Automated Train Bearing Inspection Machine

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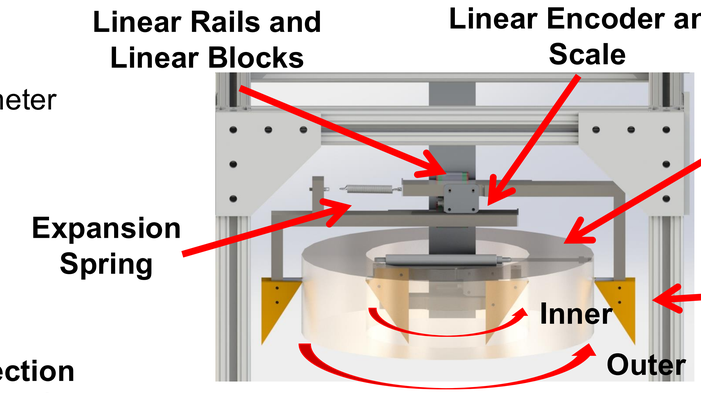
BACKGROUND

- Wabtec is an innovator in the locomotive industry
- Inspection of used bearings is currently conducted manually with dial indicators, taking operators 10-15 minutes
- Assesses individual bearings for roundness and inspects for surface irregularities, improving precision, clearly identifying unfit bearings, therefore improving process quality
- The machine is a continuation from last year, their design of the measurement system, off the shelf conveyor, and unloading ramp is the basis for our project

REQUIREMENTS

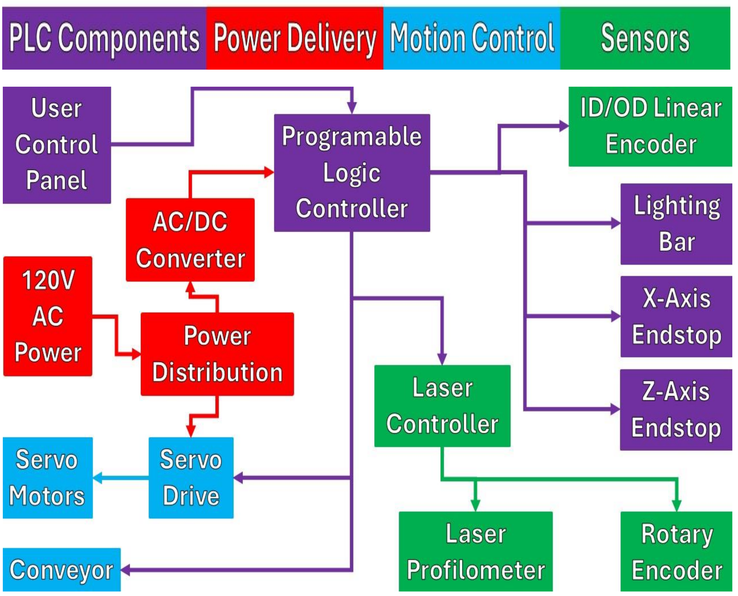
- ☑ Sustain five of the same type of bearing at a time weighing more than 350 lbs. combined
- ☑ Accurately measure Inner Diameter and Outer Diameter (ID/OD) to the 1/10,000th of an inch
- ☑ Detect Surface Defects to 1/1,000th of an inch
- ☑ Determine a Bearings Out-of-Roundness
- ☑ Make a Go/No-Go decision from measured values
- ☑ Safety Frame for Operator Safety from pinch/ crush hazard

ID/OD MEASUREMENT



Inner and Outer Diameter Measurement

ELECTRICAL SYSTEMS

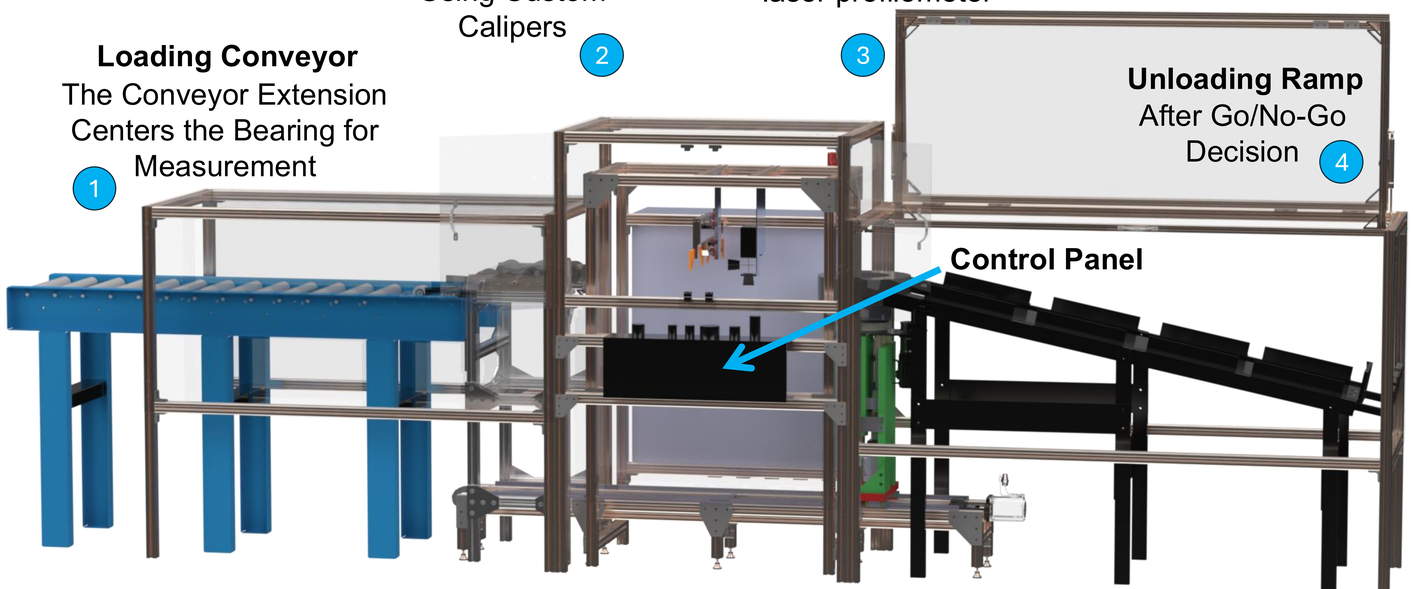


Loading Conveyor
The Conveyor Extension Centers the Bearing for Measurement
1

ID/OD Measurement
Using Custom Calipers
2

Defect Detection
Scans bearings using a laser profilometer
3

Unloading Ramp
After Go/No-Go Decision
4

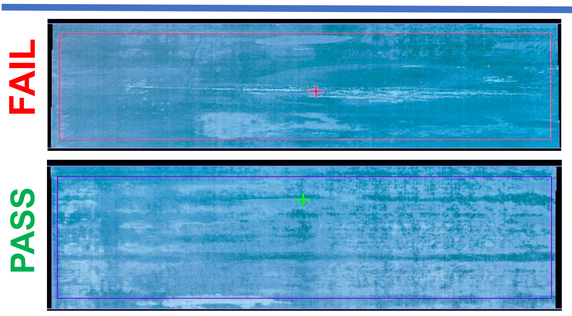


Safety Frame
Constructed from 80/20 Extruded Aluminum and faced with Polycarbonate

SAFETY

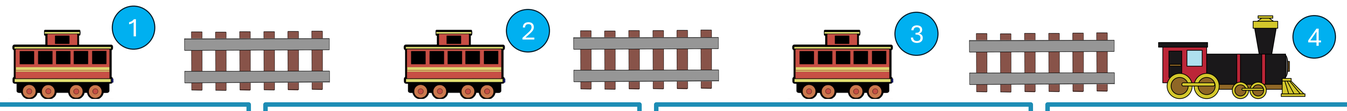
- Reduces pinch points and prioritize operator safety according to ISO standards
- Dolly access doors are designed as a cabinet style to provide easy maintenance and operation
- Hall effect sensors on each individual door are directly tied to the emergency stop, the machine cannot operate while the doors are open
- Gas struts allow ease of opening the unloading trunk door

RESULTS & NEXT STEPS



Fail/Pass Scan Indicator
+ FAIL
+ PASS
This is one of two parameters the bearing must pass to be considered a useable bearing

Next Steps
- Full System Automation: complete automated integration & movements
- Go/No-Go Decision: redesign component to not be a passive indicator
- Bearing Foot Redesign: a circular foot would allow for closer scans
- Gage R&R: test both the repeatability and reproducibility of measurements with multiple operators



Loading Conveyor
- Five bearings are loaded simultaneously
- A bearing is centered using the conveyor extension and moves in three axes: X, Z, and C for rotation
- The Conveyor Extension provides a transition location from the conveyor to the dolly foot, to center each bearing for measurement

Inner/Outer Diameter
- ID/OD: the dolly lifts into the custom inner and outer diameter calipers, guided by triangular wedges to measure the bearing
- 6 measurements are taken for both the inner and outer diameter
- Mounted electrical box, and the control panel rests on the safety frame

Defect Detection
- Surface Profilometer: the dolly rotates the bearing along the c-axis, allowing the laser profilometer to construct a profile of the bearing surfaces
- An enhanced aluminum surface mirror prevents scattering of the surface profilometer laser as it is reflected onto the bearing

Unloading Ramp
- A passive indicator marks it as "No-Go" or diverts the indicator to signal "Go" along path to the ramp
- The Dolly raises the bearing up to the unloading ramp where each bearing is gently released
- Unloading Ramp stores 5 bearings until unloaded by an operator or crane

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