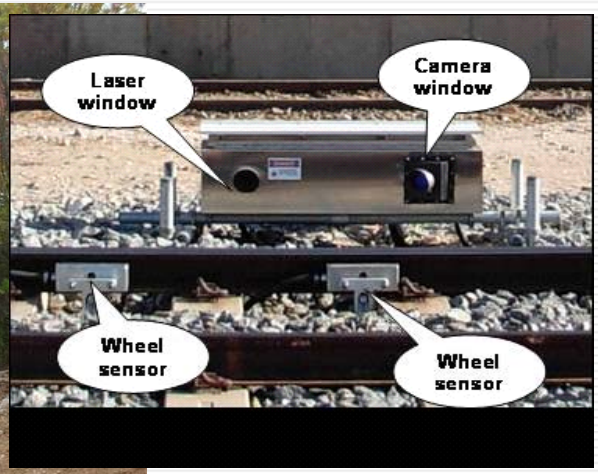
How tomorrow moves

Geometry Detector Teardown Results

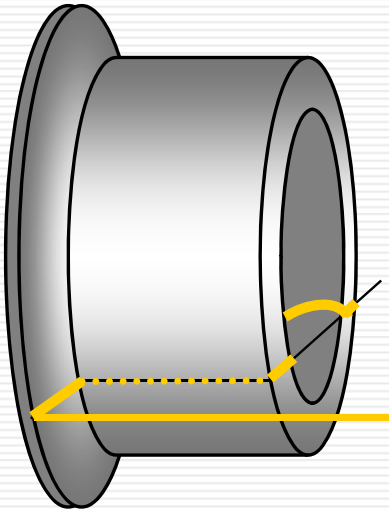
September 10, 2010

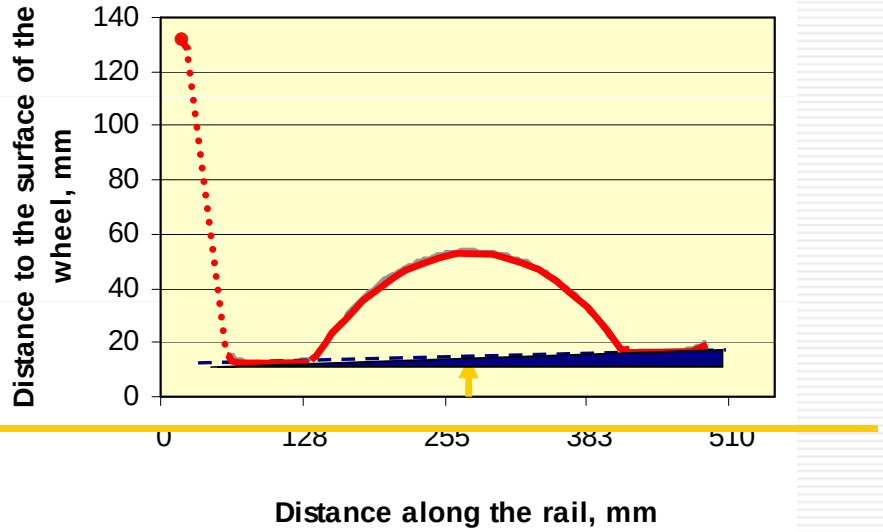
Kim Bowling

What is a Geometry Detector?



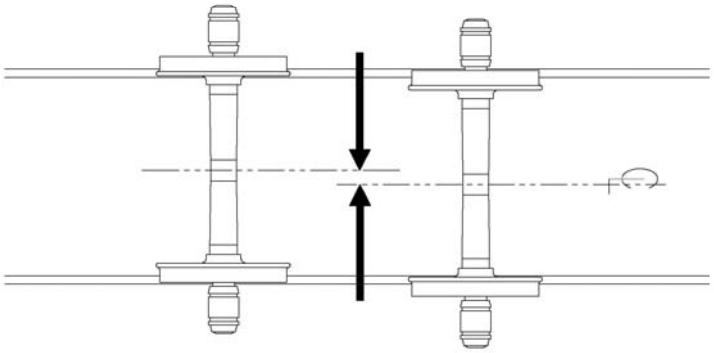
Principle of Operation



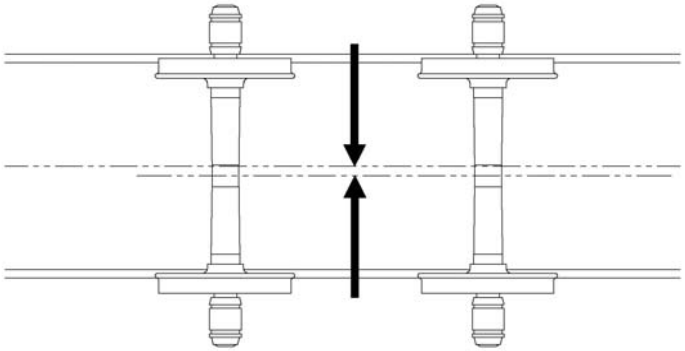


- *Angle of Attack (mrad)*
- *Tracking Position or TP (mm)*

A Few Definitions…



TRACKING ERROR



SHIFT

The axle based measurements can be combined into:

Tracking Error – Difference of leading axle's TP and the trailing axle's TP

(when axles move in **OPPOSITE** directions)

Shift – Average of leading axle and trailing axle's TP (when axles move in **SAME** directions)

How bad is bad?

- 87% of all alert cars in 2008 were either Tracking Error or Shift
- 13% of the alert cars were IAM or Rotation

Tracking Error	2.8% of all readings are above 20 mm	.8% of all readings are above 25 mm
Shift	3.0% of all readings are above 10 mm	.4% of all readings are above 15 mm

Teardown Methods

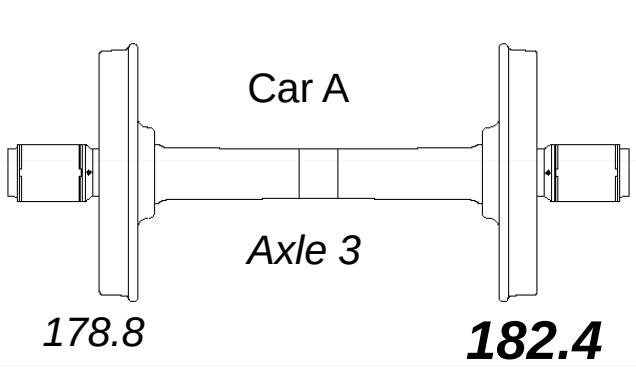
Teardown Methods

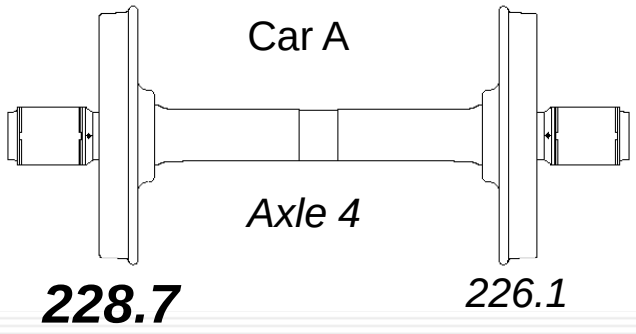
Teardown Methods

Tbogi Teardown Form

Pattern #1: Tape Differentials

- Car A (C111) with S-2-C trucks
  - A Truck Tracking Error = 33.1 mm (1.3 in)
  - Axle 3 Tape Differential – 3.6 tapes (0.45 inches)
  - Axle 4 Tape Differential – 2.6 tapes (0.325 inches)
  - After #3 and #4 axles were replaced, its Tracking Position dropped to 4.9 mm (.2 in)

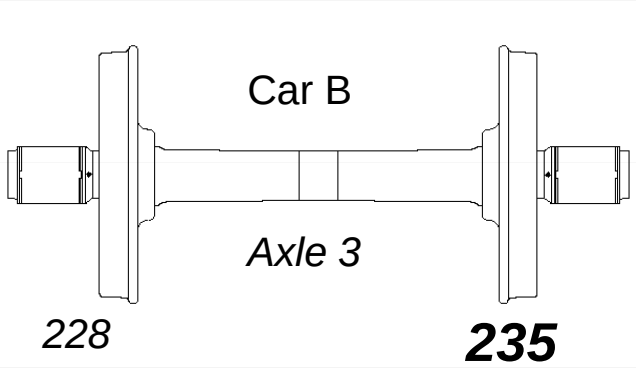


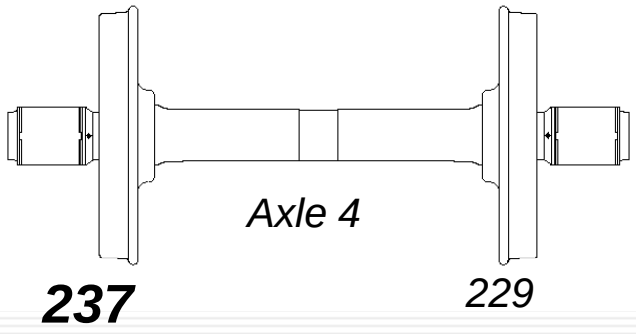


Pattern #1: Tape Differentials

- Car B (F253) with RideControl trucks
- A Truck Tracking Error = 40 mm (1.6 in)
  - Axle 3 Tape Differential – 7 tapes (0.875 inches)

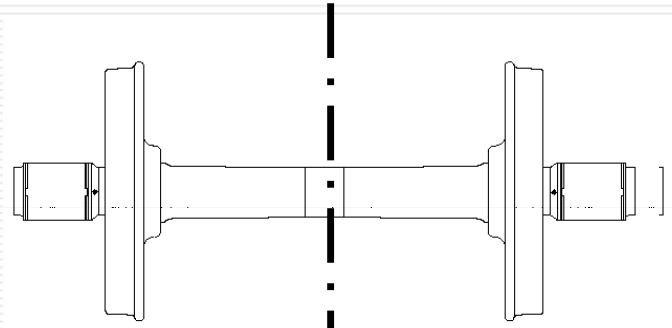
  - Axle 4 Tape Differential – 8 tapes (1.0 inches)



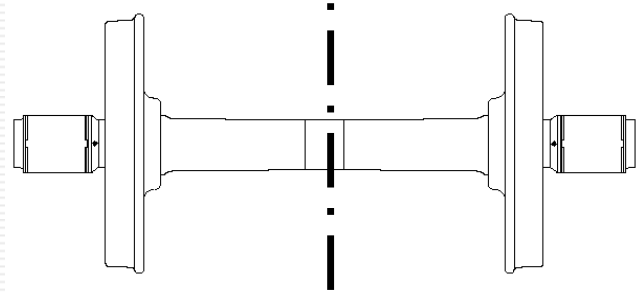


Pattern #2: Morphing!

- What happens when only the most severe axle is changed? And an axle is left in place with moderate tracking problems?
- Tracking Error morphs to Shift!

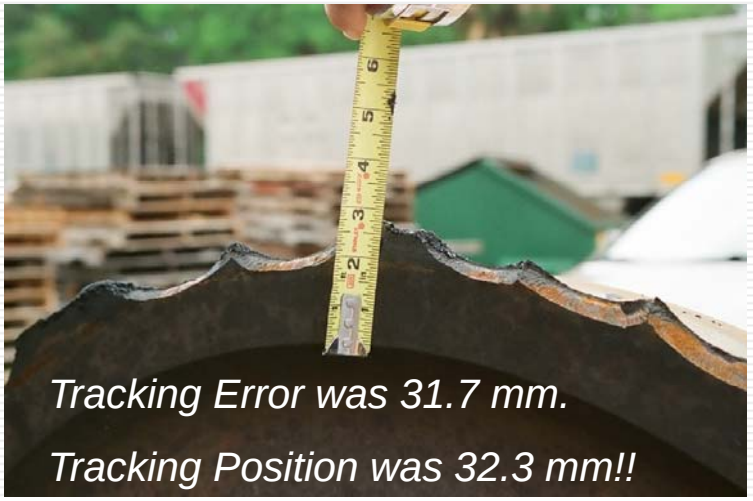


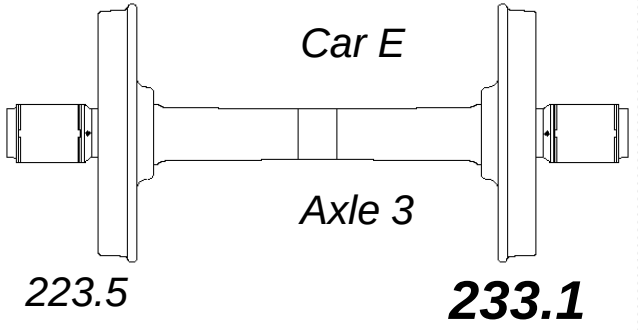
Moderate Left Tracking



Moderate Left Tracking

Pattern #3: Individual Axles

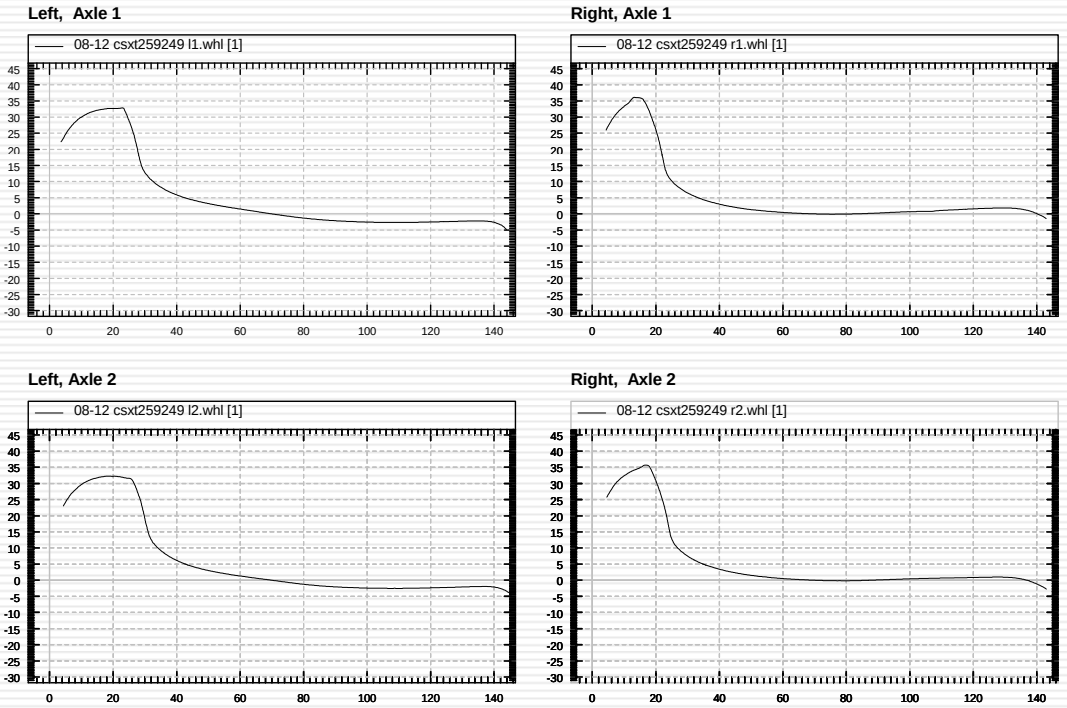




Pattern #3: Individual Axles

- Car D (T104) with S-2-C trucks
  - B Truck Tracking Error = -31.1 mm (1.2 in)
  - Axle 1's Tracking Position was 2.3 mm
  - Axle 2's Tracking Position was -28.8 mm (1.1 in) and had a condemnable thin flange
- Turned wheels had been applied in 2008
- After #2 axle was replaced, its Tracking Position dropped to -6.2 mm

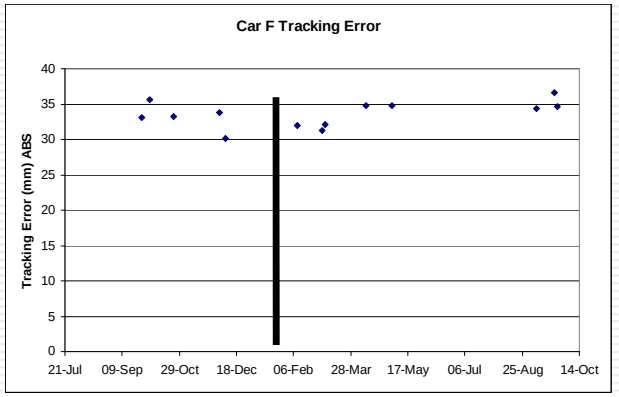
What can fix Tracking Problems?



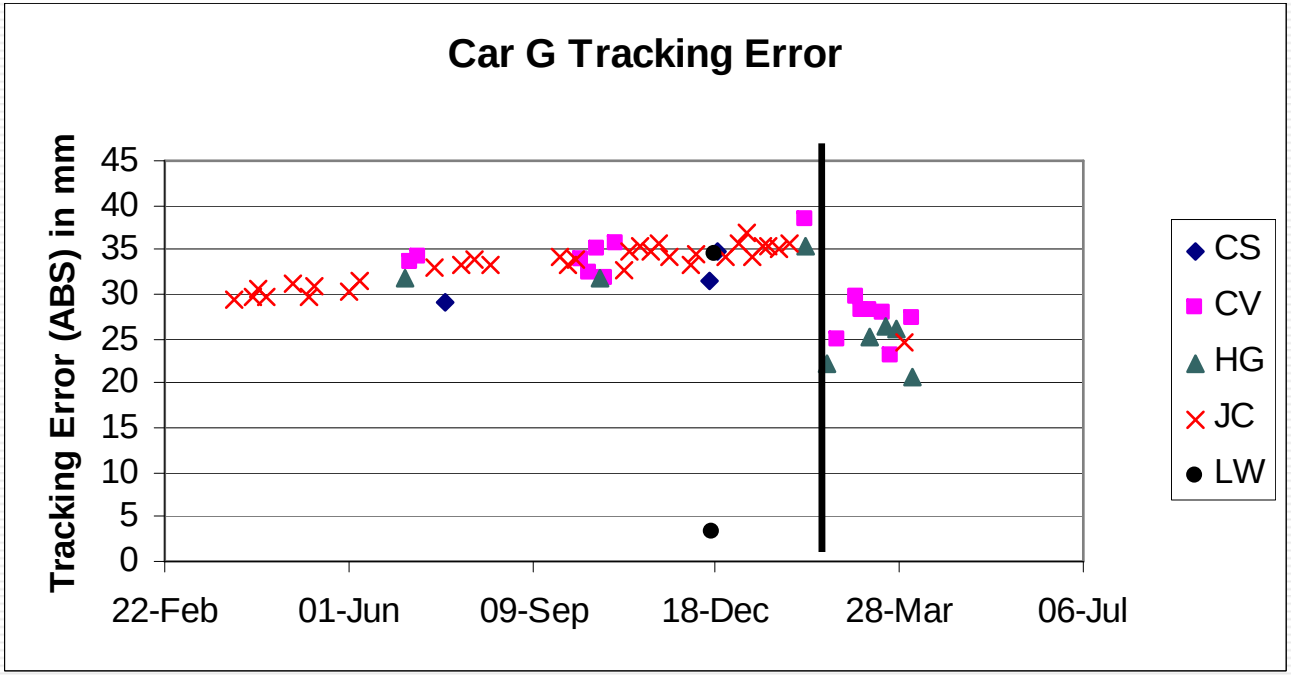
- CSXT 259249 (C113) with S-2-C trucks
  - B Truck Shift = 15 mm
  - Axle 1 Tape Differential – 4 tapes
  - Axle 2 Tape Differential – 3 tapes
  - **After both condemnable axles were replaced, its Shift dropped to ZERO mm**
- **Wheels with EQUAL circumferences solve most tracking problems.**

What doesn't fix Tracking Problems?

- Car F (C113) with S-2-C trucks
  - B Truck Tracking Error = 33.3 mm
  - Axle 3 Tape Differential – 3.5 tapes
  - Axle 4 Tape Differential – 3.5 tapes
- Car was Retrucked – with reconditioned castings, new springs, new friction castings and the SAME MISMATCHED WHEELS.
- B Truck Tracking Error *after* repair shop: 33.8 mm!
- **New Trucks do not fix Tracking Problems!**



Are Tracking Values Repeatable?



Operational & Research Questions

- What comes first? Truck problems or mismatched wheels?
- What is the source of mismatched wheels?
  - Repeated imbalanced loads or overloads?
  - Wheel shop quality issues?
  - Worn out trucks?
  - Unit train operation always running in the same direction?
- If wheels are found with mismatched circumferences, what action is required? Where should we set the condemning limits?

Take Aways

- Optical Geometry detectors with repeat logic are a reliable and useful tool for finding poorly performing trucks and wheelsets.
  - Core problem: mismatched wheel circumferences
  - Root cause: unknown!
- Both newly turned wheels and newly manufactured wheels can exhibit extreme Tracking Positions.
- Optical Geometry data will be available from ATSI in the future.