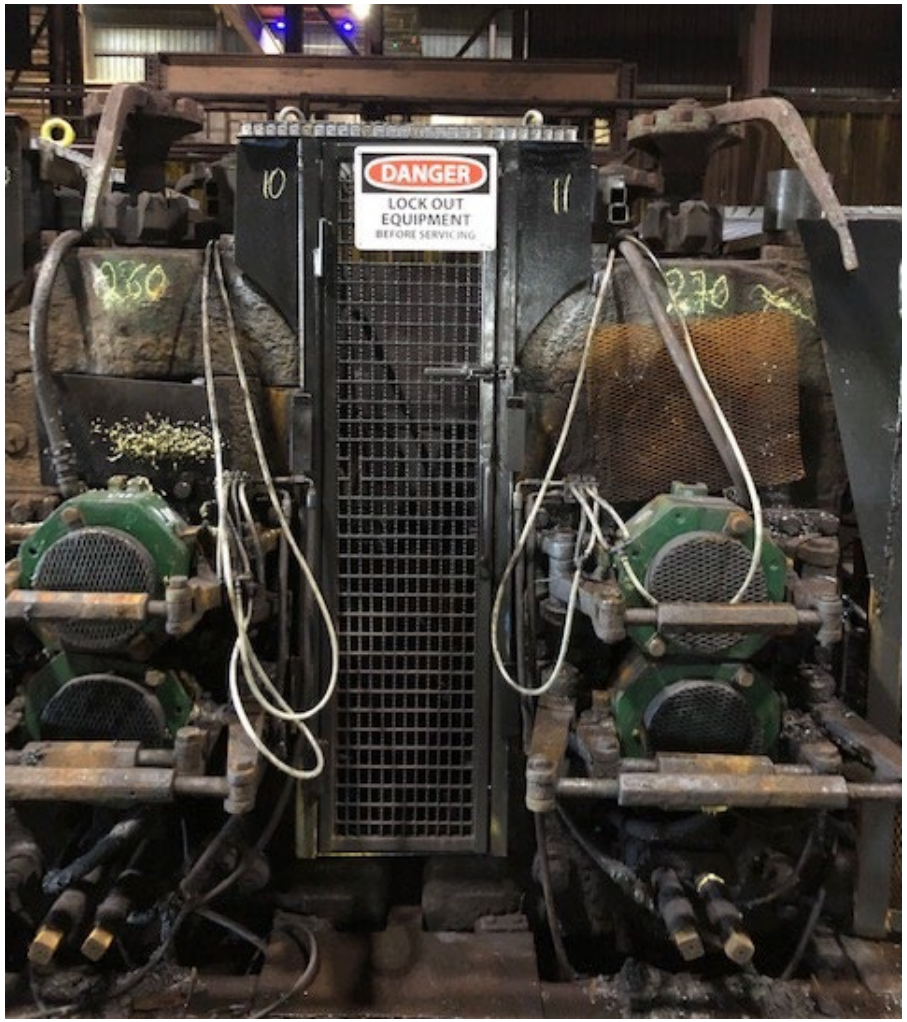
- Improve production process
- Enhance safety
- Reduce Costs
- Optimize Resources
- Maximize Quality

Nucor Steel Connecticut Safety Initiatives

How can we make the steel rolling process safer for our team?

- Control potential cobbles.
- Eliminate potential cobbles.
- Get the team away from the mill while there is a bar in it.
- Real time feedback for bar size and guides.

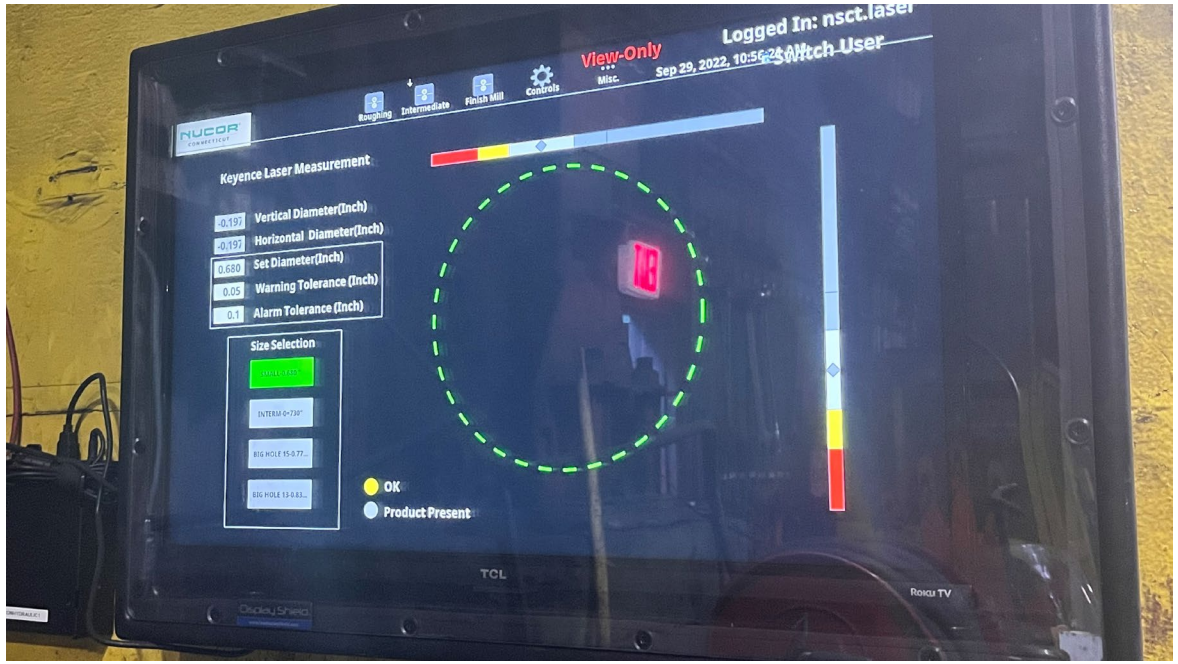
Safety Caging in Intermediate Mill



Hands off Measuring Devices

Sizing Gauge Reading Finished Product Size

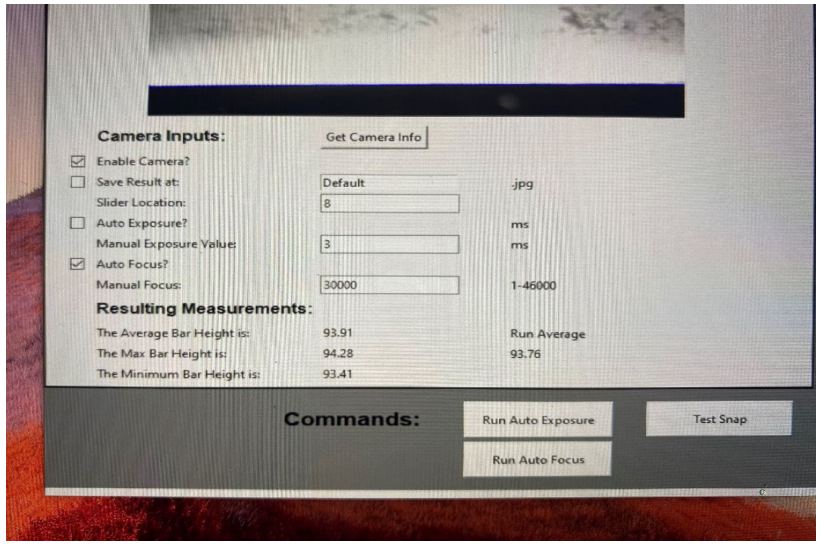
Bar Reading Camera System with In-house Display Reading Intermediate Bar Size



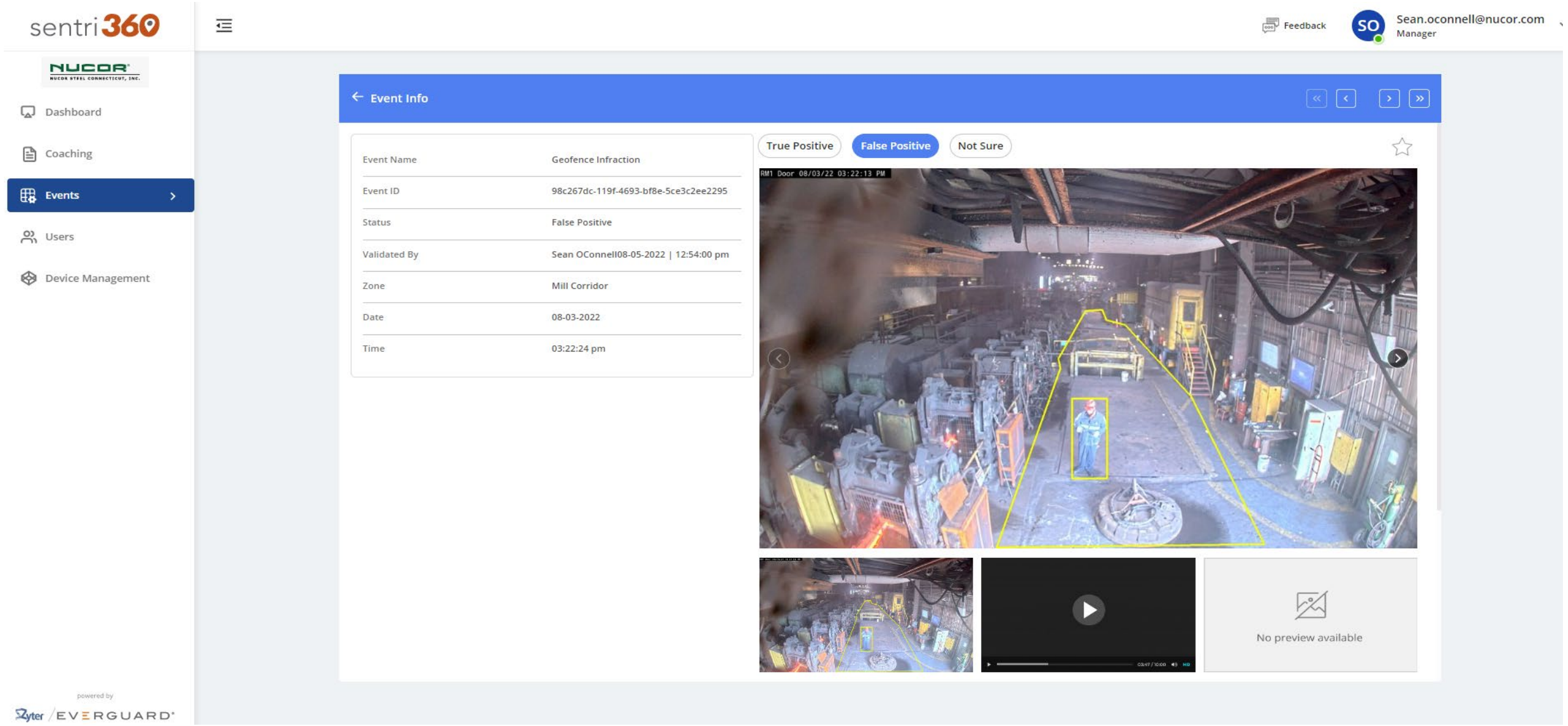
Adjusting Stands from a Distance

In-House Designed and Built Hydraulic Gap Adjusters for Intermediate Mill Stands

Camera System For Real Time Section Measurement



AI Technology tied into existing Cameras to Monitor Go/No Go Zones



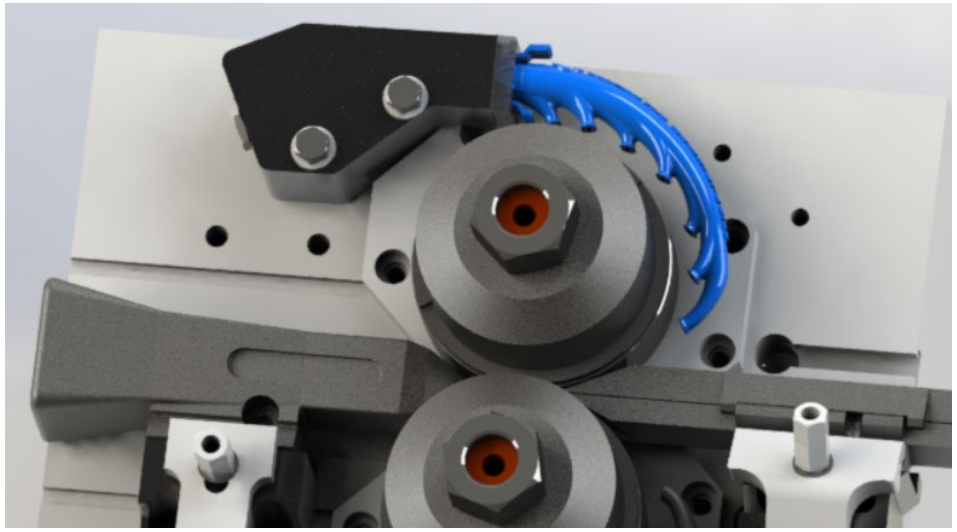
Collaboration

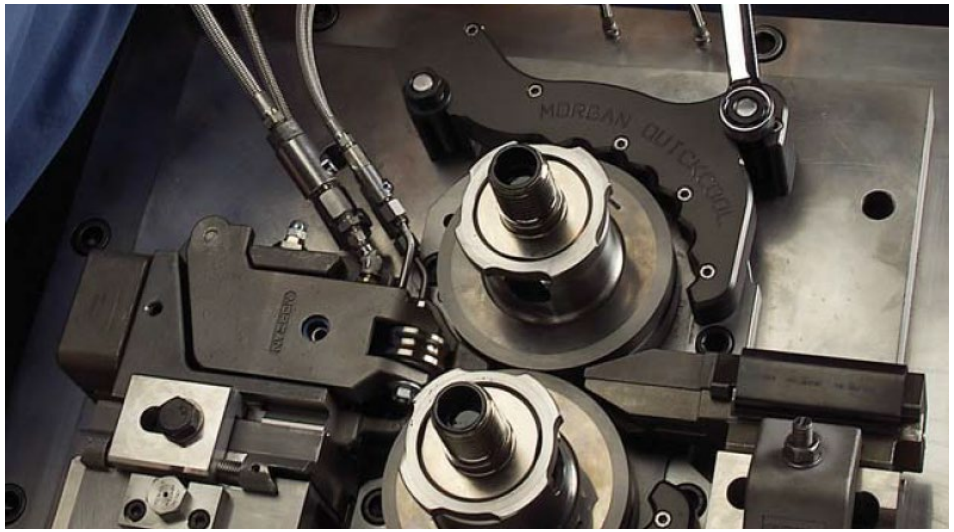
- Primetals and Nucor have worked collaboratively on development projects multiple times over the years.
- Currently, 2 new technology developments are being jointly developed at Nucor Steel Connecticut.
- Primetals provides the engineering and materials, and Nucor provides the facilities and manpower.
- Jointly alterations, improvement ideas, and results are shared & implemented.
- Partner based testing allows for a far more robust and sorted product before bringing to market.

Next Generation Roll Cooling Headers

Next Generation Roll Cooling Headers are a Patent Pending AM / smart sensing design for any size rolling mill stand.

- Quick-change spray nozzle cartridges ensure consistent and optimal cooling of work rolls.
- Increased roll life and decreased operating costs.
- Enhanced safety
- Non-handed cartridge reduces quantities to stock.
- Reduced water ingress into lubrication system on cantilevered stands with dummy cartridges.
- Quickly check wear condition with color wearing indication.
- Distinct cartridge color for each stand size makes identification simple.
- Durable, exclusive polymer cartridge material.



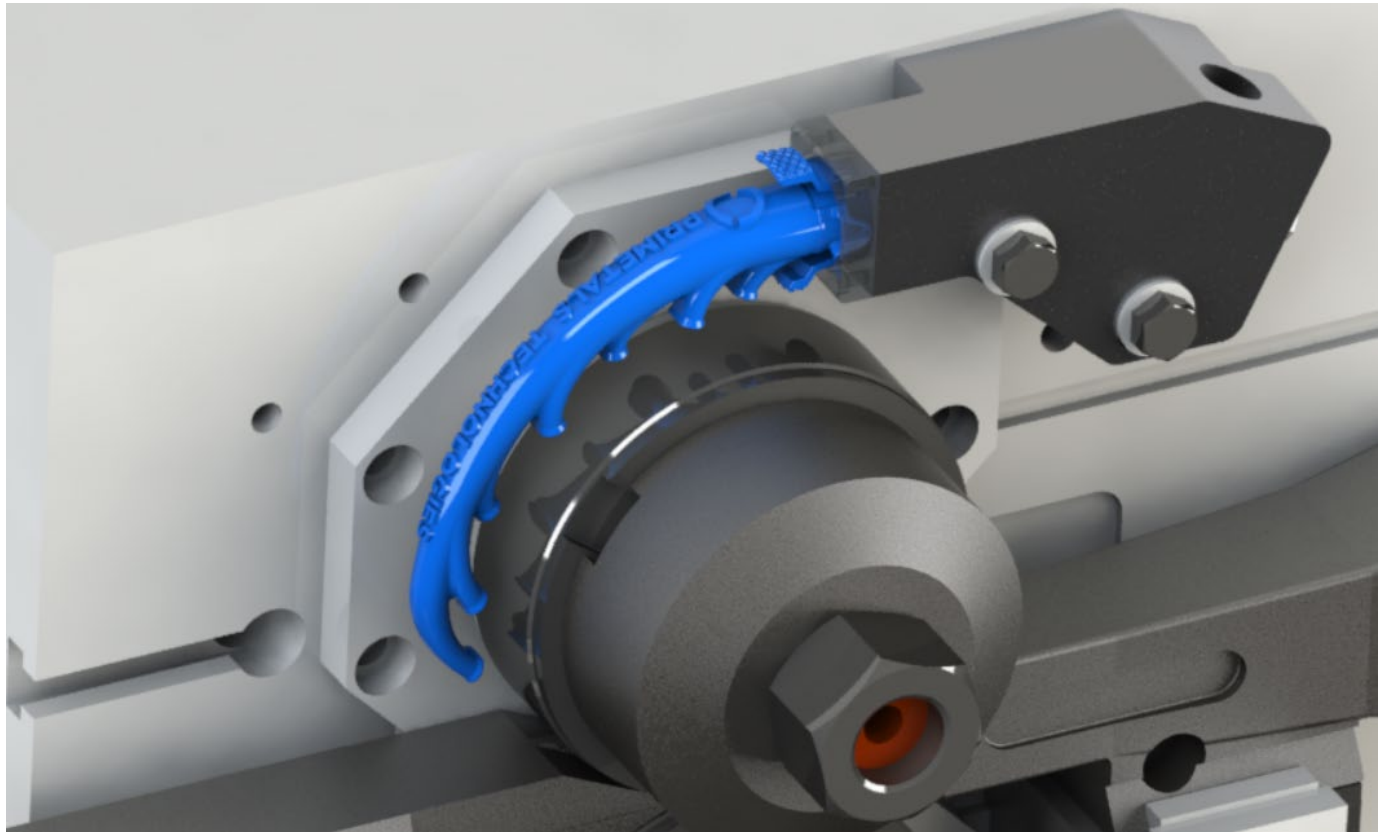


Next Generation Headers - Safety

1. Reduced possibility of roll failure & cobble.
   - Optimized and consistent cooling across all stands.
   - HMI alerts to check worn or clogged header before a roll fails.

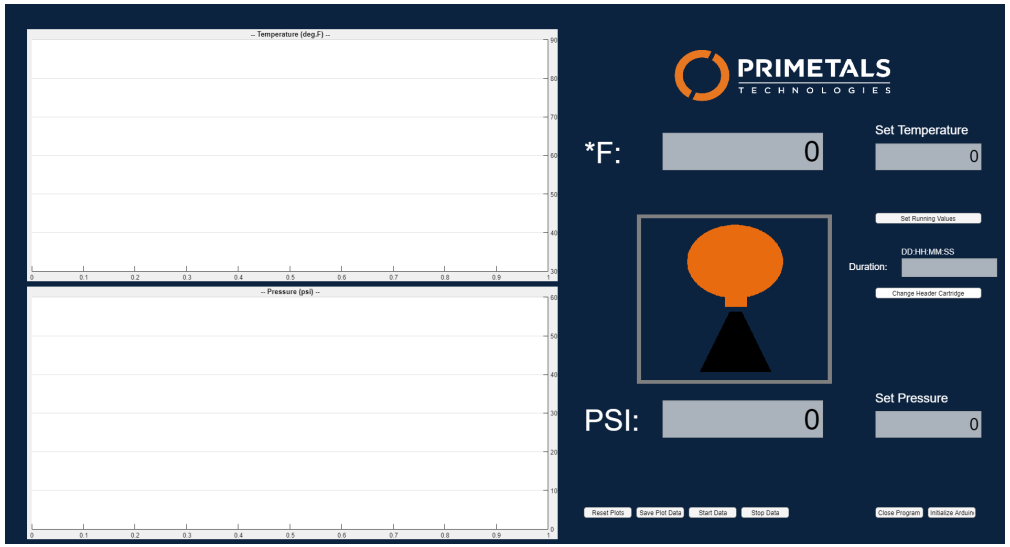
2. Simplified & Decreased hands-on work
   - Tool-less quick-change design.
   - Eases cantilevered roll change process, quickly rotate headers out of way.
   - Lightweight design.

3. Reduction in time spent near the rolling line
   - Proper operation is verified by HMI, visual checks are unnecessary on R&I stands.



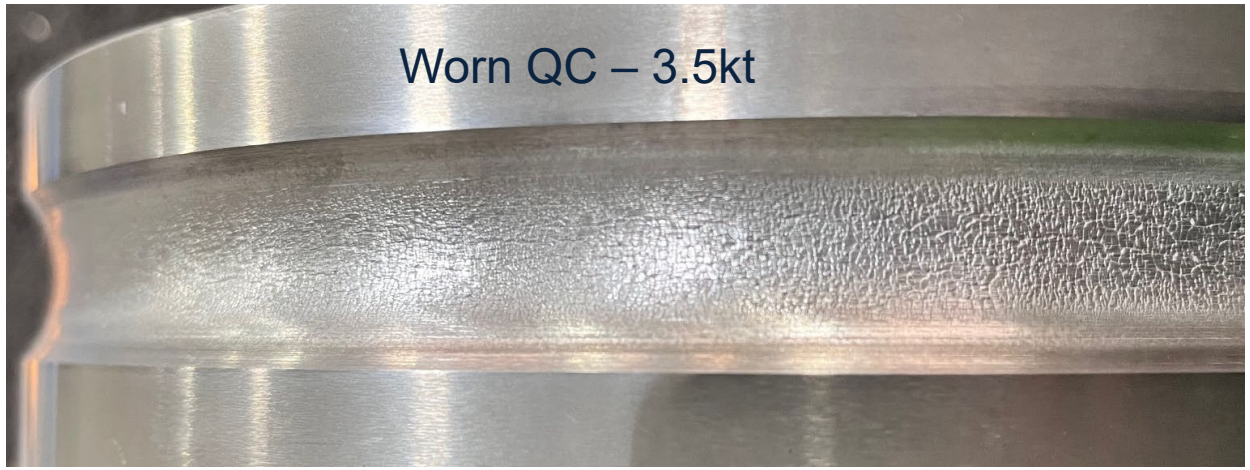
Next Generation Headers – In-Mill Testing

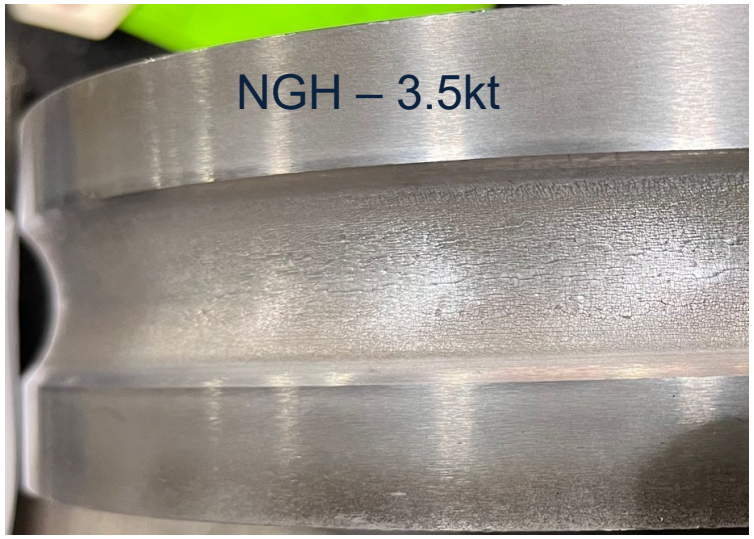
- Nucor CT – 10 Stand Morgan K-mill
- System Water Pressure: 4 bar
- Single AM header mounted opposite new standard QC Header
- Testing started on May 30, 2022



Next Generation Headers – In-Mill Testing Results

- Header has currently been in mill for approx. 6 months (140k tons).
- Roll cooling capability is equivalent to original QC header when new, and much better than worn QC header.
- Negligible visible wear on cartridge nozzles or interior surfaces.
- No damage or breakage issues.
- Quick disconnect design did not work well.
- Temporary wiring for sensors did not last long.





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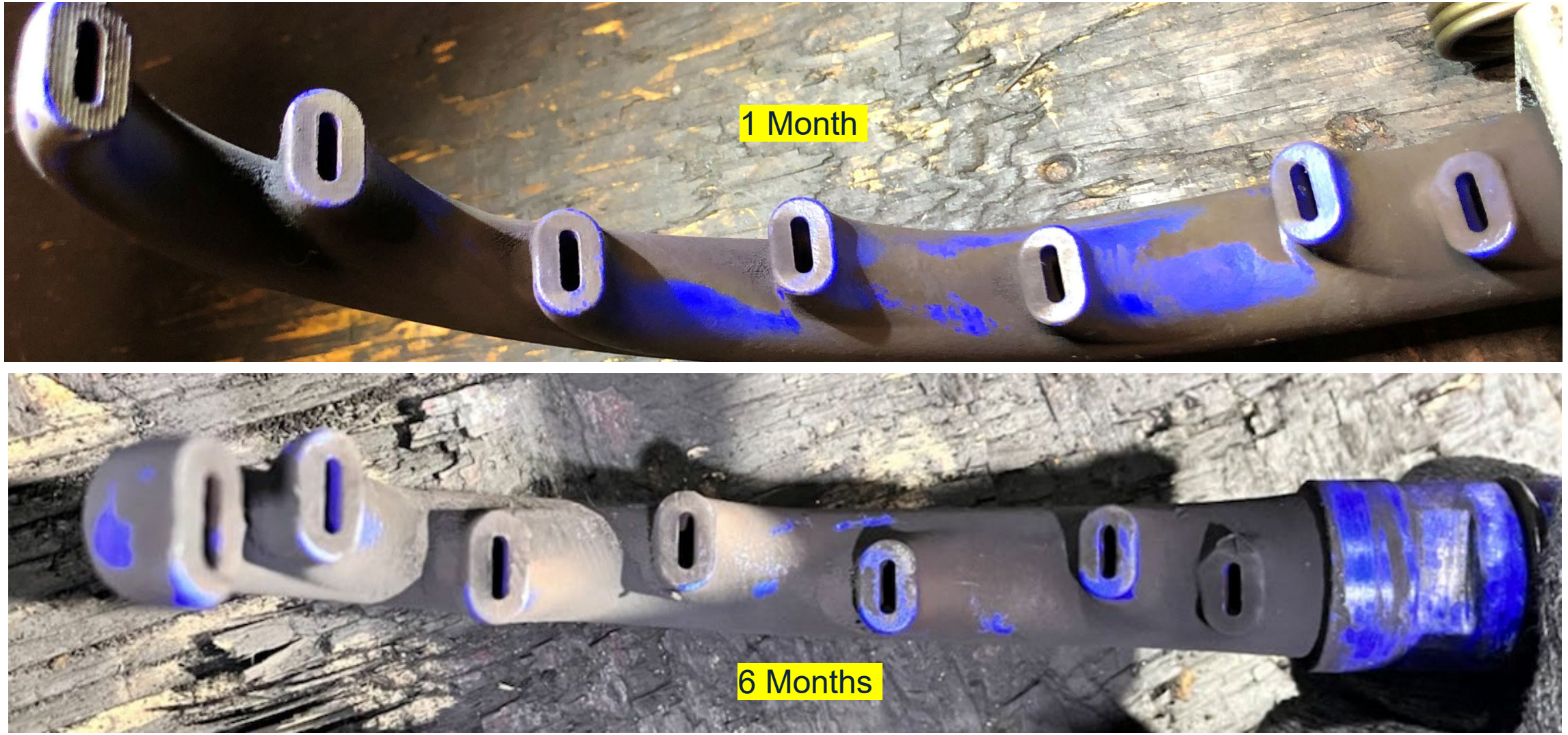
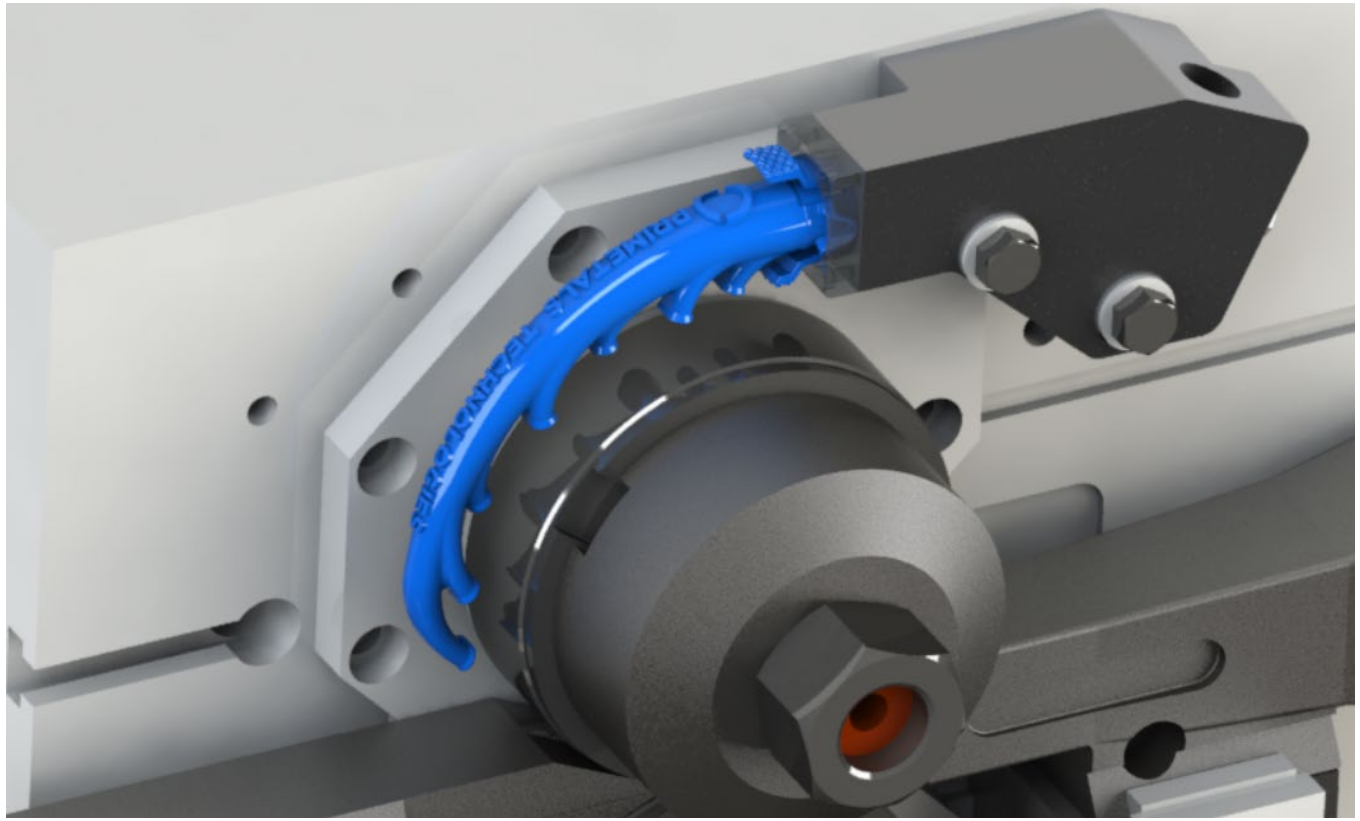


Production Next Generation Headers



Assembly with Sensor & Valve.

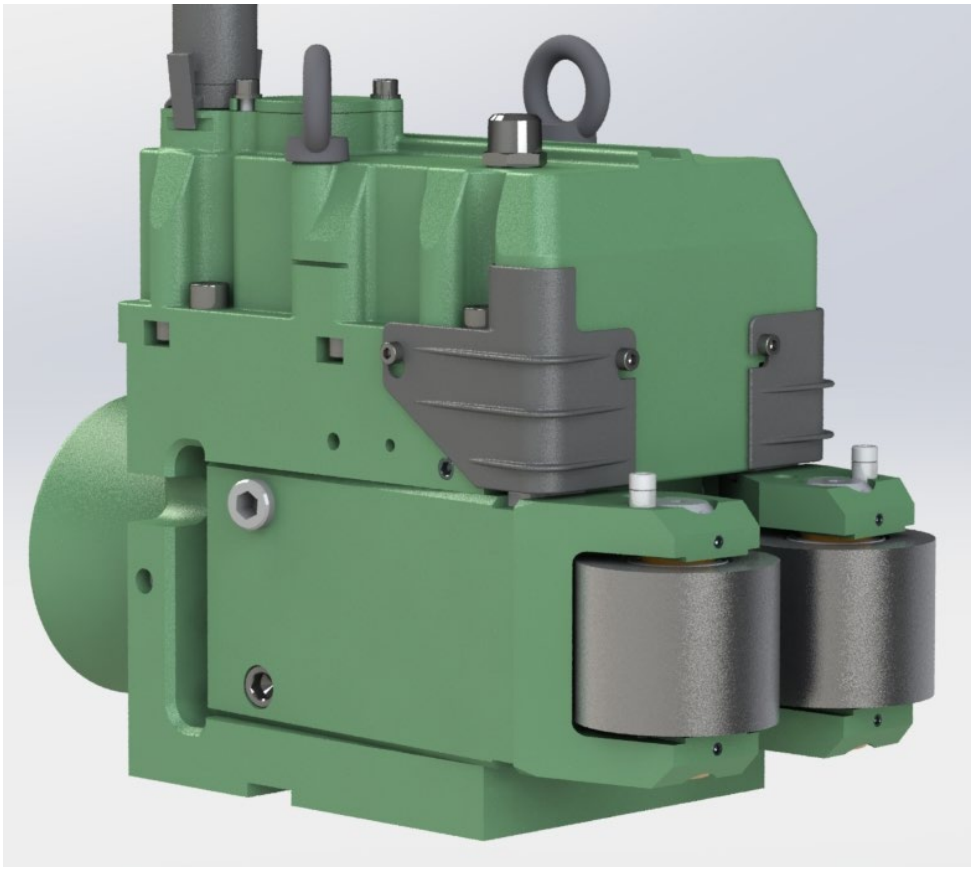
Quick-disconnect Cartridge

Advanced Guides

The latest generation of patent pending guiding equipment combine smart sensing technology with rugged user-friendly operation.

Key Benefits:

- Increased safety:
  - Hands-off, operators spend less time near rolling line.
- Rolling process optimization
  - Increased insight into rolling process with trending and analysis of rolling process data.
- Increased production
  - Decreased mill down time due to fewer cobbles and time required for guide adjustments
- Operational cost savings
  - Reduced hands-on time requirements and reduced peripheral equipment damage.



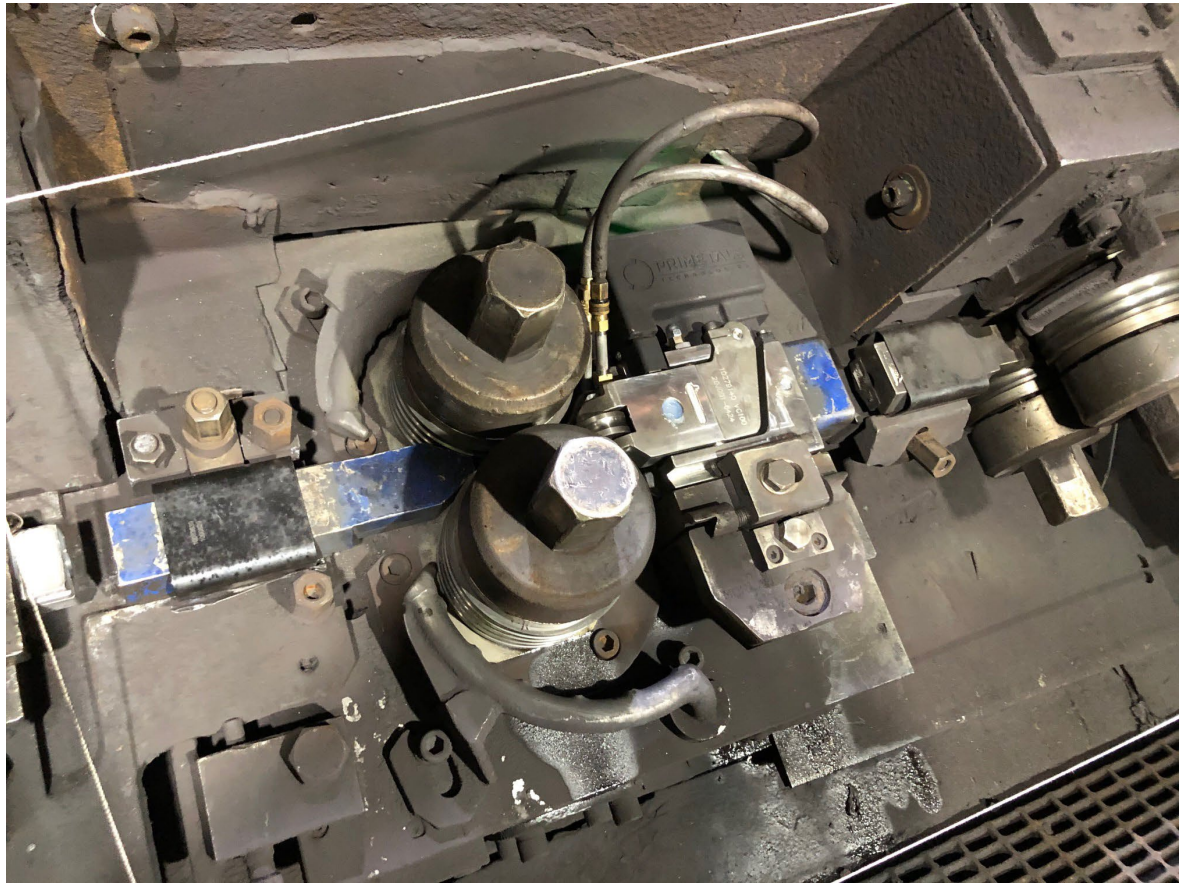
Advanced Guides - Safety

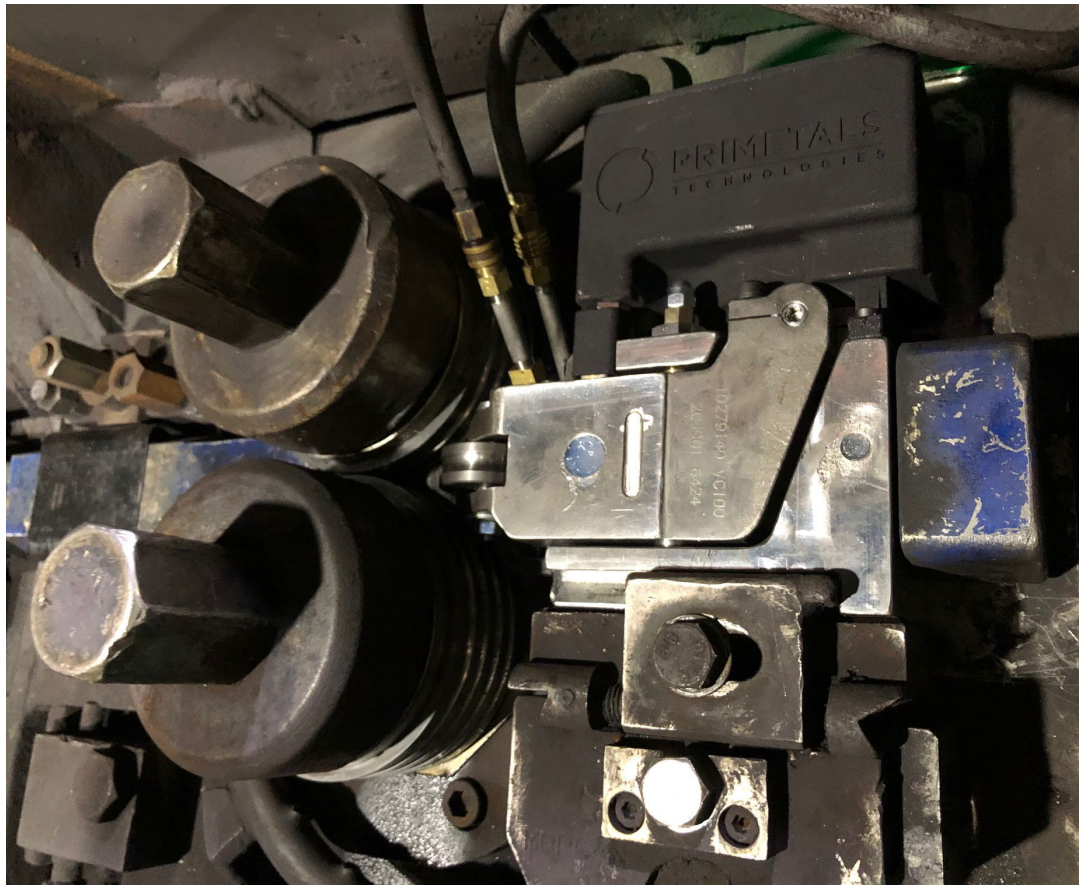
1. Reduction in time spent near the rolling line
   - Burning wood to check section height is eliminated.
   - Adjustments to guide are handled remotely.

2. Cobble reduction - feedback from guide helps warn operators of issues before developing into a cobble.
   - Head end impact detection.
   - Guide roller and bearing failure feedback.
   - Loose or tight guide condition is identified.
   - Guide off-hole condition is identified.

3. Potential for extended operating time in mill.
   - Fewer rebuilds – reduced hands-on time.

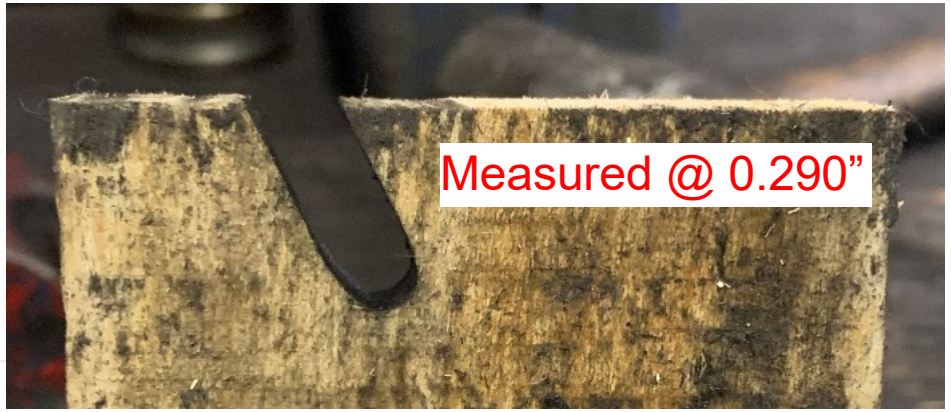
High Speed Test Arrangement at Nucor CT

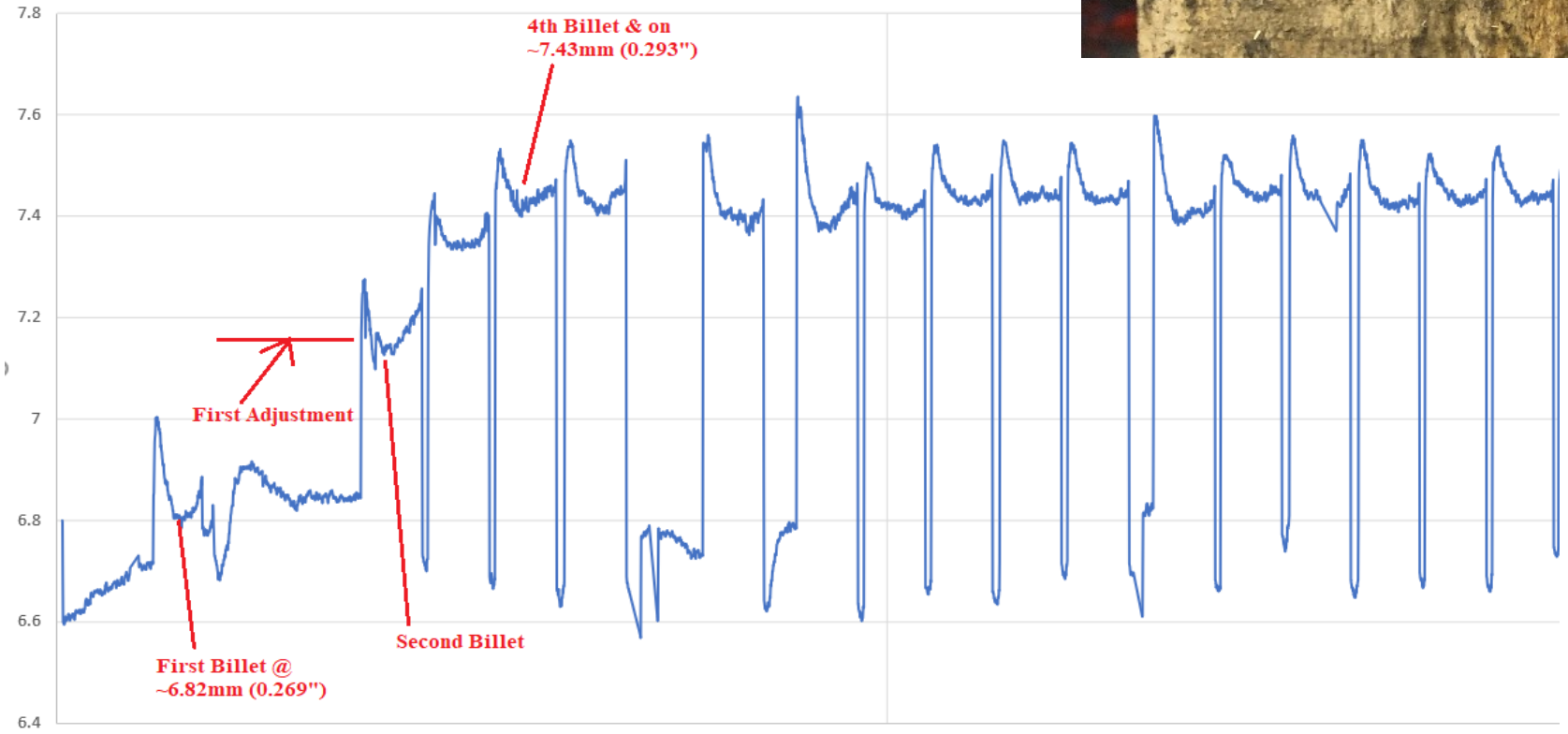




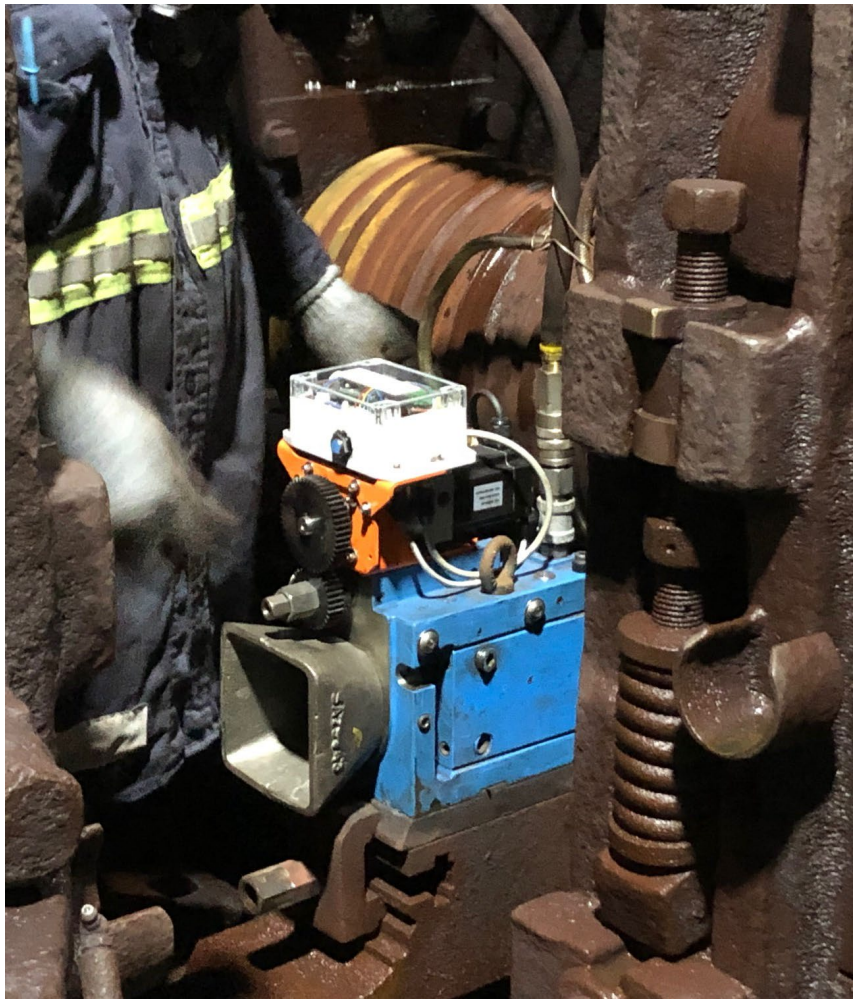
High Speed Testing Example

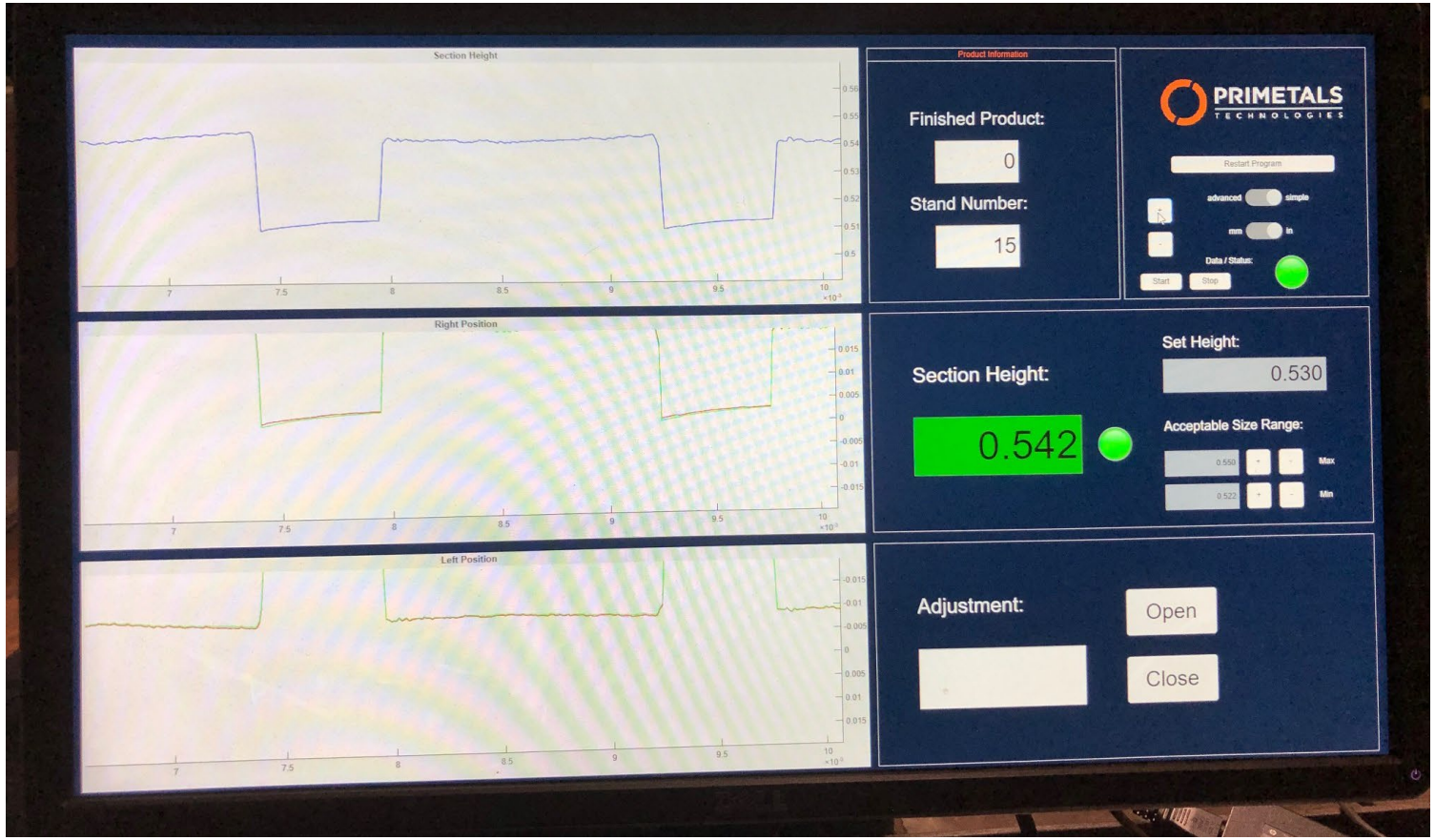
- Size changes were very accurately measured when compared to a burnt wood measurement: 0.290” vs. 0.293”



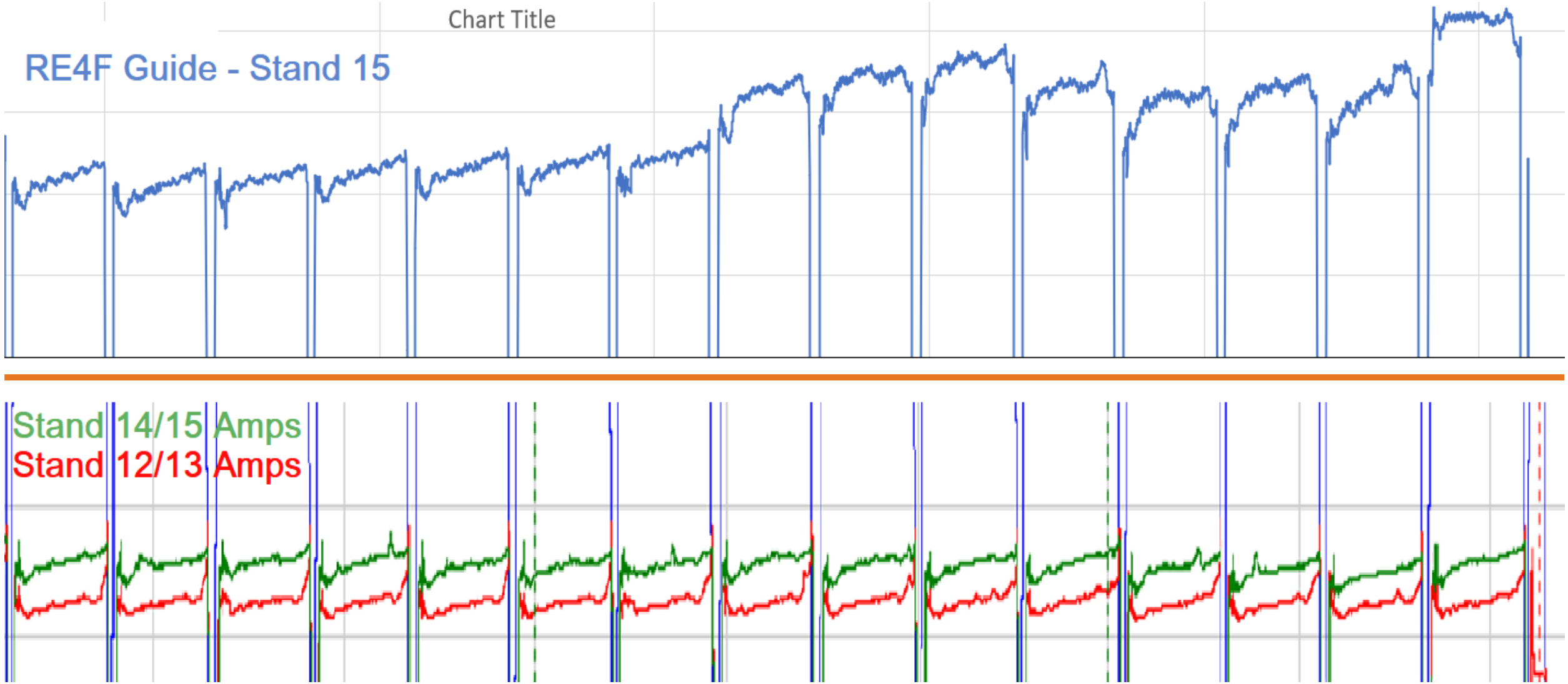


Low Speed Test Arrangement at Nucor CT



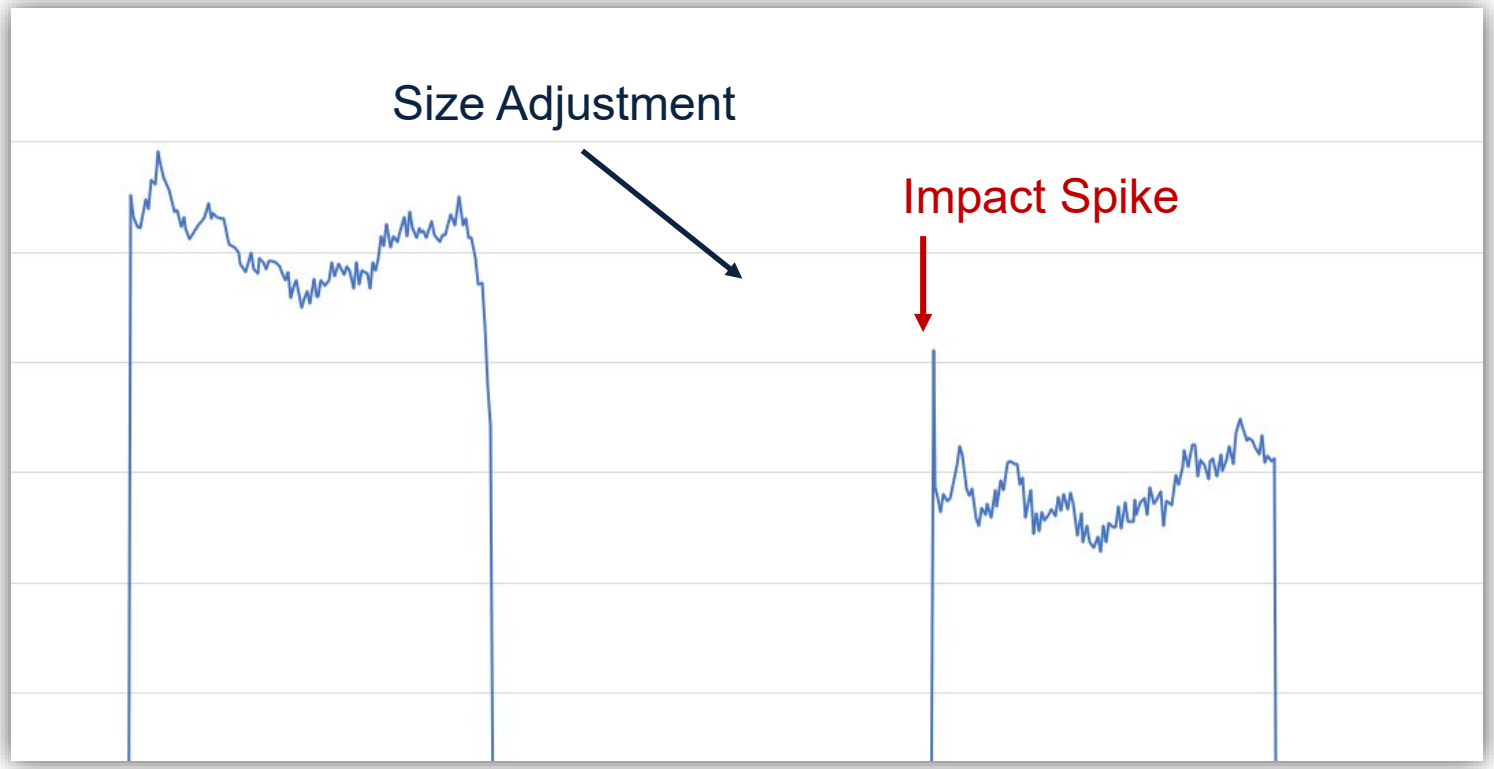


Size Measurement: Low Speed



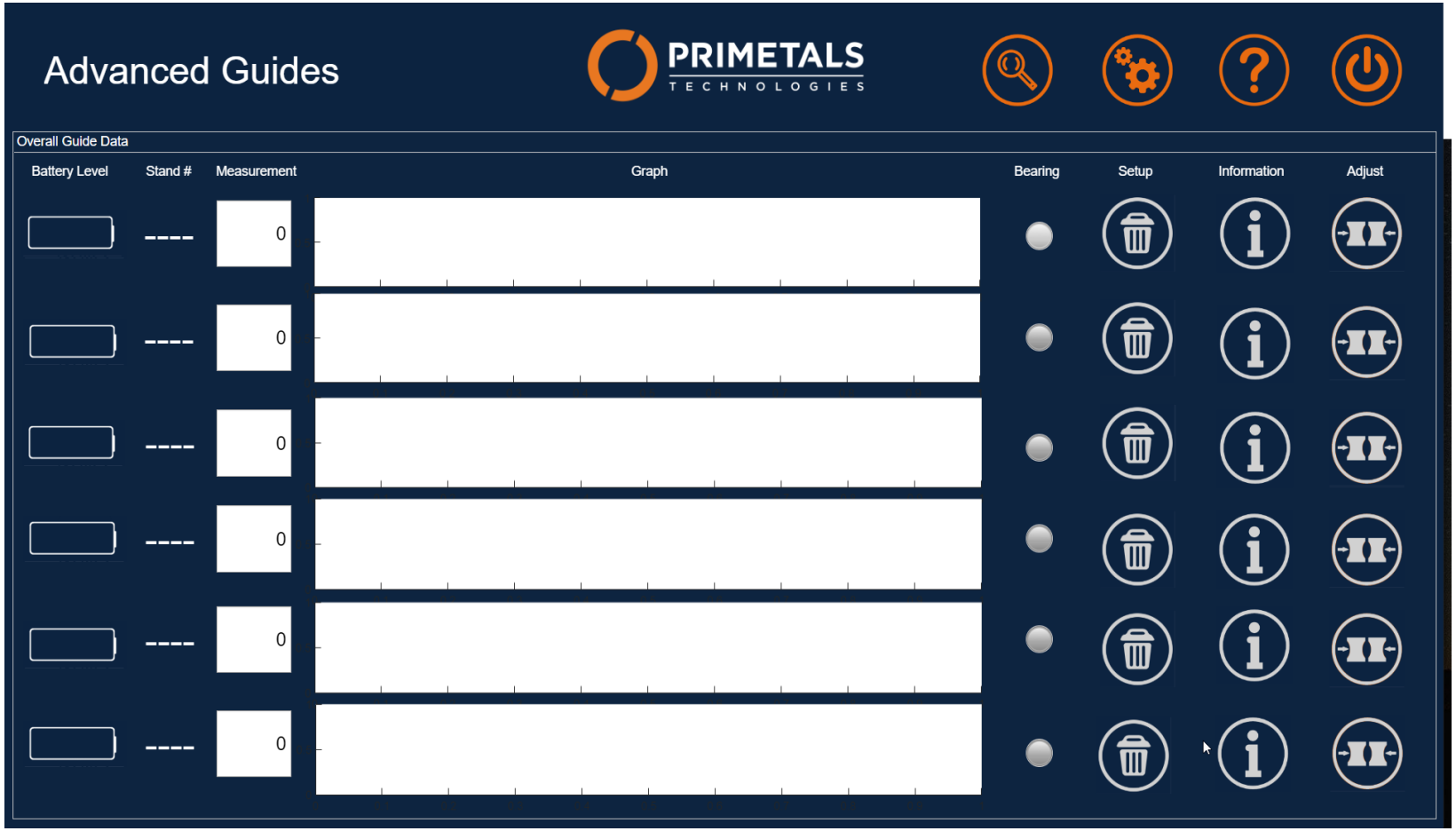
Size Measurement: Impact Detection

- HMI identifies and counts billets
- Identifies head-end impacts
- Calculates an ‘impact warning’ score.



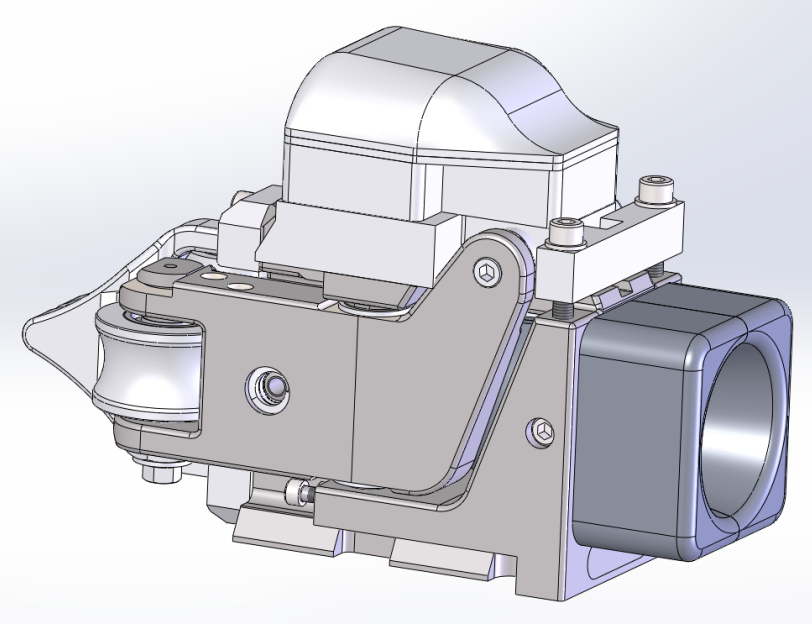
Production HMI

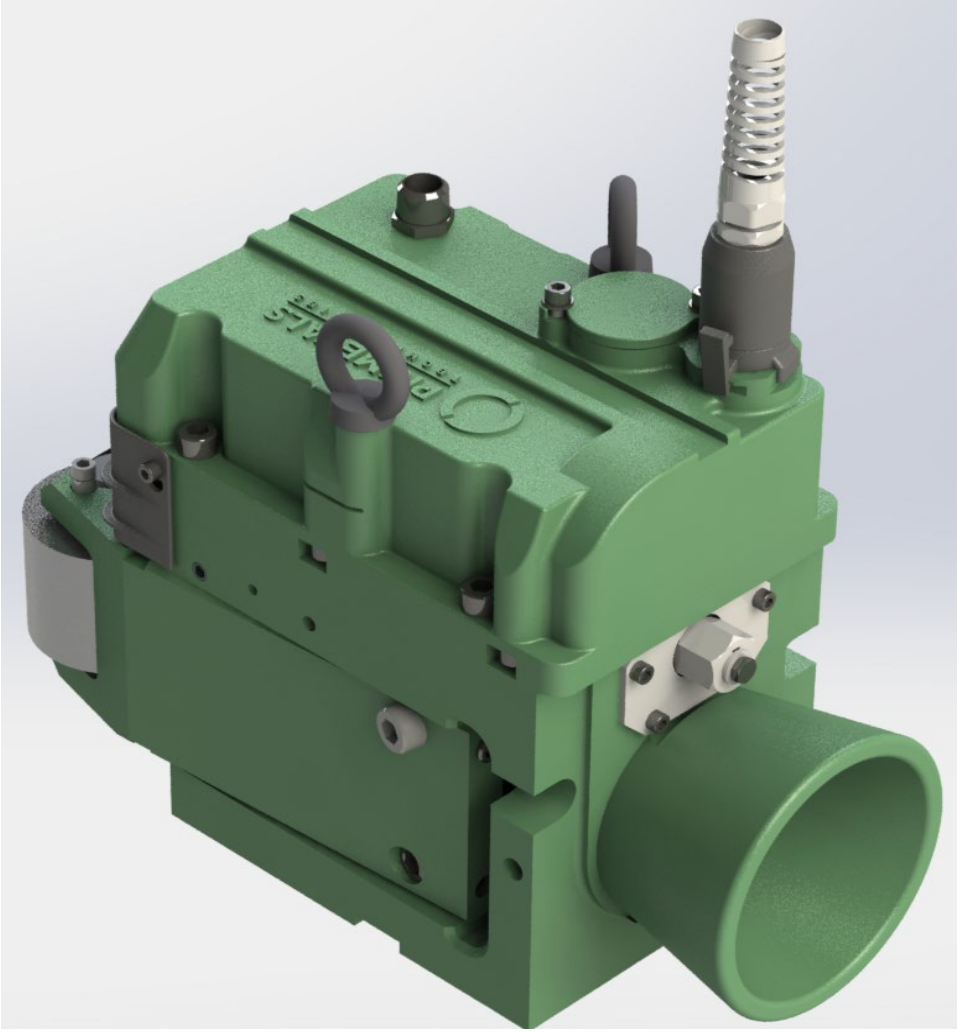
- Production version of HMI that will be part of the advanced guide package is under development.
- Designed to be as flexible as possible and handle all types of customer installations.
- Similar design aesthetic to the Advanced Optics system



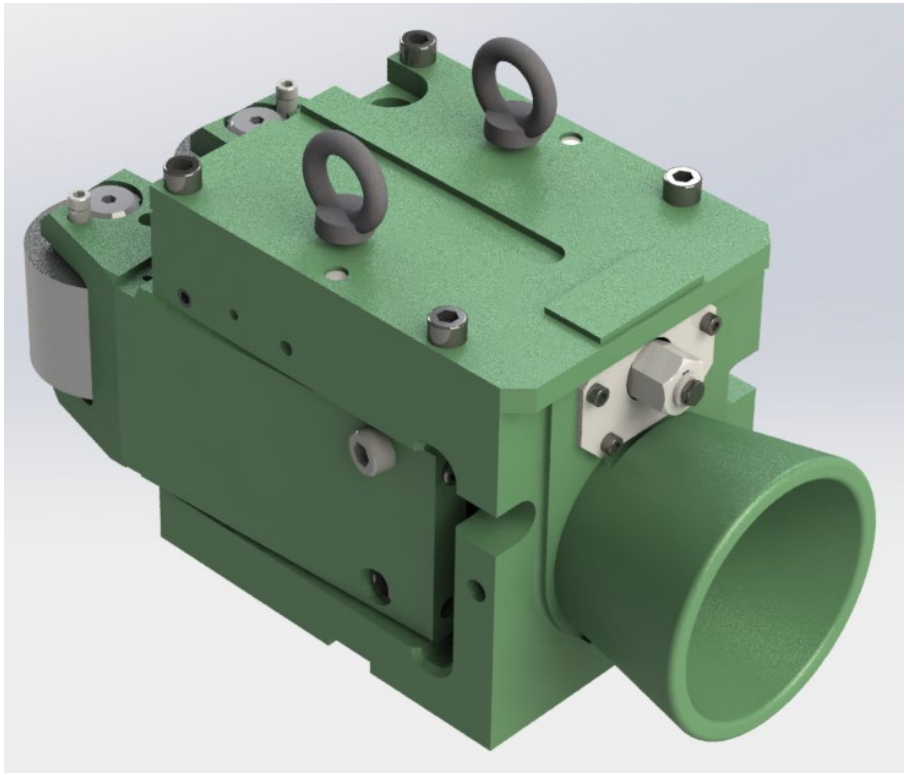
Production Advanced Guides

- Quick change module contains electronics, motors, sensors, etc.
- Improved durability.
- Simplified setup and maintenance.



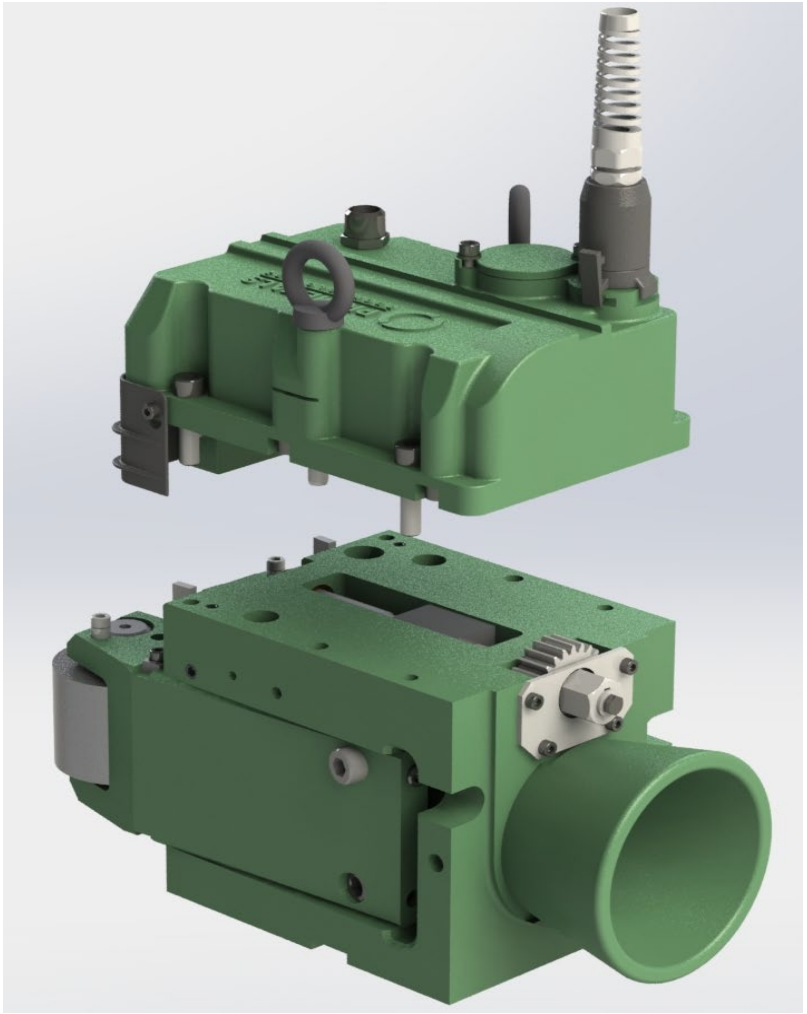


Production Advanced Guides

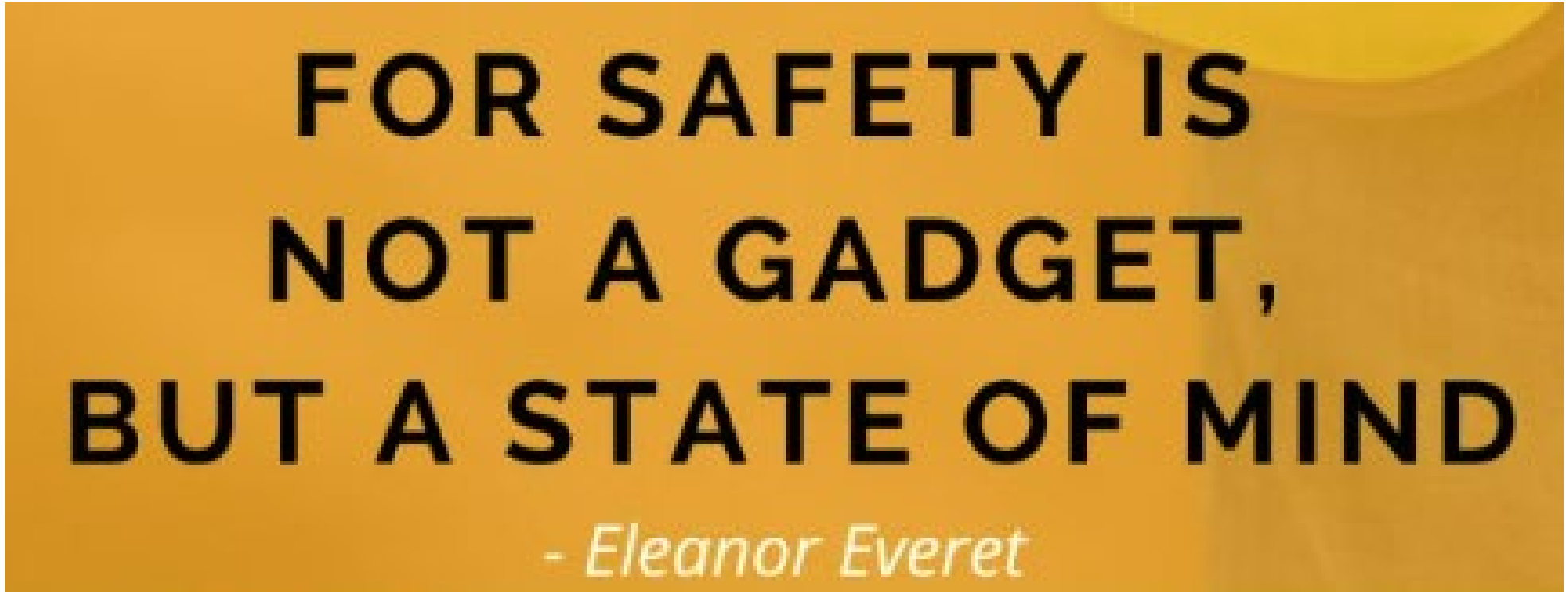


Dummy Cover

Quick-Change Module



Safety is. . .



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THANK YOU