

SIF Reduction

(Significant Injury or Fatality)

Remove Employees from Line of Fire

Roughing Mill - Saukville



Keyence Measuring System



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Line of Fire Definition

- Line of Fire is **the path an object will travel and create a risk of injury.** 'You are in the line of fire when you are at risk of coming into contact with a force that will, or may hurt you' What is a 'Line of Fire' hazard?
- Keep Employees & Visitors out of the designated area

Roughing Mills



Why do we want to keep this area clear of employees and visitors?
Looks quiet and safe?

Cobble



Cobbles



- **Definition:**

An incident when bar that is being hot rolled either jams in the mill guides, resulting in delays to reset the guides and rolls, or comes out of its normal rolling trajectory, frequently landing (often at high speed) in the area adjacent to the rolling mill stands

Remove Employee From Line of Fire



- So how did we accomplish this?



Formed a Team



Brainstormed ideas?

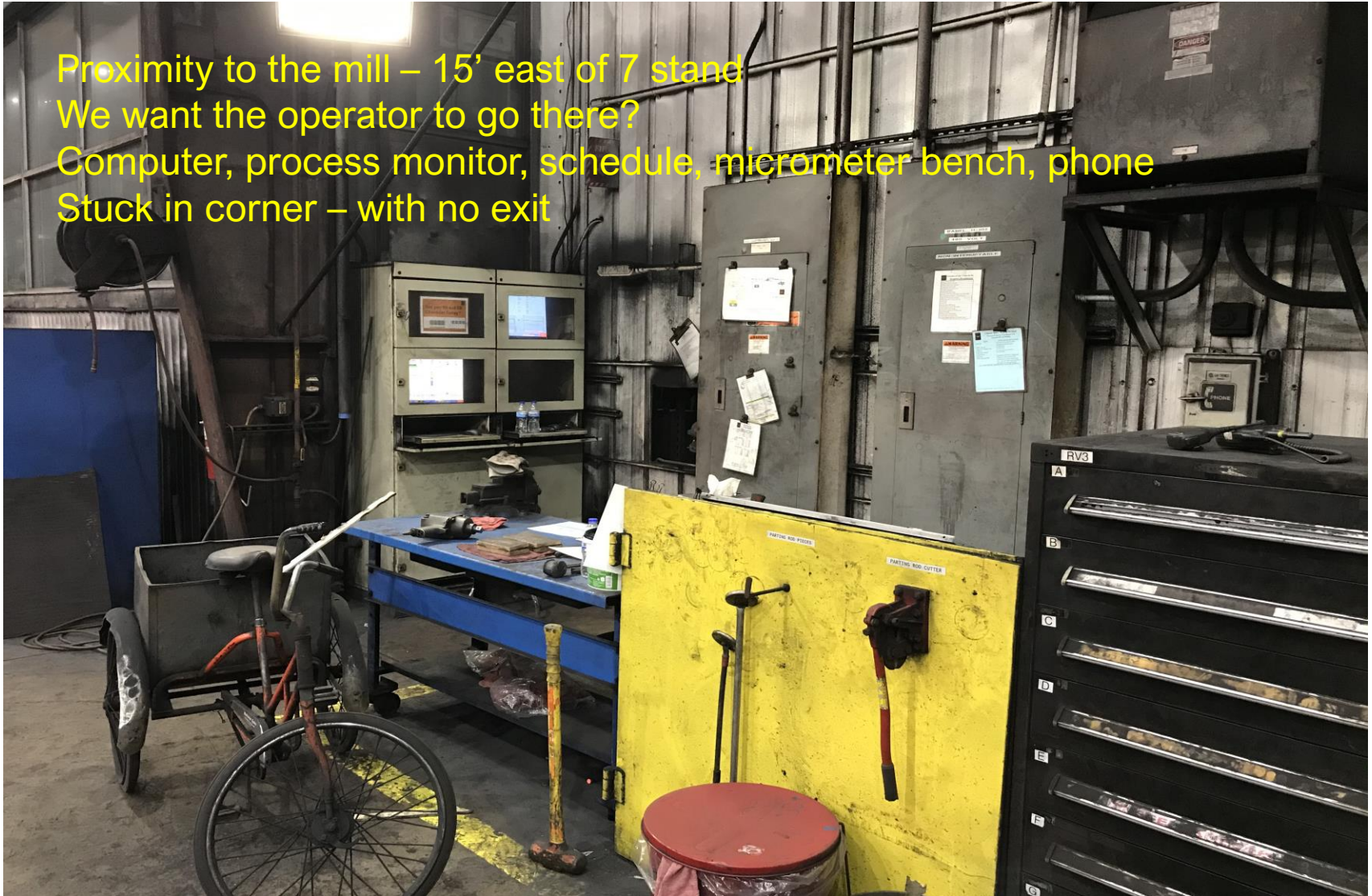


Operators Station

Anything wrong with this or needs improvement?



Proximity to the mill – 15' east of 7 stand
We want the operator to go there?
Computer, process monitor, schedule, micrometer bench, phone
Stuck in corner – with no exit



Operators Station



- Move computers & Process Equipment
- Move bench
- Removed old computer cabinet and scrapped
- Purchased 10' x 10' building – where are we going to put it?
- Cut hole in wall & added steps – Escape route

Operators Station



Move it here

West side of mill behind motors



Move in day



Purchased 10' x 10' modular building, put it on the west side of the mill.
Installed computer and process equipment



Cabinet on the move



Construction mode



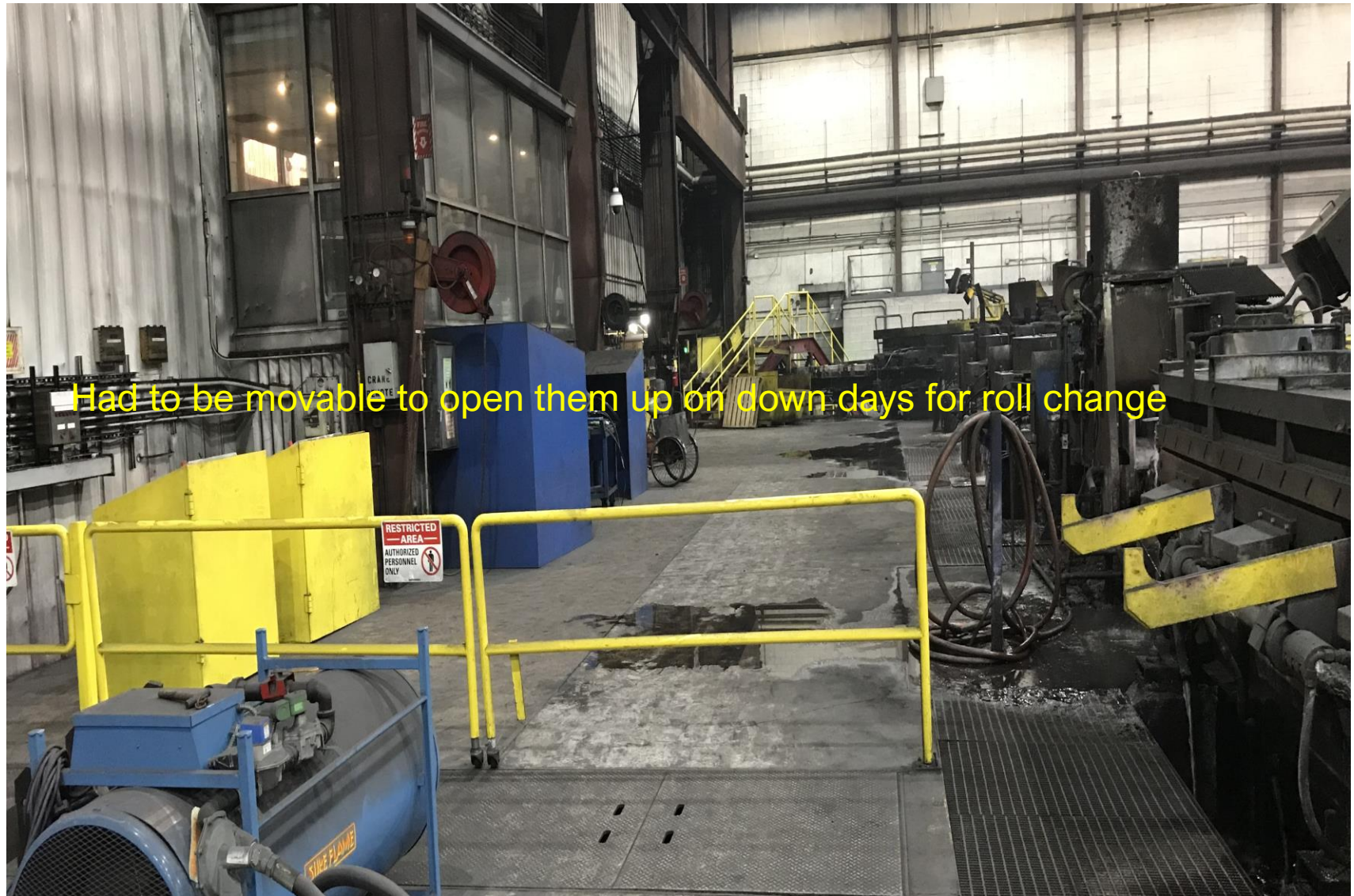
Construction done



Construction done



Installed Guard Rails



Had to be movable to open them up on down days for roll change

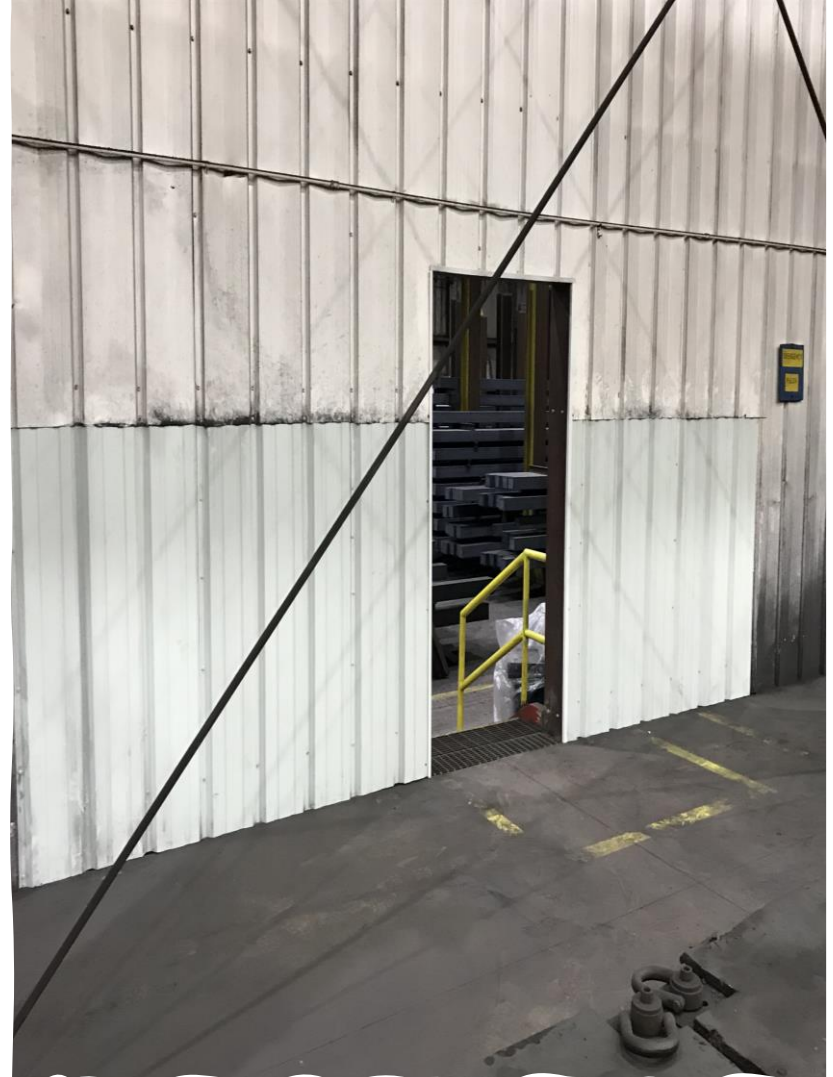
Roll Change (Gates open)



East wall



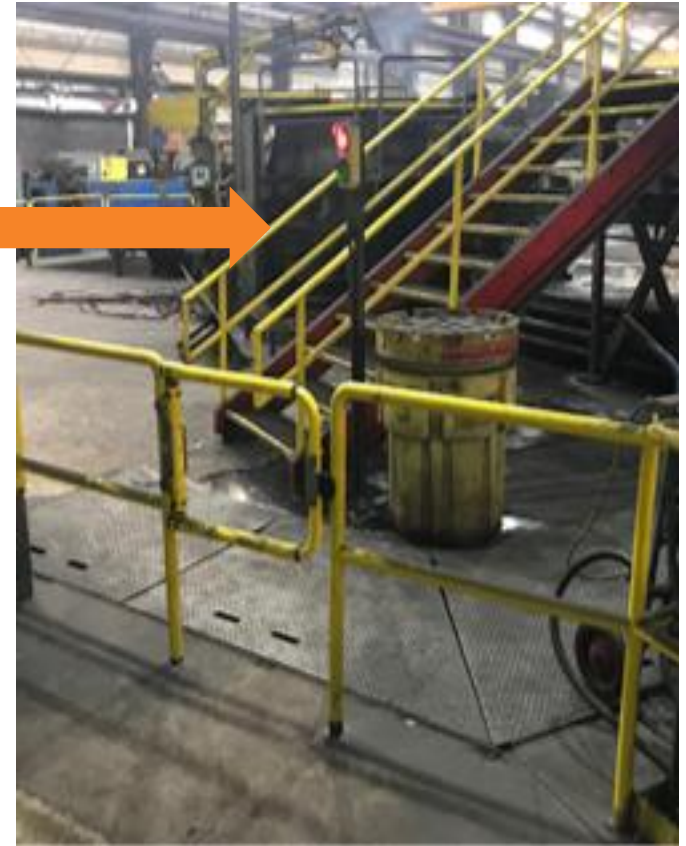
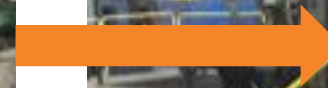
East wall finished



West Side of Mill



Installed Railings and Signage



Mill Cross Over after 10 Stand



Signs & lights

Mill Cross Over after 10 Stand



Remember



Company Confidential

Removed Stairs



Old Trough

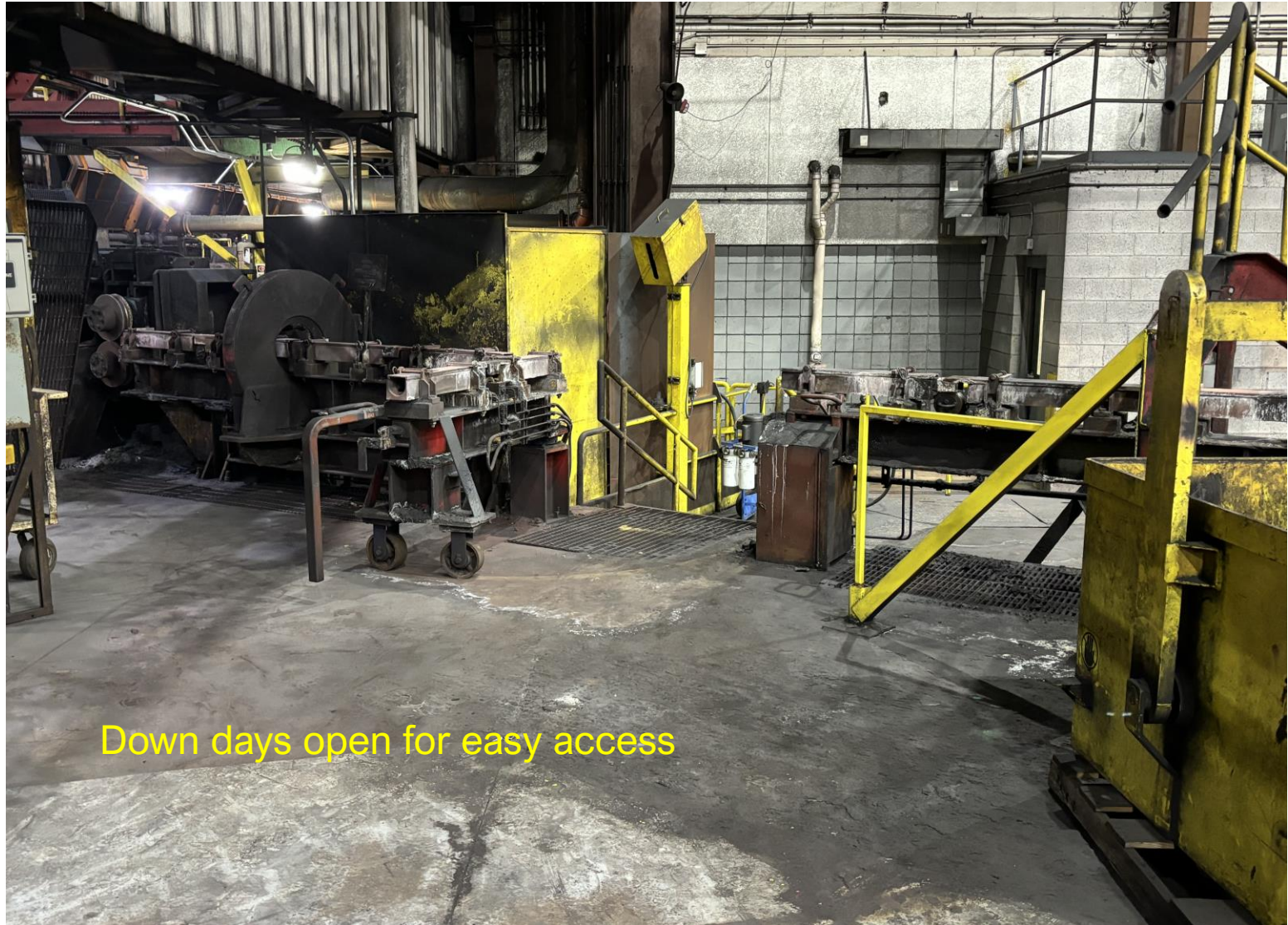


New Swing Trough



Interlock – proximity switch – chop command

Swing Trough



Down days open for easy access



- Purchased 10' x 10' building
- Moved computers & Process Equipment
- Removed old computer cabinet and scrapped
- Cut hole in wall & added steps
- Removed broken overhead door and added pedestrian access
- Installed railings /gates before 5 stand to keep people out
- Removed mill access by 10 stand Pinch Rolls
- Put operator work bench under pulpit

Where's Waldo?



Keyence Section Measurement



Quick Video – Calipering



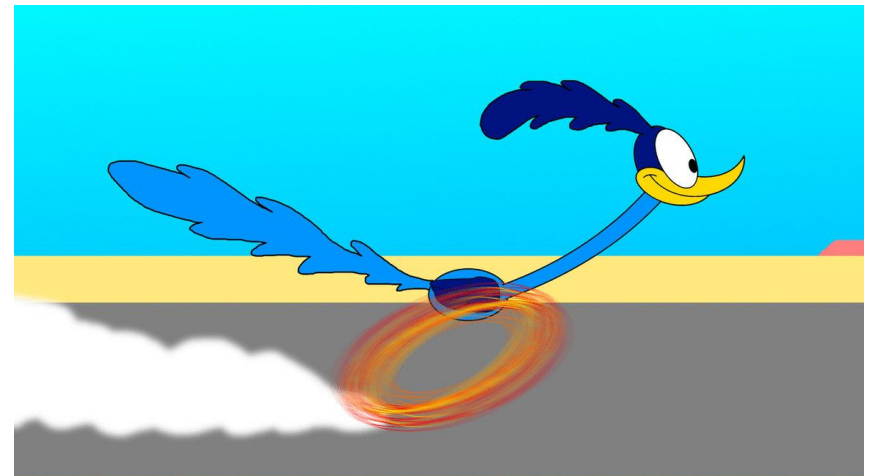
Quick Video - Sticking



What's wrong in the previous videos?



CAUTION
HOT SURFACE
DO NOT TOUCH

A black silhouette of a hand reaching towards a red and orange flame-like icon representing a hot surface.

If its so wrong, then why do we do it?



- Calipering
 - Operator measures the height or width sections of the billet.
 - Correct size reduction leads to efficient rolling.
 - Performed at the beginning and ending of every shift (4 times a day)
- Sticking
 - Operator burns a profile into a stick and feels for vibrations.
 - Sticking the mill catches surface defects.
 - Performed once per hour (24 times a day)



How can we perform these checks safely?



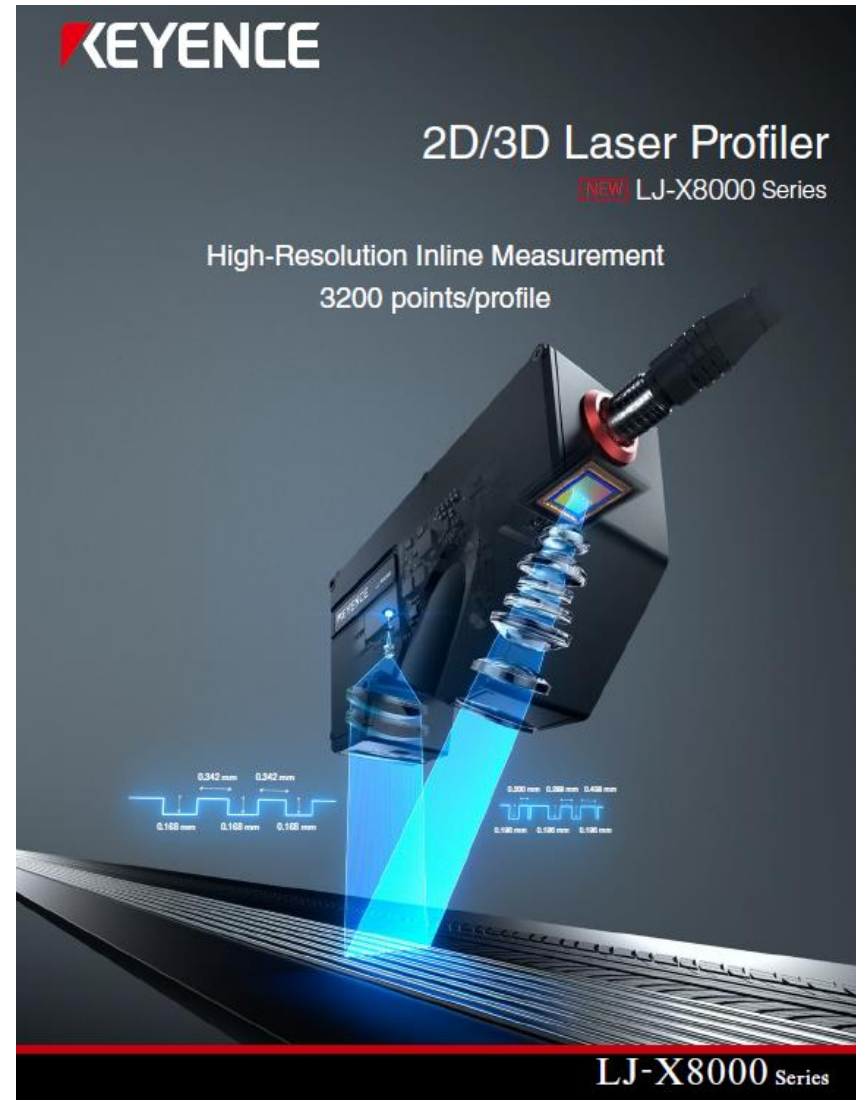
Ideas?



Solution



- Keyence 2D/3D Laser Profiler
 - Away from line of fire and extreme temperatures
 - Reliable and repeatable
 - Measures at high speeds
 - Low-cost alternative to LAP gauge



Away from line of fire and extreme temperatures



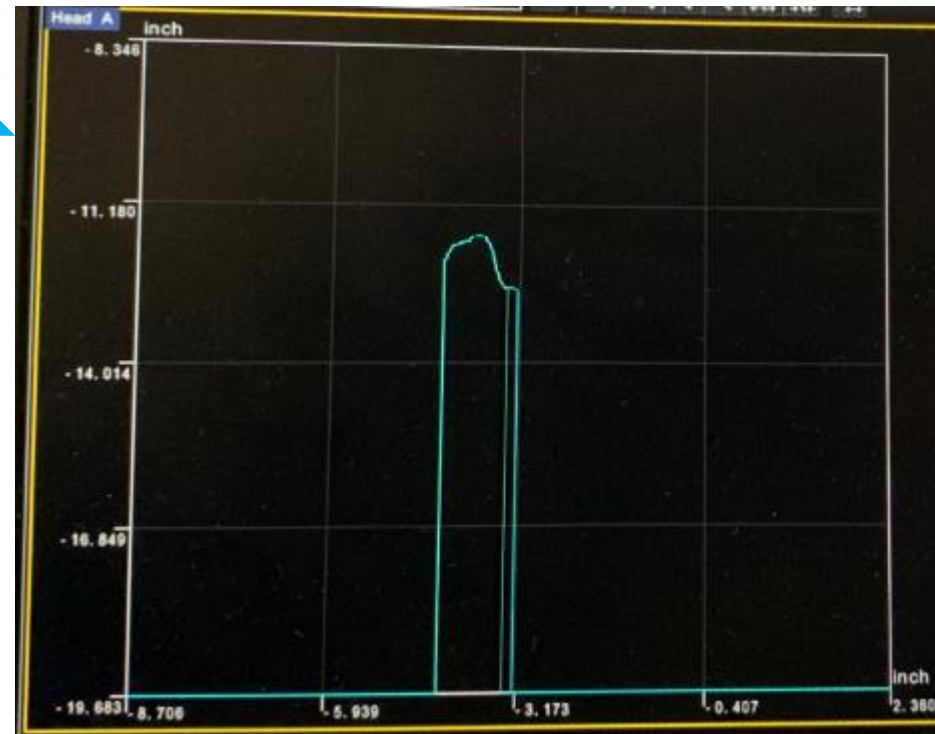
- Measures from a range of 22.83”-54.33” away from the steel.
- Installed on the West side of the mill stands.
- Remote monitoring capabilities
- Continuous monitoring



Reliable and repeatable



- Resolution
 - Z-axis (height): 0.015"
- Repeatability
 - Z-axis (height): 0.0004"
 - X-axis (width): 0.0010"
- Profile data interval
 - X-axis (width): 0.0089"



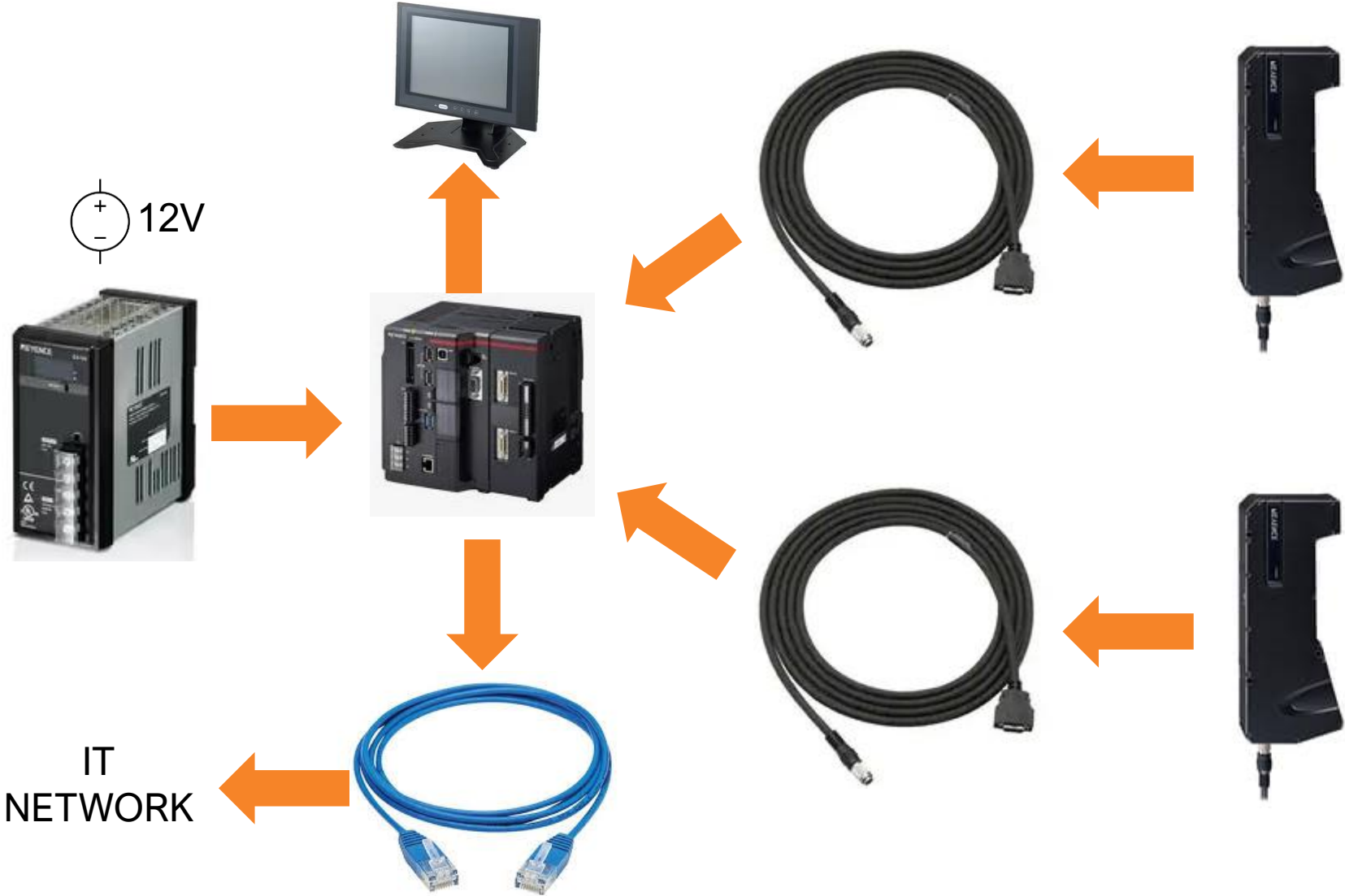
Measures at high speeds



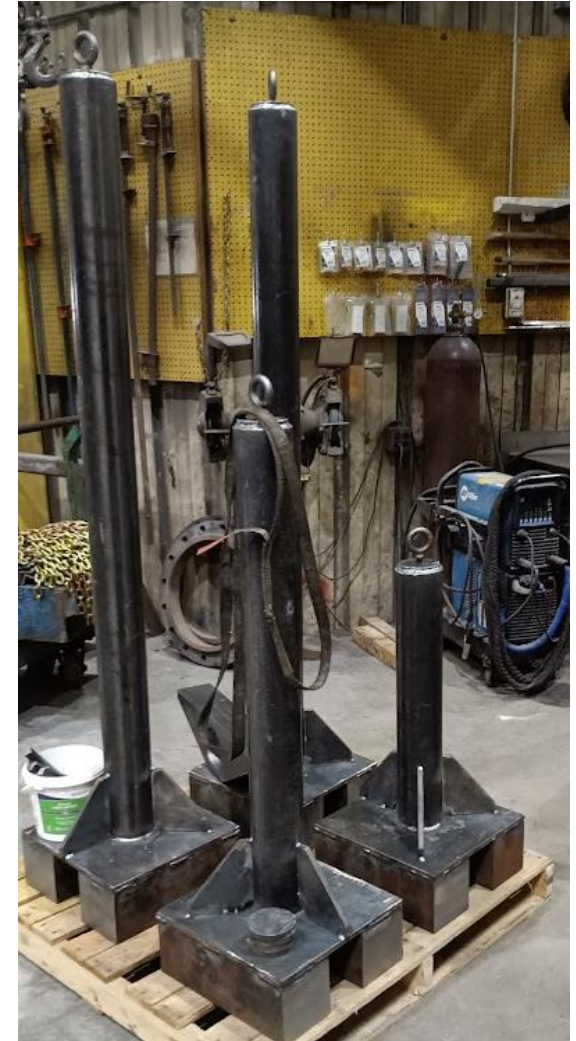
- Sensor head collects 3200 points per second.
- In 3D mode the controller has a sampling cycle maximum speed of 16 μ s.
- Can accurately measure up to 709 ft/min.
 - Can increase speed by sacrificing resolution in direction of travel, width, or height.



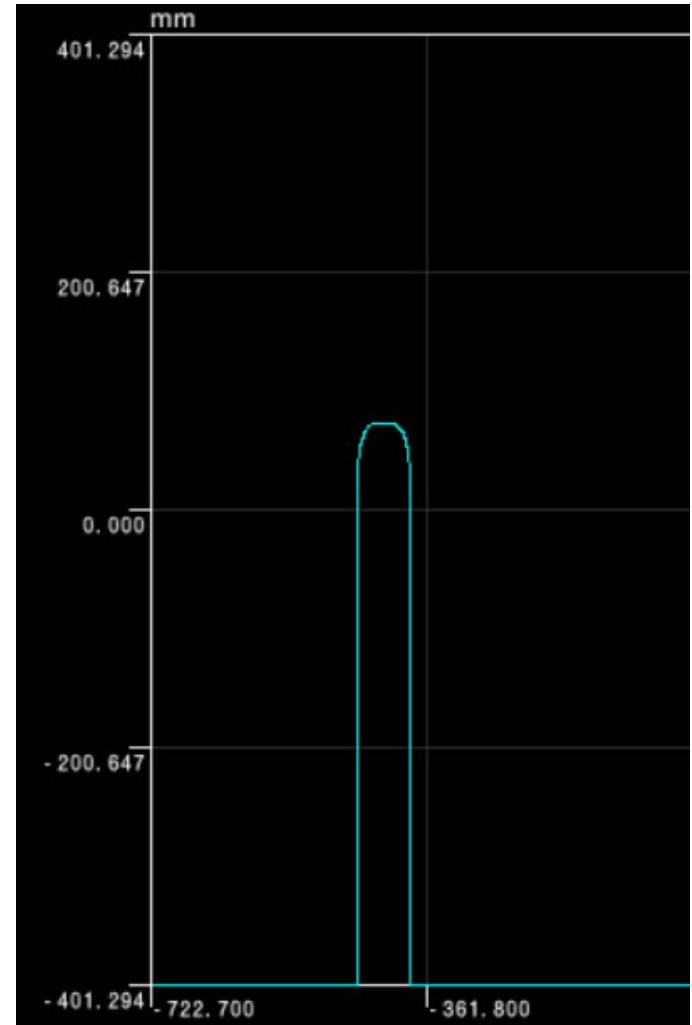
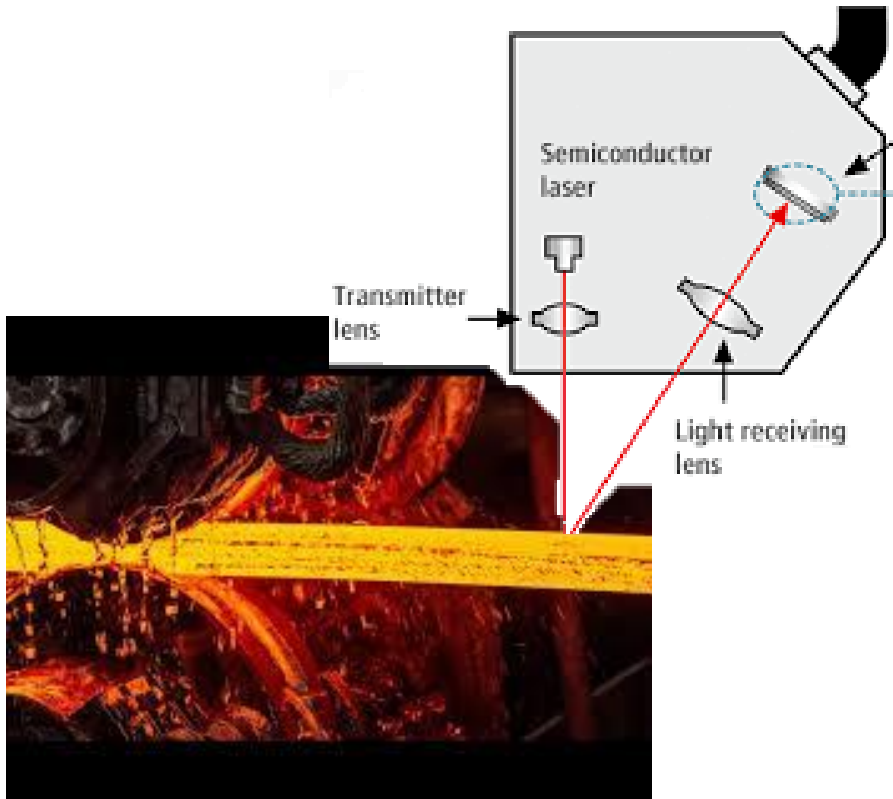
Components



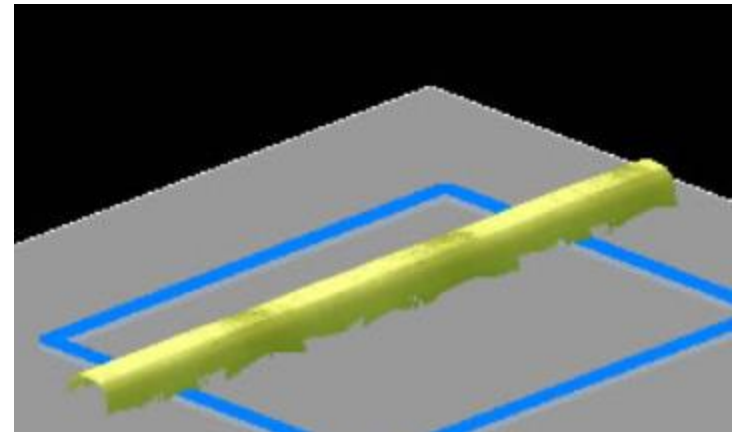
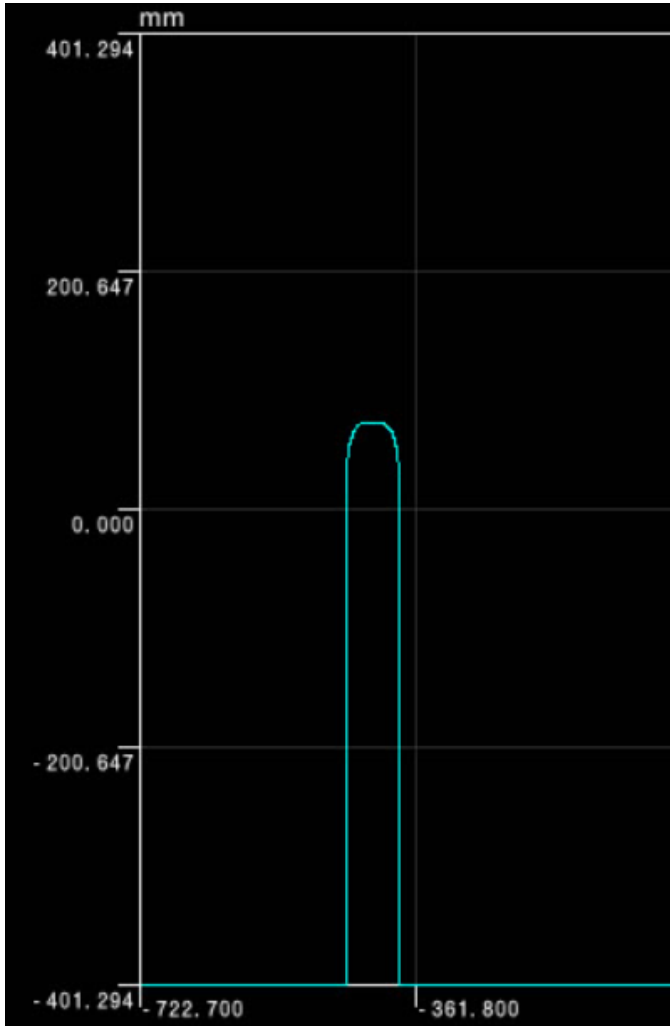
Additional Components



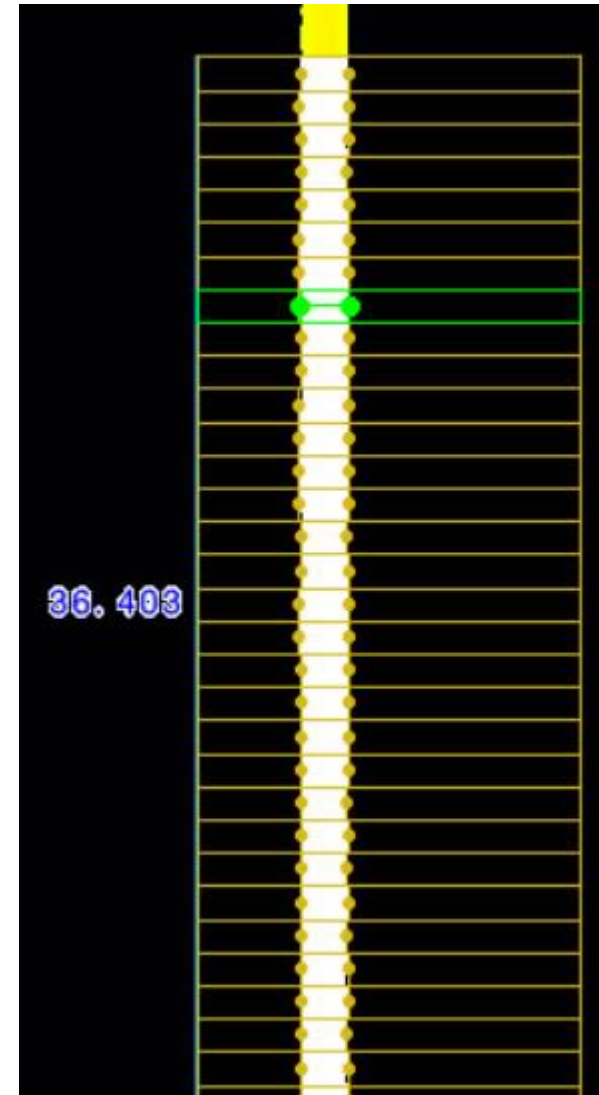
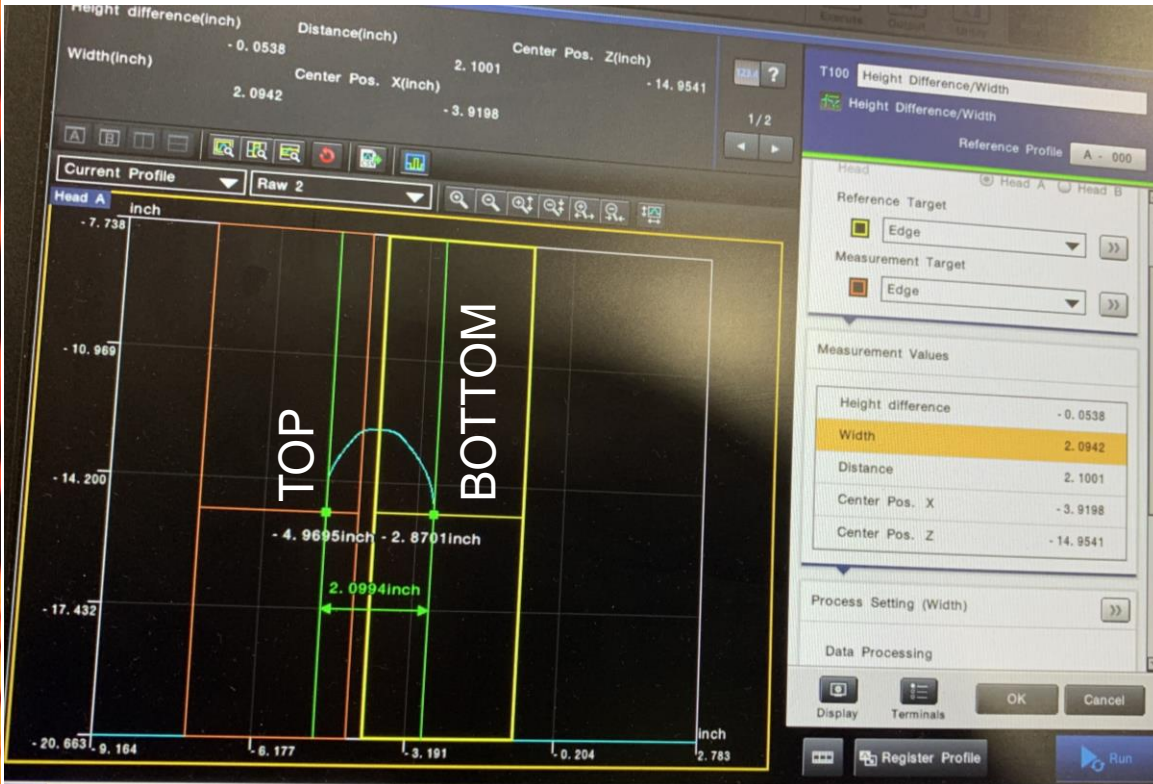
How it works



2D to 3D



Measure Section Height



Operator visual



1 Set001 3d insp-defect 6.29.23 S00:Current Image 1 Prog. Time 9987.2 ms Interval 9131.2 ms

Tools List S00 Utility Go to Setup Mode

2D 3D Cross-Section T100: Position Adjustment with Edge

Measured List

Stand	Value	HI	LO
Stand 5	2.134 inch	2.1250 inch	2.0625 inch
Stand 6	2.623 inch	2.6250 inch	2.3750 inch

Sensor Head A
Location/Size/Parameters/Status

Sensor Head B
Location/Size/Parameters/Status

- 400.0 400.0 mm

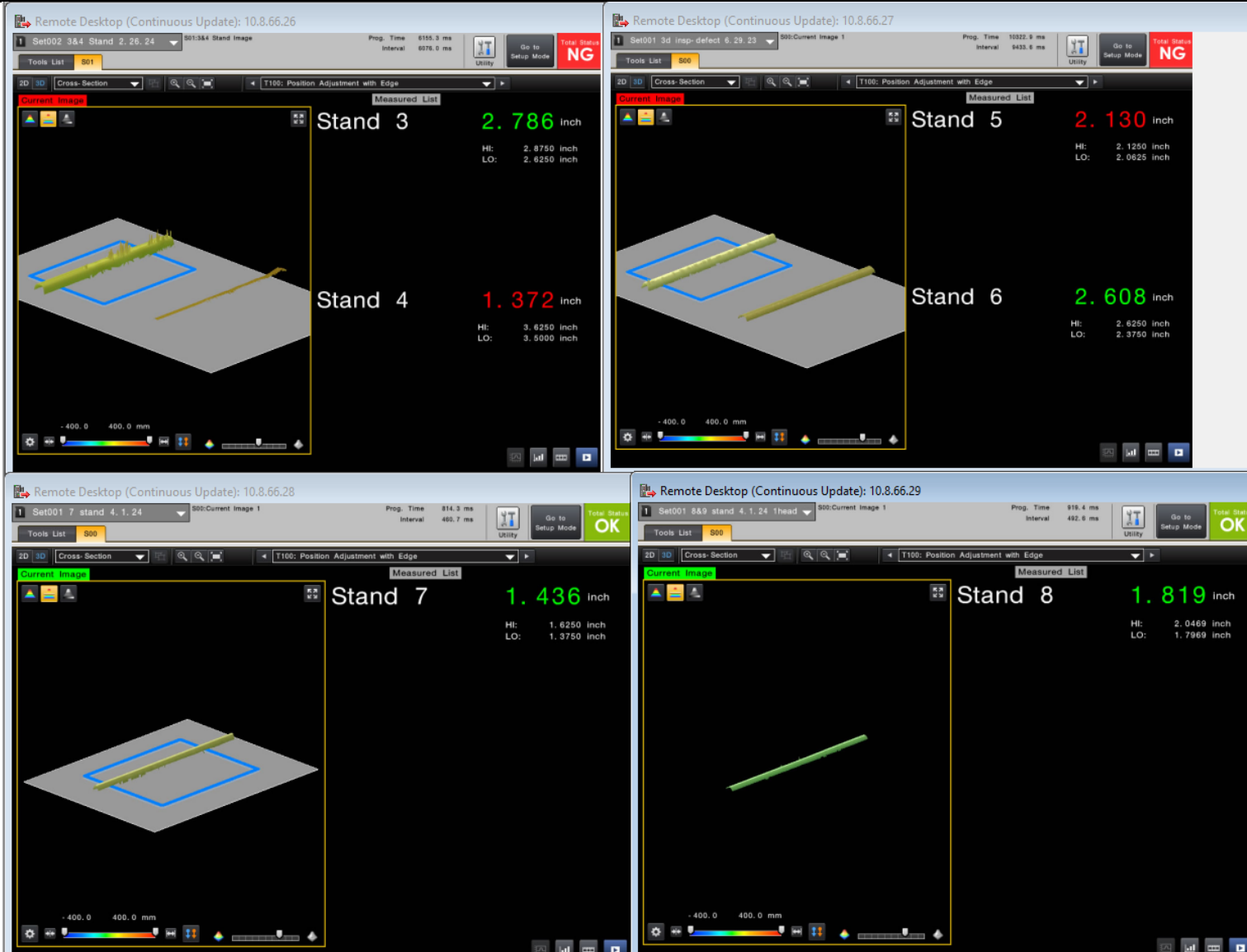
Run Button

Total Status Display

Run Button

Current Image Display

Multi-view



Size Parameters



- Size parameters are determined by Level III Procedures.
- Size measurements are recorded into daily checklists.



Data Saving Capabilities

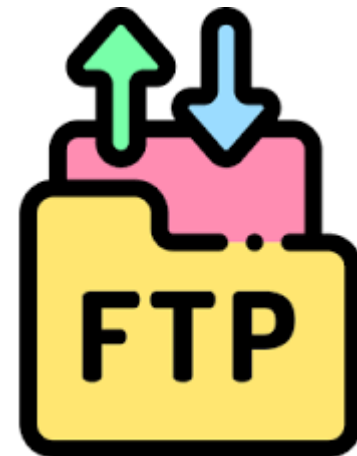


- Controller saves both grayscale and height images.



- Can save to flash drive, SD card, PLC, or network.

- Images can be reviewed through a Keyence simulation software.



Future Possibilities



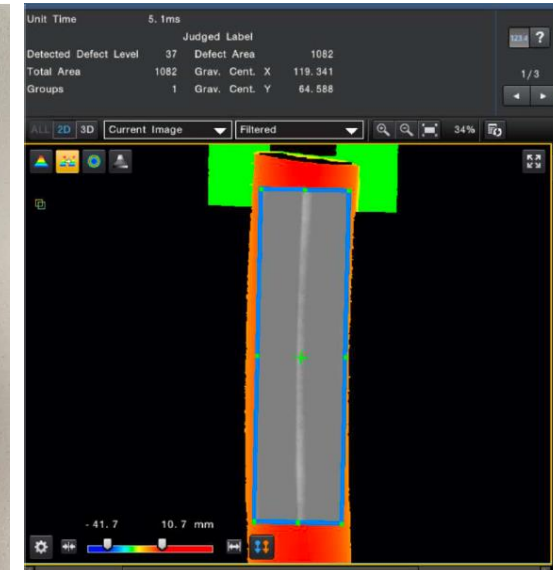
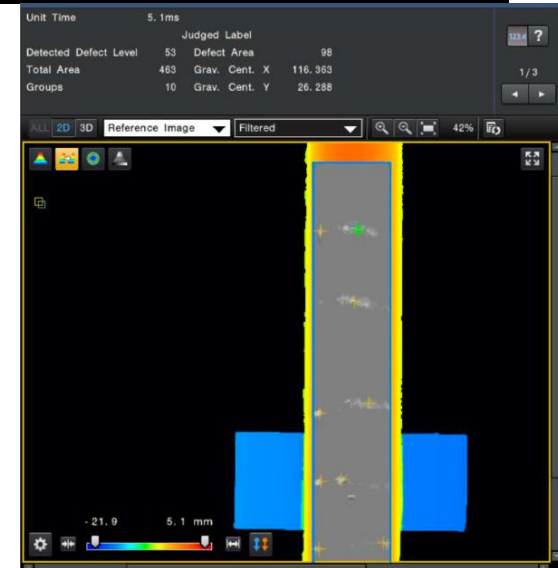
- Surface Defect Detection
- Split Nose Detection
- Automatic Size Adjustment
- Bar Code & QR Code Scanning



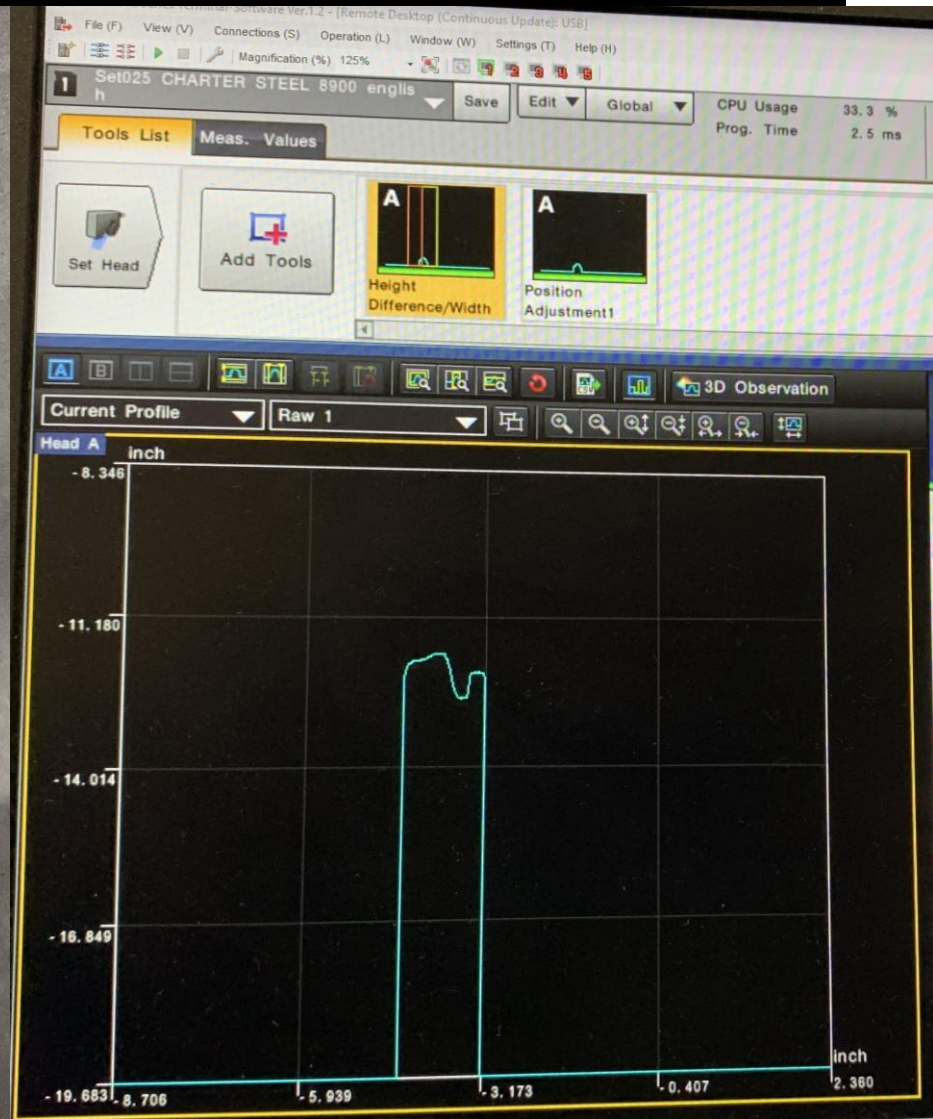
Surface Defect Detection



- Sensors can measure difference in surface height.
- Cracked Roll
- Seams
- Overfill
- Scabs & Slivers



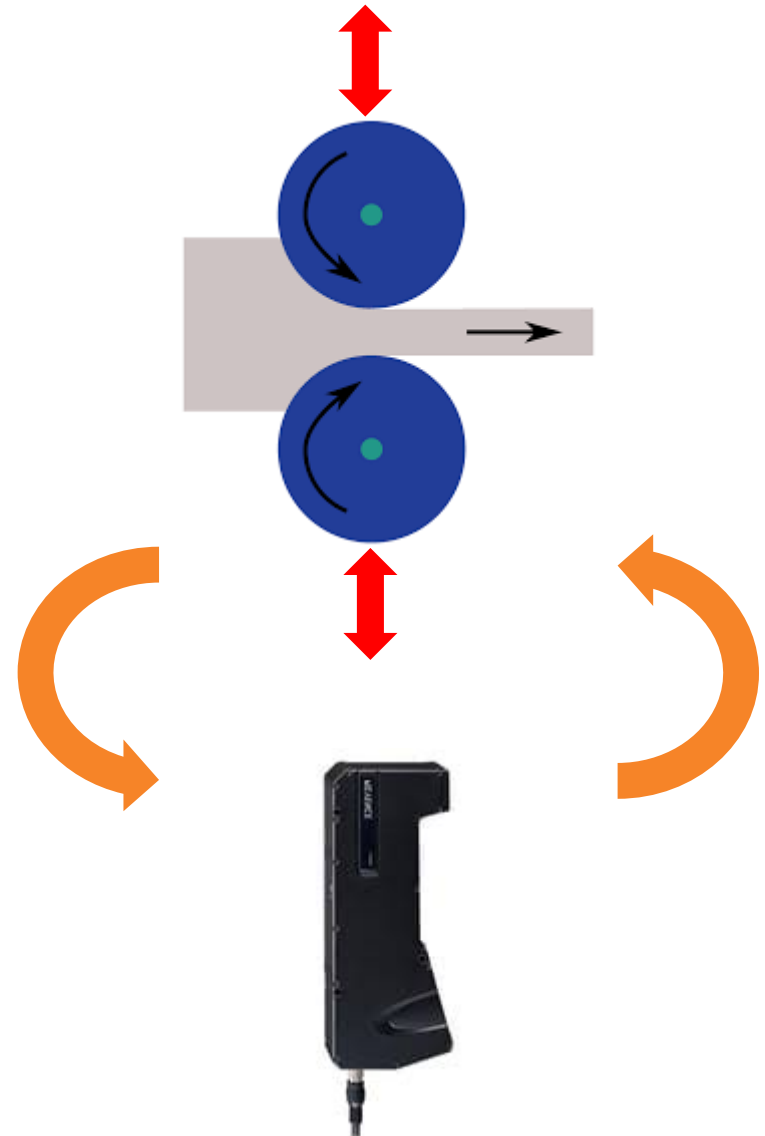
Split Nose Detection



Automatic Size Adjustment



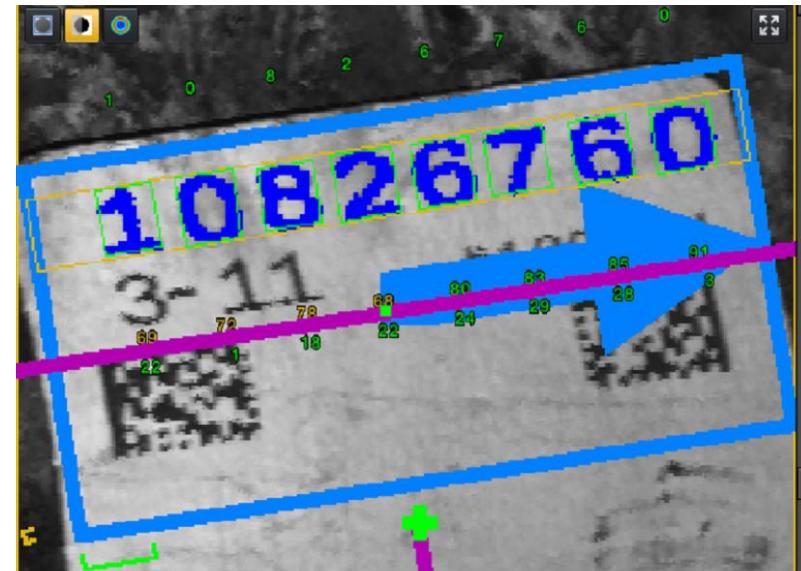
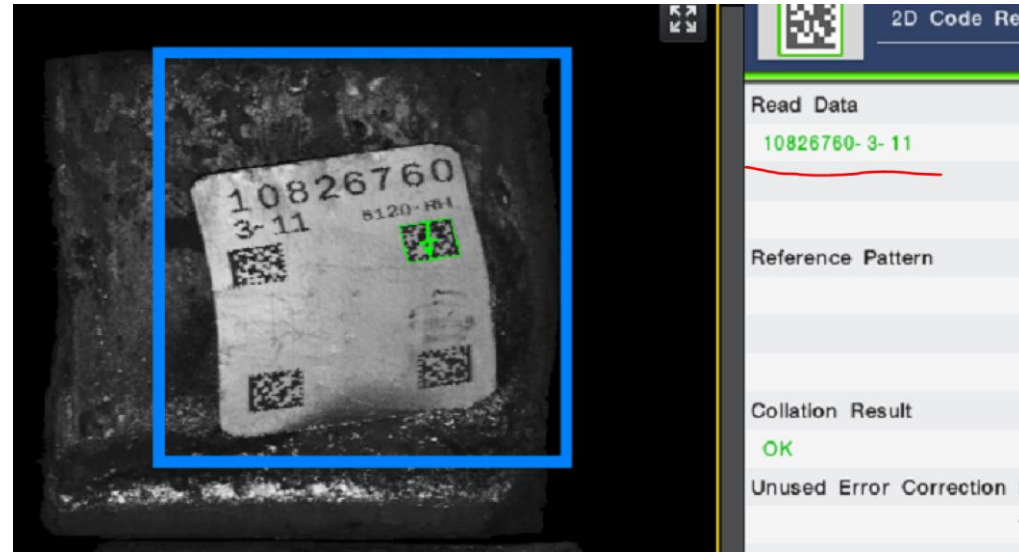
- Continuously monitor size after each mill stand.
- Adjust roll pass overtime to account for wear.
- Reduces risk of overflow.



Bar Code & QR Code Scanning



- Can measure multiple billets at a time.
- Data can be communicated through PLC to ensure correct billets are sent to reheat furnace.
- Can also measure the quality of front-end torch cut.





One Family. One Team.

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