Geometry Detector Teardown Results

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Kim Bowling
What is a Geometry Detector?
Principle of Operation

- Angle of Attack (mrad)
- Tracking Position or TP (mm)
A Few Definitions…

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

<table>
<thead>
<tr>
<th>Metric</th>
<th>Above 20 mm</th>
<th>Above 25 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracking Error</td>
<td>2.8%</td>
<td>.8%</td>
</tr>
<tr>
<td>Shift</td>
<td>3.0%</td>
<td>.4%</td>
</tr>
</tbody>
</table>
Teardown Methods
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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!

Diagram:

- Moderate Left Tracking
- Moderate Left Tracking
Pattern #3: Individual Axles

Tracking Error was 31.7 mm.

Tracking Position was 32.3 mm!!
**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?

Car G Tracking Error

Tracking Error (ABS) in mm

- CS
- CV
- HG
- JC
- LW

Dates:
- 22-Feb
- 01-Jun
- 09-Sep
- 18-Dec
- 28-Mar
- 06-Jul
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.