

Wheels Gone WILD

A Look into the World of Equipment Condition Detection

Southwest Association of Rail Shippers

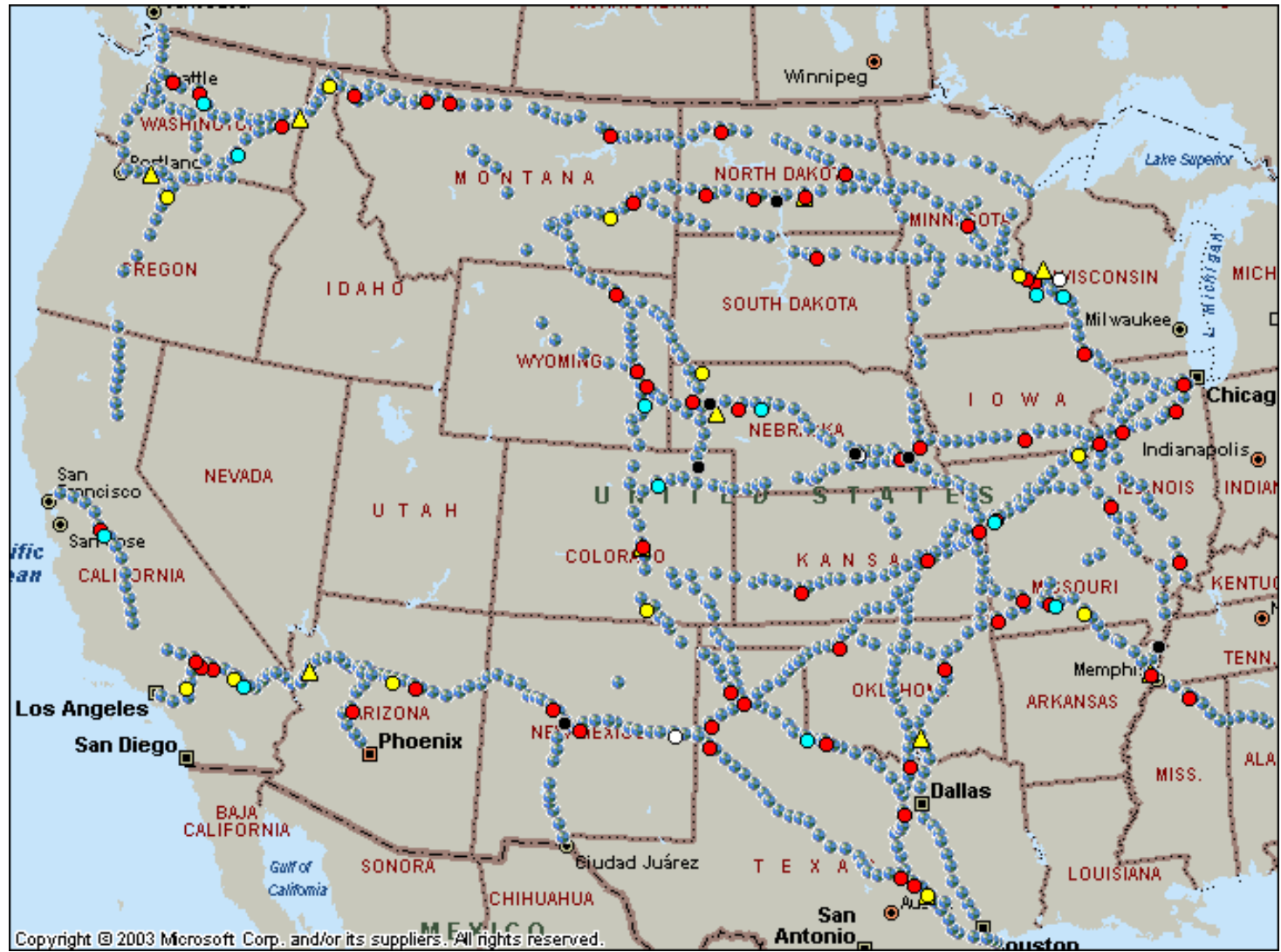
February 18, 2010



BNSF[®]
RAILWAY

BNSF Mechanical Wayside Detector Network

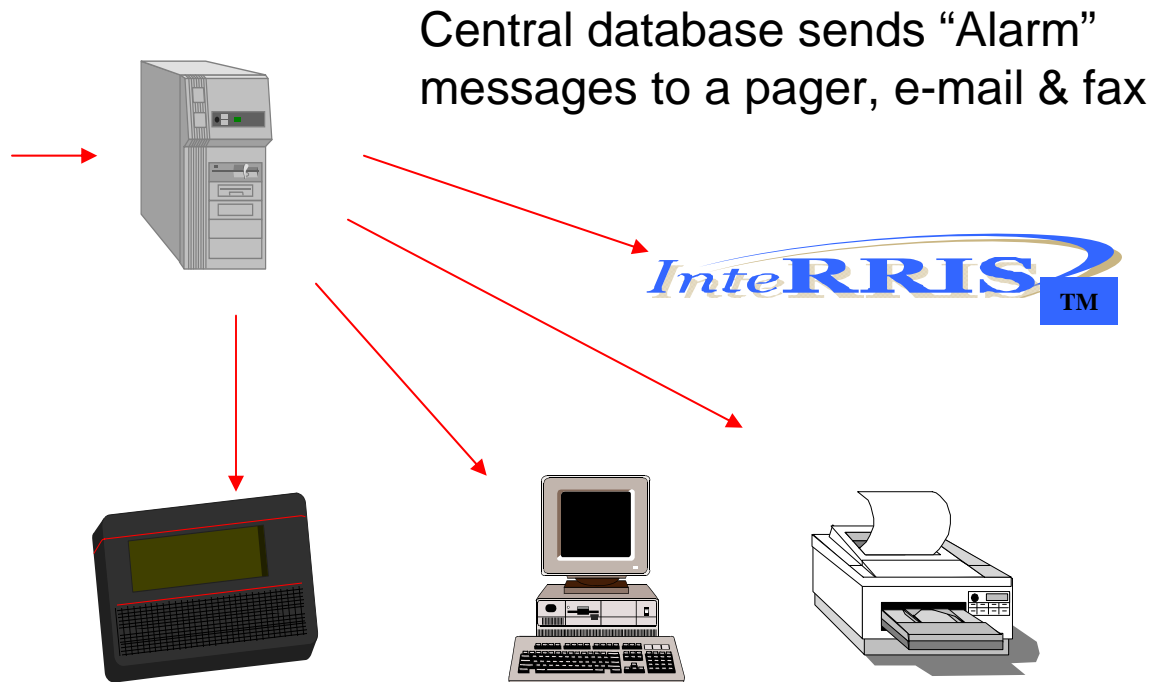
- WILD (13)
-8 w/ Truck Hunting
- Force-Based Truck Performance (12)
- Laser-Based Truck Performance (4)
- Warm Bearing System Detectors (810)
- ▲ Acoustic Bearing (10)
- HOT WHEEL (89)
- Machine Vision Systems (7)



Freight Car Detector Network



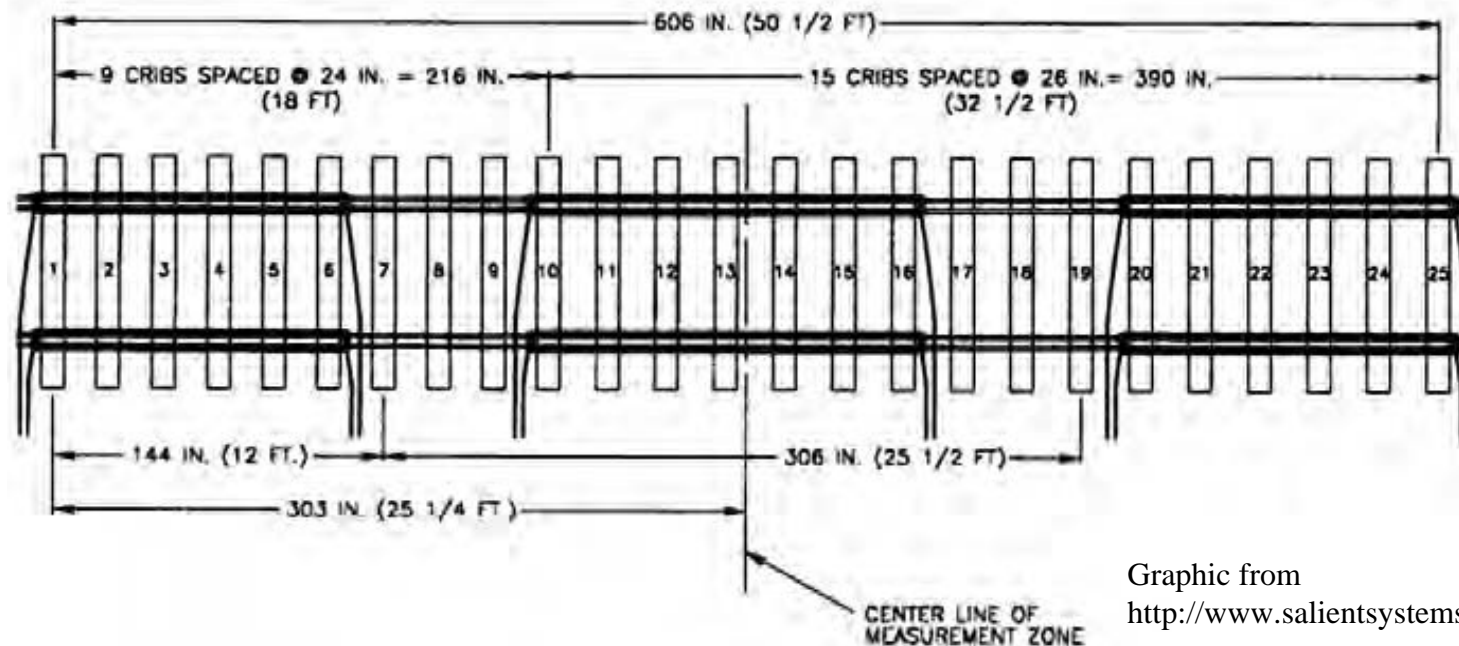
Detectors report cars with poor performing trucks and wheel defects to a central database, TSS, Railinc & InteRRIS



Cars are identified, inspected & repaired

Wheel Impact Load Detectors (WILD)

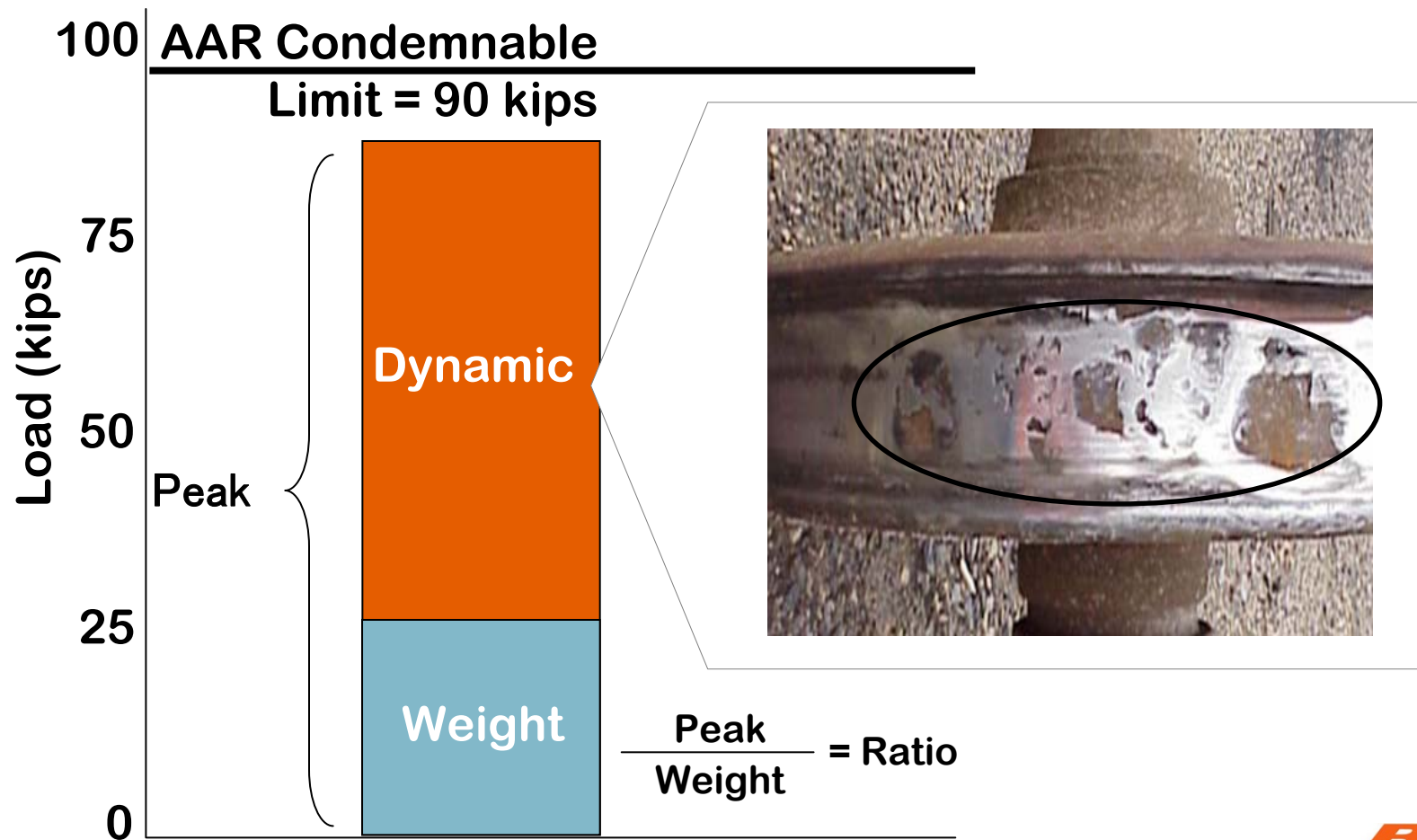
- Strain gages applied to rail
- Automatic Equipment Identification (AEI) reader
- Each wheel identified by car number and location in car
 - Maximum load through site
 - Average load through site – outliers removed



Graphic from
<http://www.salientsystems.com/wild.pdf>

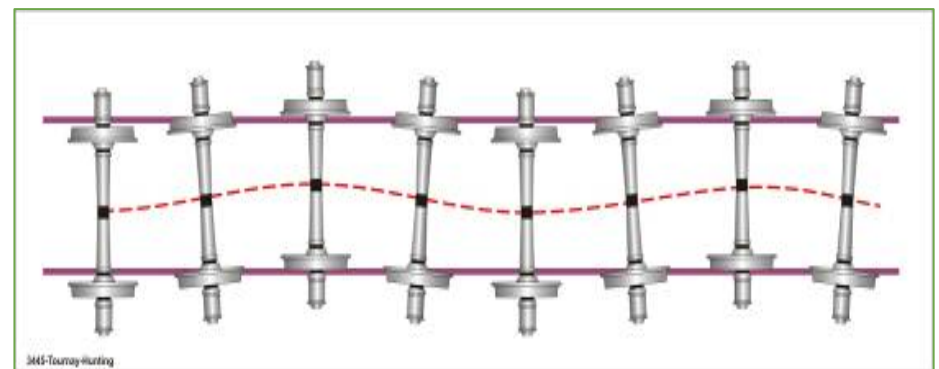
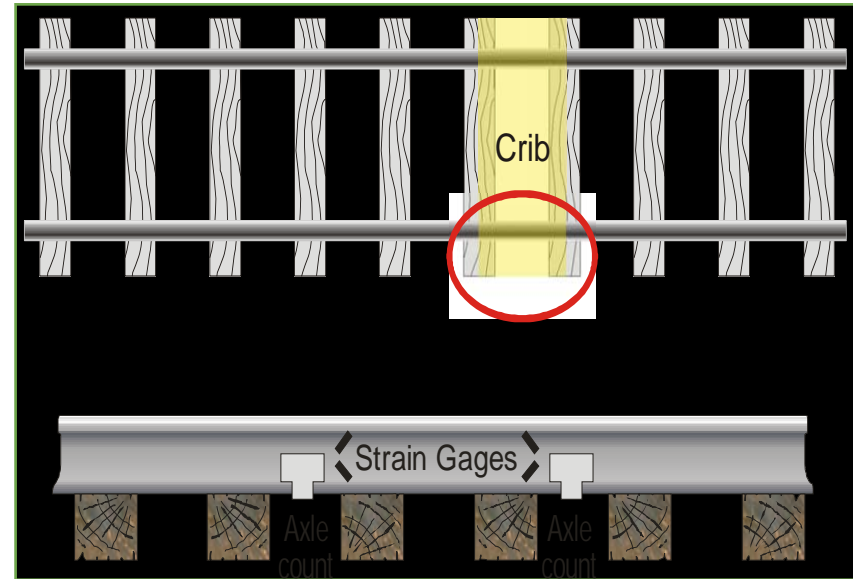
Wheel Impact

- Window of Opportunity ≥ 65 kips
- Opportunistic Repair ≥ 80 kips
- AAR Condemnable ≥ 90 kips
- AAR Final Alert ≥ 140 kips



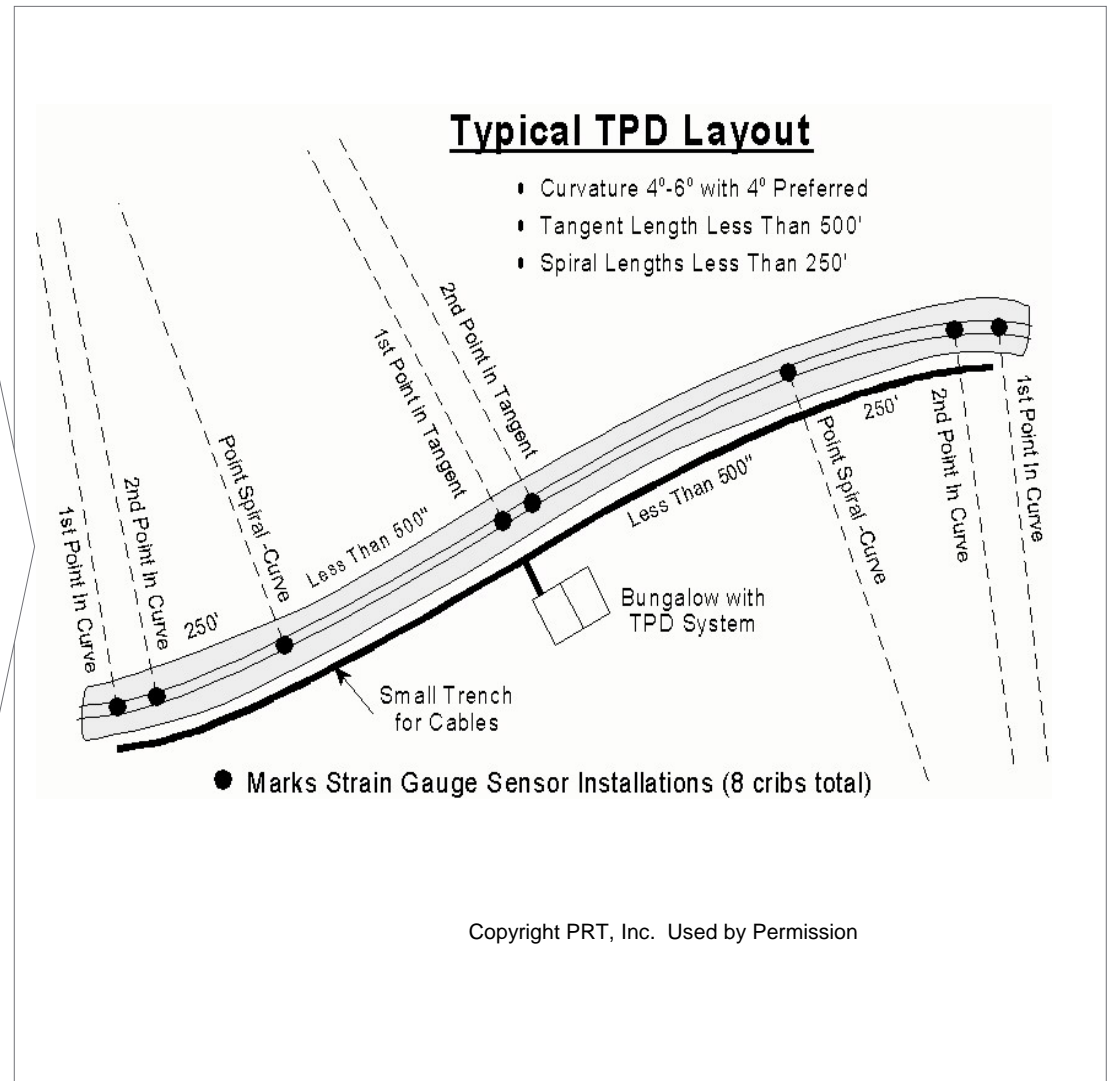
Truck Hunting Detector

- Instrumented cribs that measure vertical & lateral wheel loads to establish a hunting index (HI) over a length of track
- A hunting truck is characterized as having poor lateral dynamic performance
- Hunting is sensed by measuring the attitude of the wheelsets on tangent track
- Current condemnable limits
 - Single HI ≥ 0.55
 - Two HI ≥ 0.40 in a 12 month period
- Window of Opportunity
 - Single HI ≥ 0.20



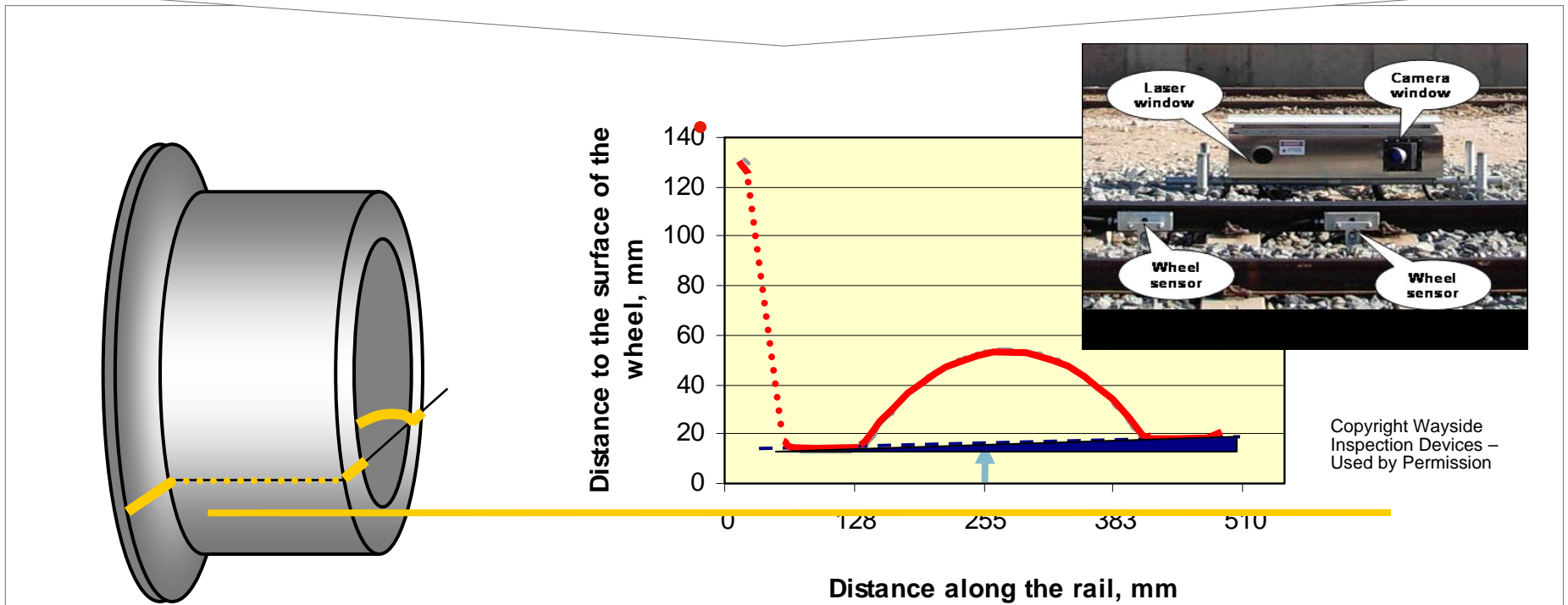
Truck Performance Detector Strain Gage

- Most TPDs in service consist of strain gauges placed at eight different locations (cribs) throughout an “S” curve in the track. These gauges measure the lateral and vertical forces experienced by the track at each crib.
- Data is collected on every car that passes a TPD site (12 in use).



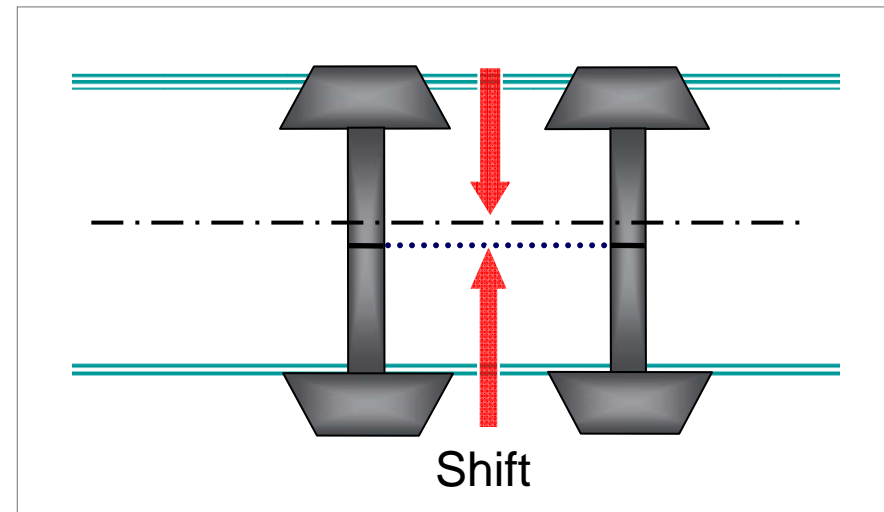
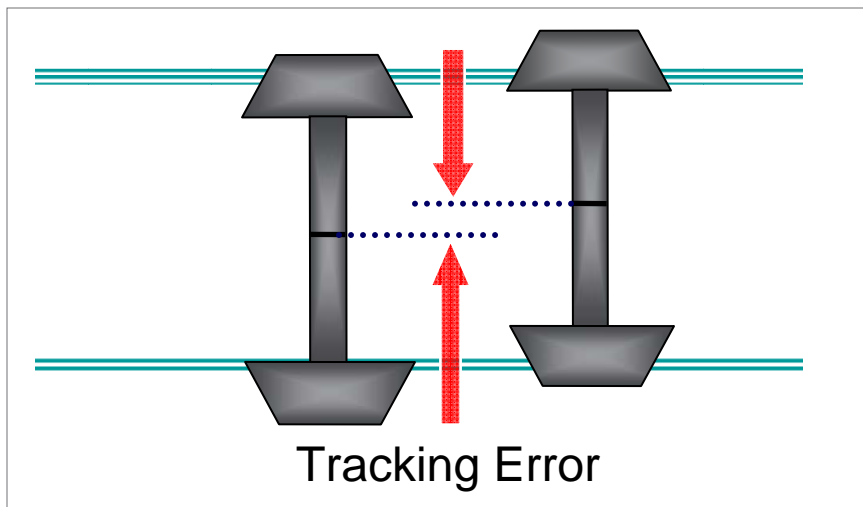
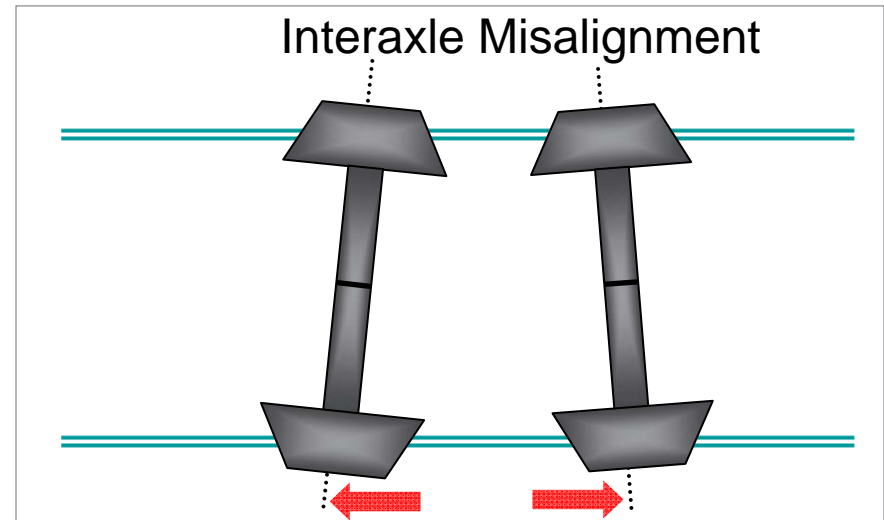
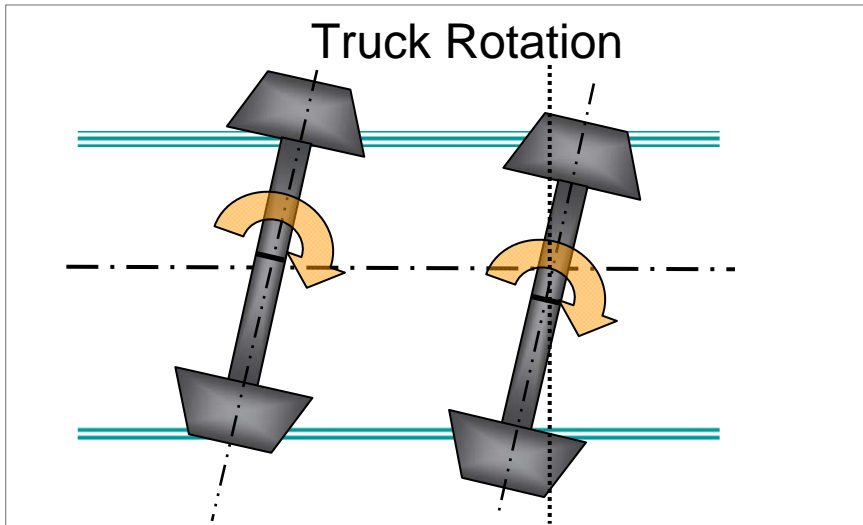
Truck Performance Detector - Laser Based Principle of Operation

- It is a laser-based system with cameras mounted on TANGENT track.
- It draws a virtual laser line on the wheel plate.
- It then compares the angle and position of this line to the track and determines wheel angle (angle of attack) and distance (tracking position) with respect to the gauge side of the rail.



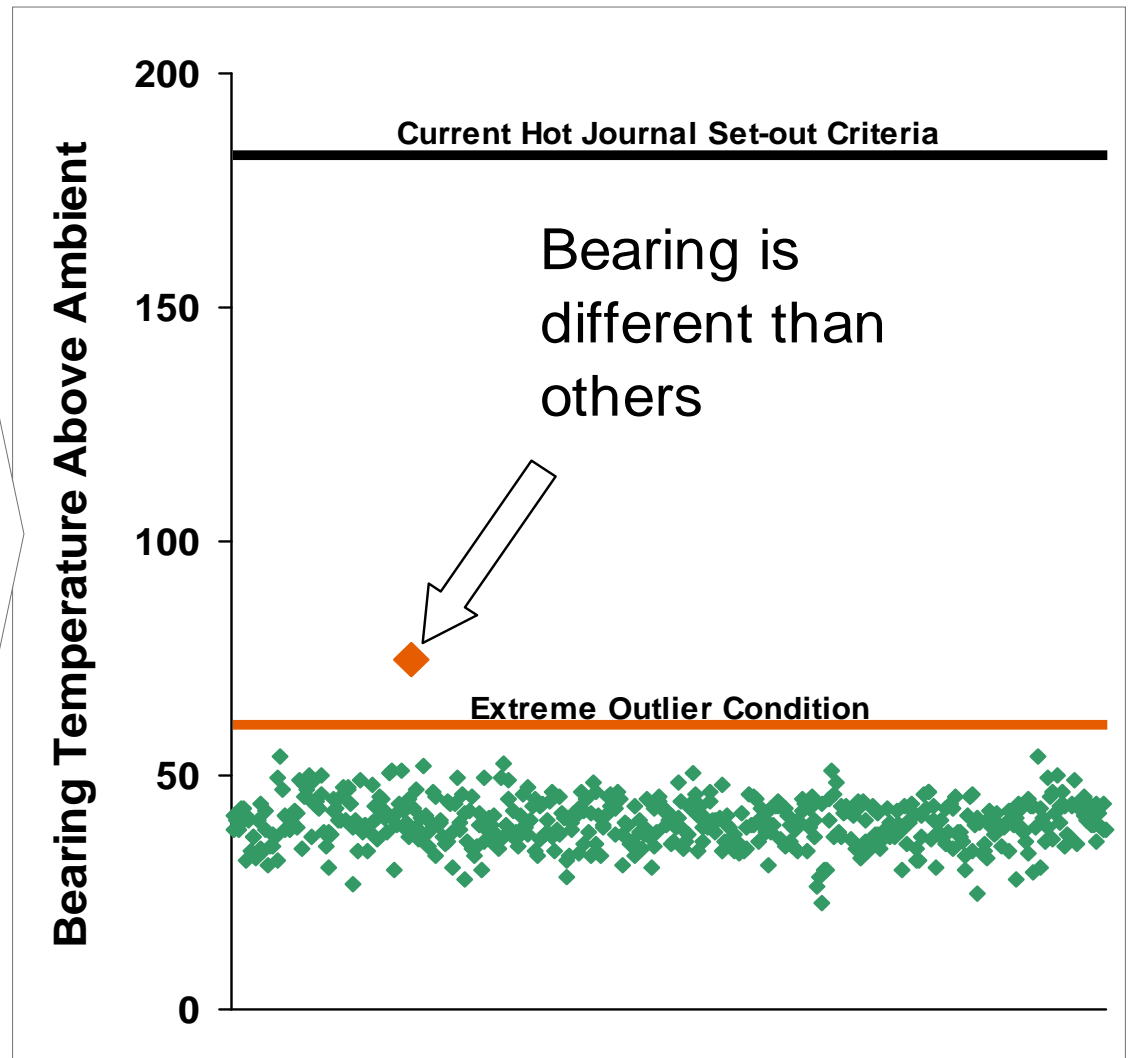
Truck Performance Detector – Laser Based

What Measurements Are Made?



Warm Bearing Detection (WBDS)

- Current hot bearing detectors alarm at an absolute temperature difference from ambient
- Warm bearing detection system looks for bearings that are different from others on the same train
- “Difference” makes car a candidate for closer monitoring



Warm Bearing Detection System

....Warm Bearing Trending found these bearings that would have been missed by traditional methods

- XXXX 12345
 - Only 117 F
 - 63F below HBD actionable level



- XXXX 123456
 - Not a HOT bearing at 152F
 - Still 28F below HBD actionable level



Acoustic Bearing Detection

The detector records and analyzes noise signatures.....

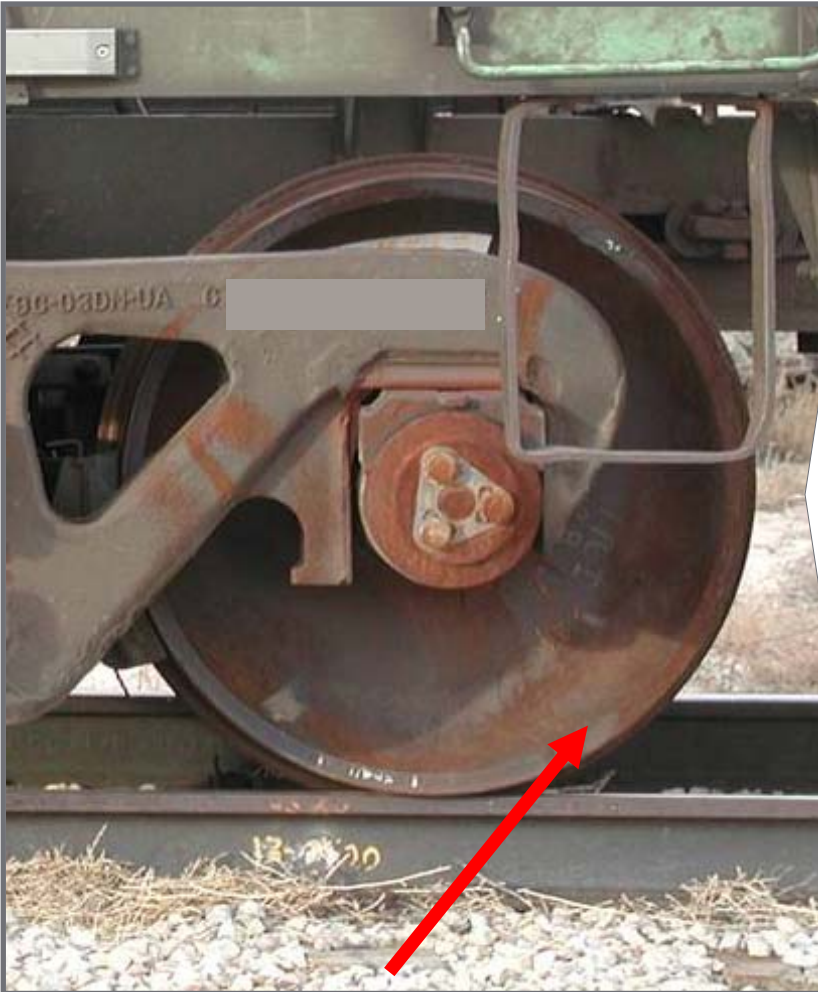
- ◆ Detector records noise over a range of frequencies
- ◆ Noise frequency/amplitude relationship compared to known bearing defect signatures



....to find distressed bearings



Wheel Temperature Monitoring



Typical Hot Wheel with Heat-induced Oxidation

- Wheel Temperature detector uses HBD technology
- Benefits
 - Identifies cars with potential brake system defects
 - Reduces false warm/hot bearing stops
- Individual readings from detectors can be analyzed as a system to determine outliers
 - Same strategy as Warm Bearing

Vision Systems

- Cameras record a picture
- Picture is compared to a known pattern
- If the pattern does not match, an alert is generated
- Vision system examples
 - Wheel profile
 - Low Air Hose
 - Outlet door securement
- Several vendors actively developing different types of Vision system modules



Vision System for Load Securement

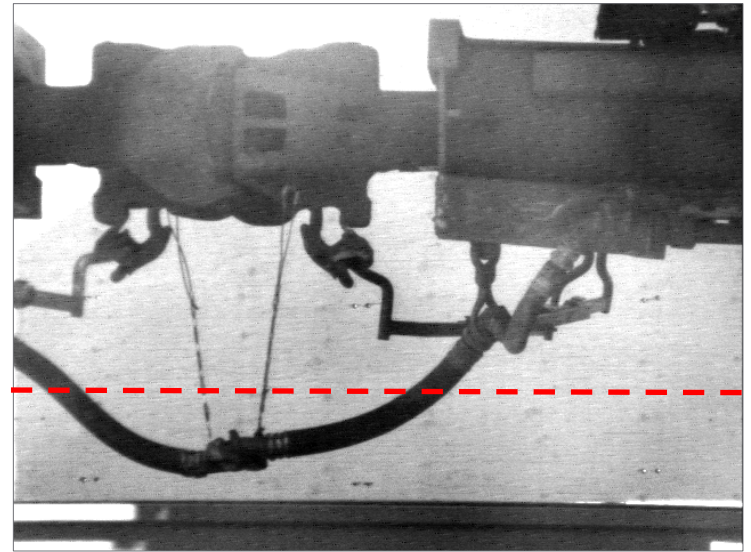
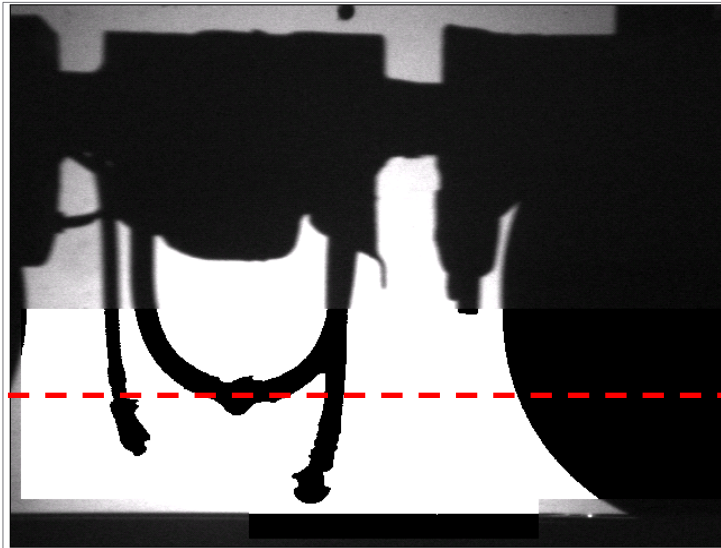
Vision System

Low Air Hose

This detector....



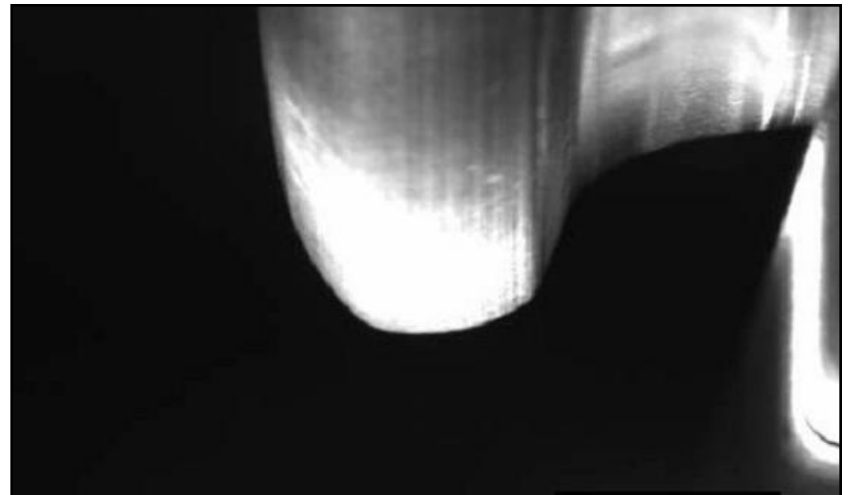
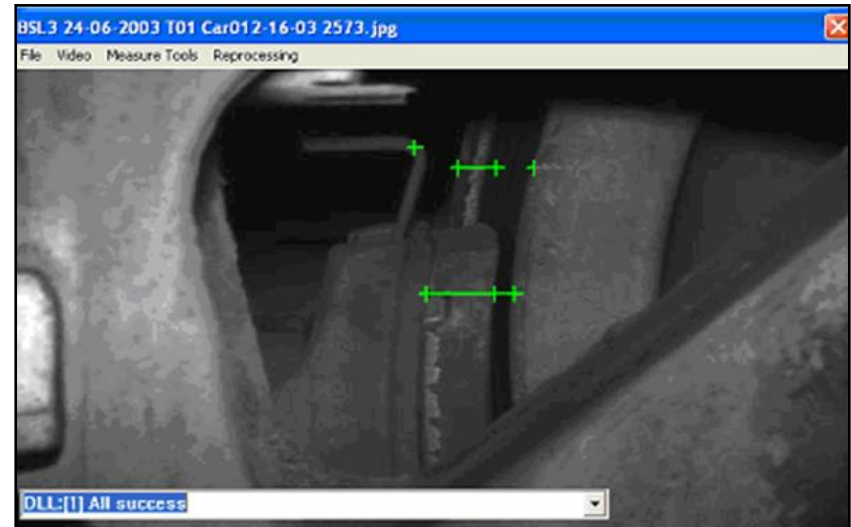
..generates these images



Vision System

Wheel Profile and Brake Shoe

- Fully Automated Car Train Inspection System
- Identifies high flange, thin flange, rim thickness, hollow tread, and brake shoe thickness
- Provides initial list of wheels needing further inspection at the terminal

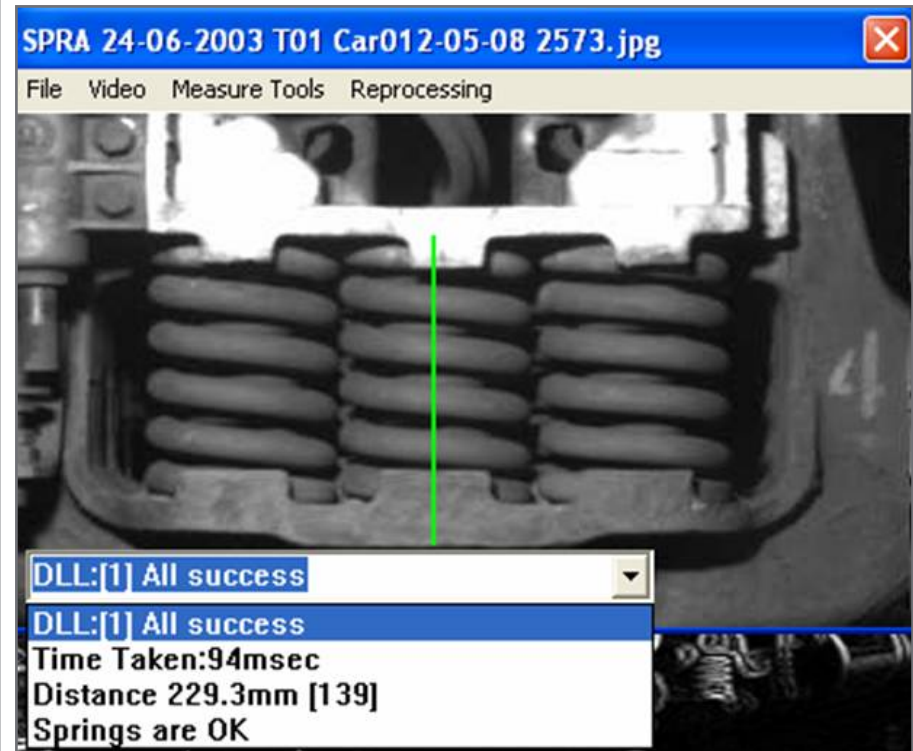


Vision System

Bearing End Cap and Spring Condition



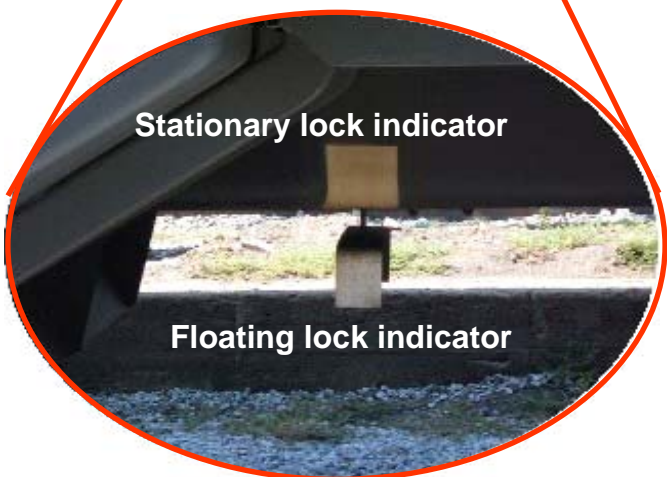
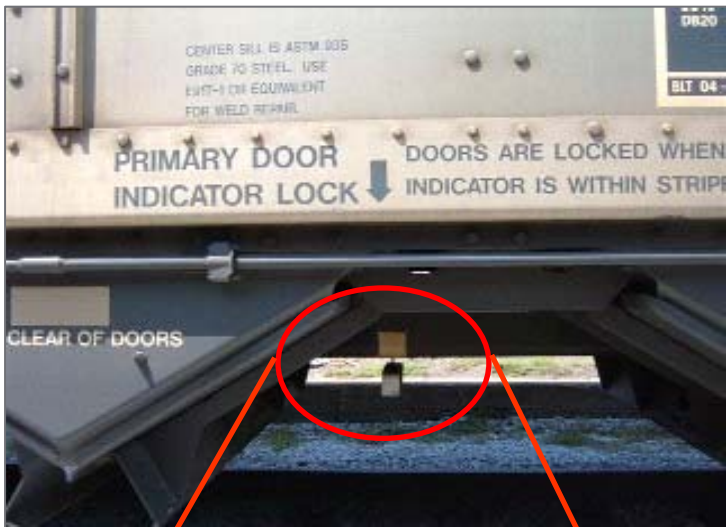
Bearing End Cap



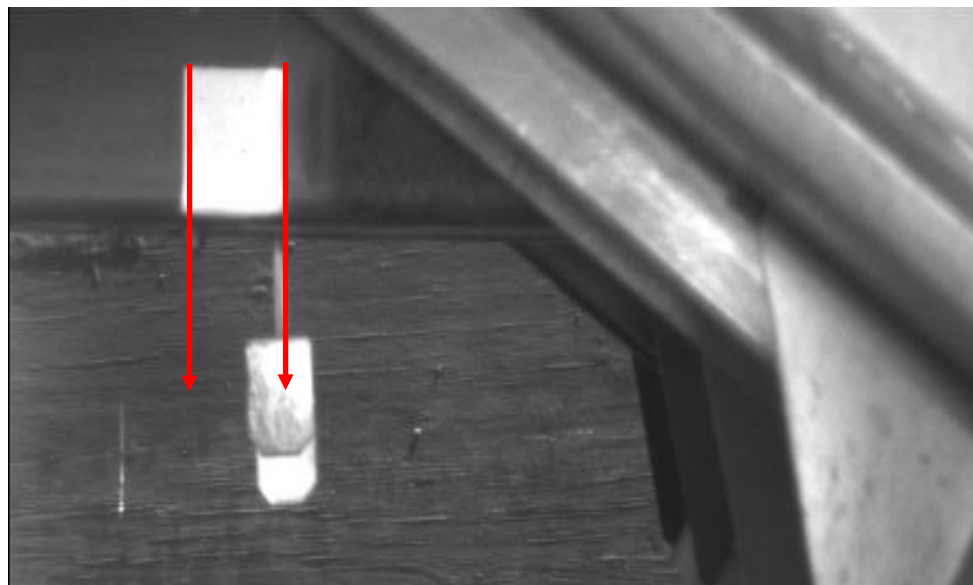
Spring Presence and Condition

Vision System

Coal Car Door Lock



Alarm from Detector – Indicator is not properly aligned

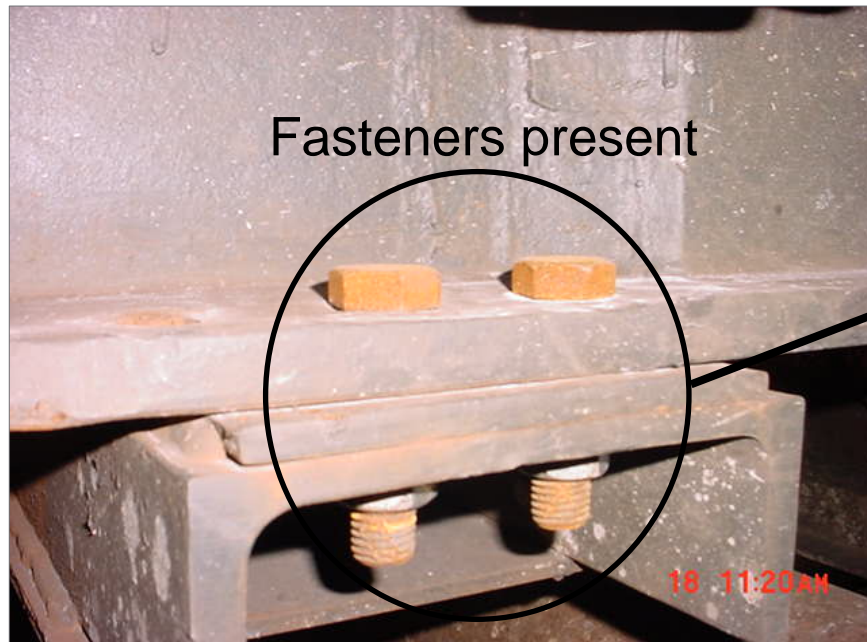


Vision System

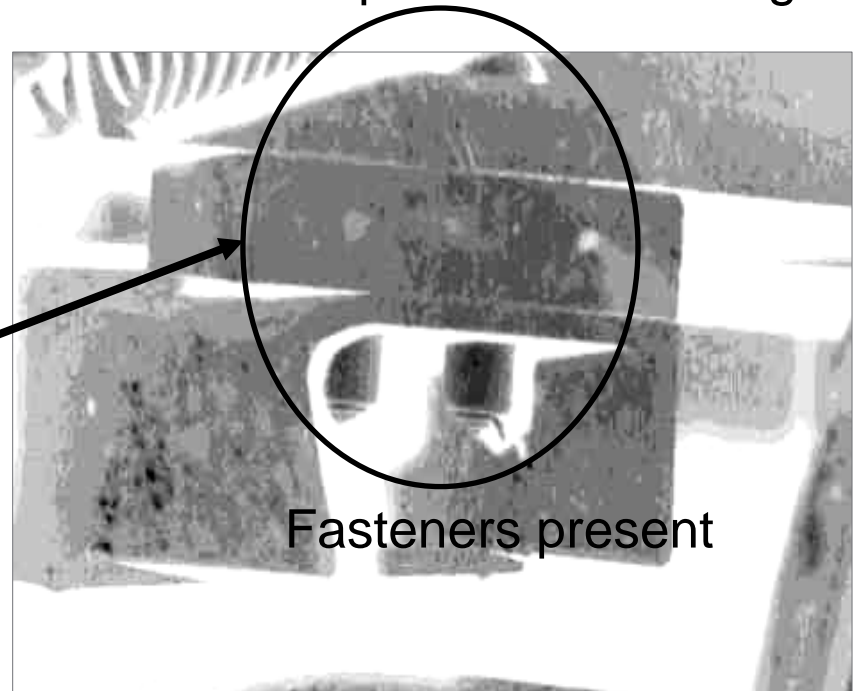
Coupler Retainer Fastener

- Mandan, ND
- Looks for presence of fasteners

Coupler Retainer



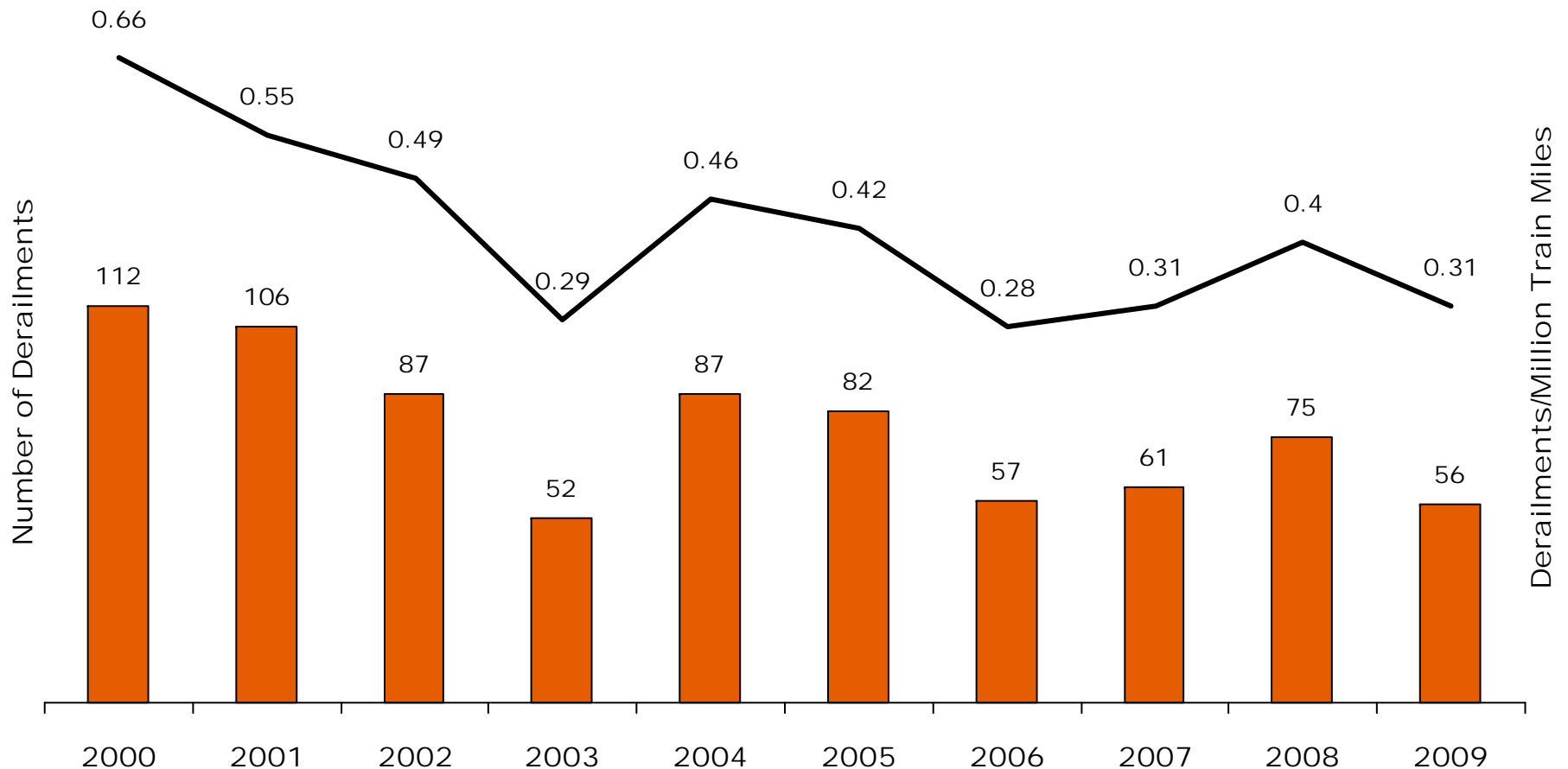
FACTIS Coupler Retainer Image



Wayside Detection Results

Mechanical-Caused Derailments

Since we began installing Wayside Detectors in 2000, we have experienced a greater than 50% reduction in Mechanical-caused derailments



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