Effects of Wheel-Rail Profile Design and Maintenance on Wheel-Rail System Performance

Vehicle / Track Systems Research

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October 6, 2015

Maximize Life of Wheel and Rail

- **Challenges addressed by SRI 1A**
  - Wear and fatigue
  - Fuel costs — rolling resistance

End products: Optimized profiles, grinding, reprofiling

Maximize Safety
Prevent Derailments

- **Challenges addressed by SRI 1A**
  - Wheel climb derailments
    - At switch-point protector
    - At worn yard switch points
  - Rail rollover derailments due to reverse rail cant

End Product: Recommendations to prevent wheel-rail interface related derailments

SRI 1A Current Work

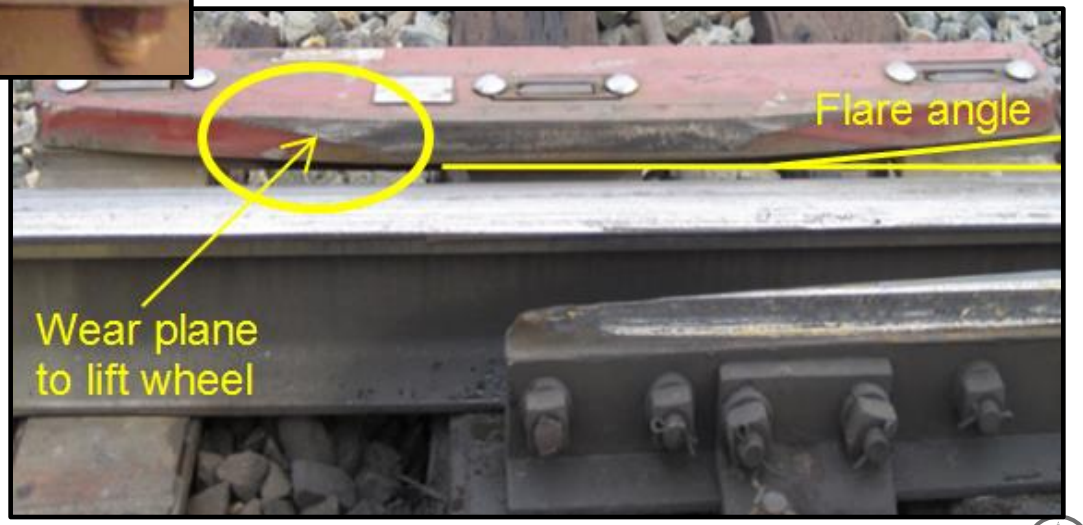
Specific Topic	Status
Derailment of locomotive wheel chamfer at switch point protector	Investigation completed, resolution underway
Wheel climb at worn yard switch points	Investigation completed
Reverse rail cant	Rail roll tests complete
SRI 1A wheel profile	Analysis of revenue service test underway
Survey of current rail grinding practices	Survey completed

Wheel Chamfer / Switch Point Protector

- **Increased risk of wheel climb at worn switch point protector with large locomotive wheel chamfer**

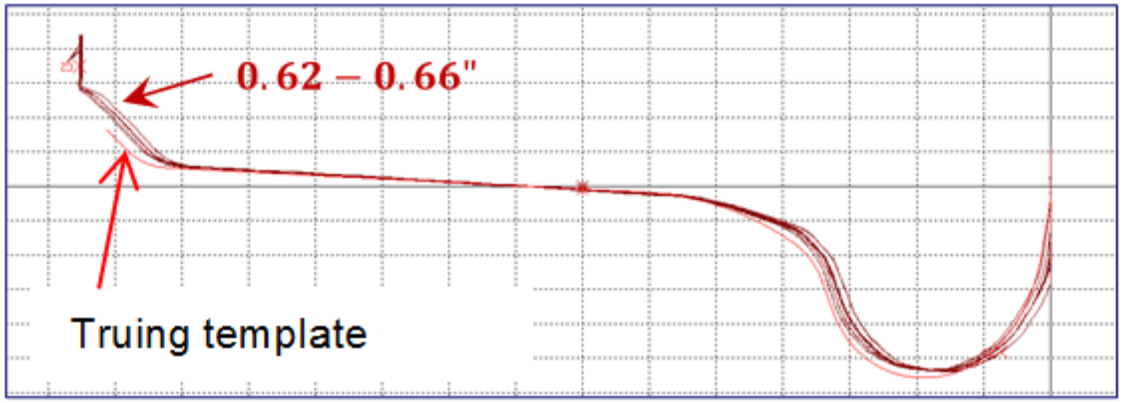
- **Chamfer issues**
  - Wheel width
  - Cutter head position
  - Chamfer size, shape

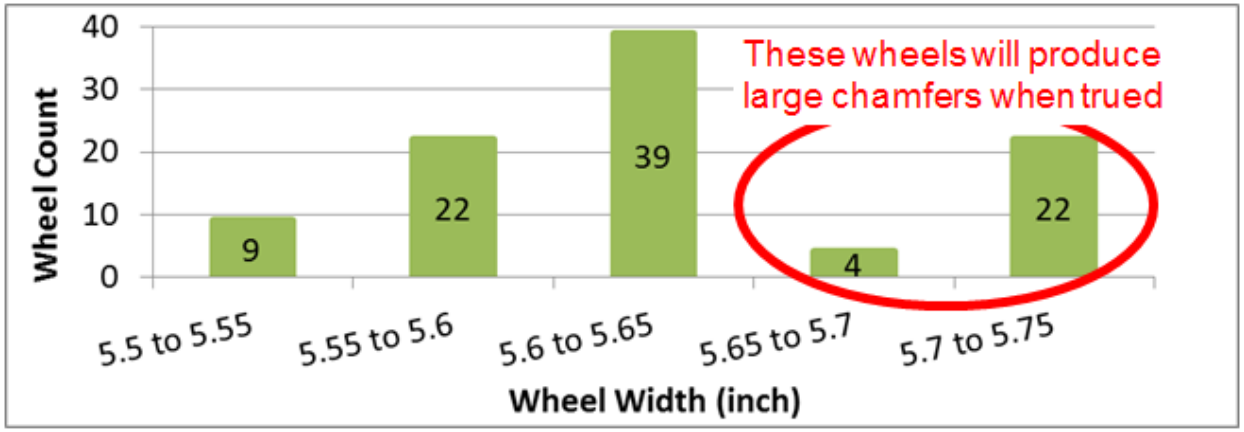
- **Protector issues**
  - Worn ramp for climb
  - Flare angle
  - Initial hardness

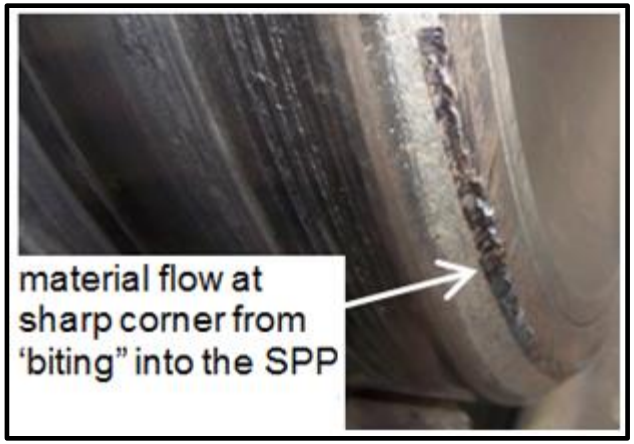


Wheel Chamfer / Switch Point Protector (SPP)

- Wheel cutter heads designed for narrow wheels: 5.563, 5.625 inch
- Lateral alignment of wheel and cutter head





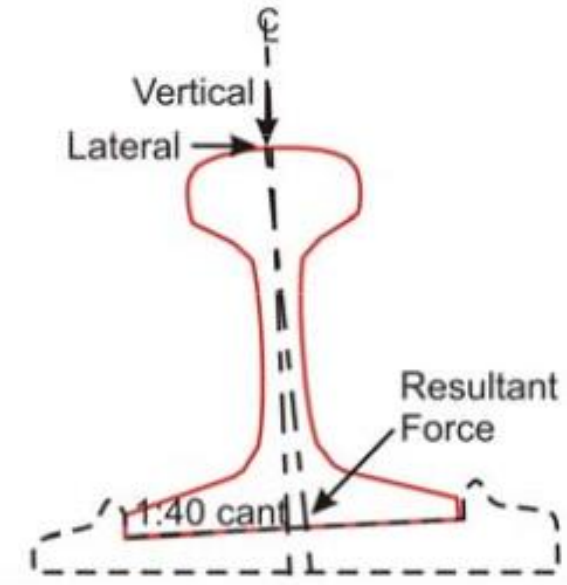


Wheel Chamfer / Switch Point Protector

- **Short term recommendation**
  - Additional training regarding optimal locomotive wheel cutter head lateral positioning and its importance
- **Longer term**
  - TTCI working with AAR committees to reduce variation in permissible locomotive wheel widths
    - Less variation in wheel width = smaller chamfers
  - Discuss switch point protectors with AREMA

Rail Reverse Cant

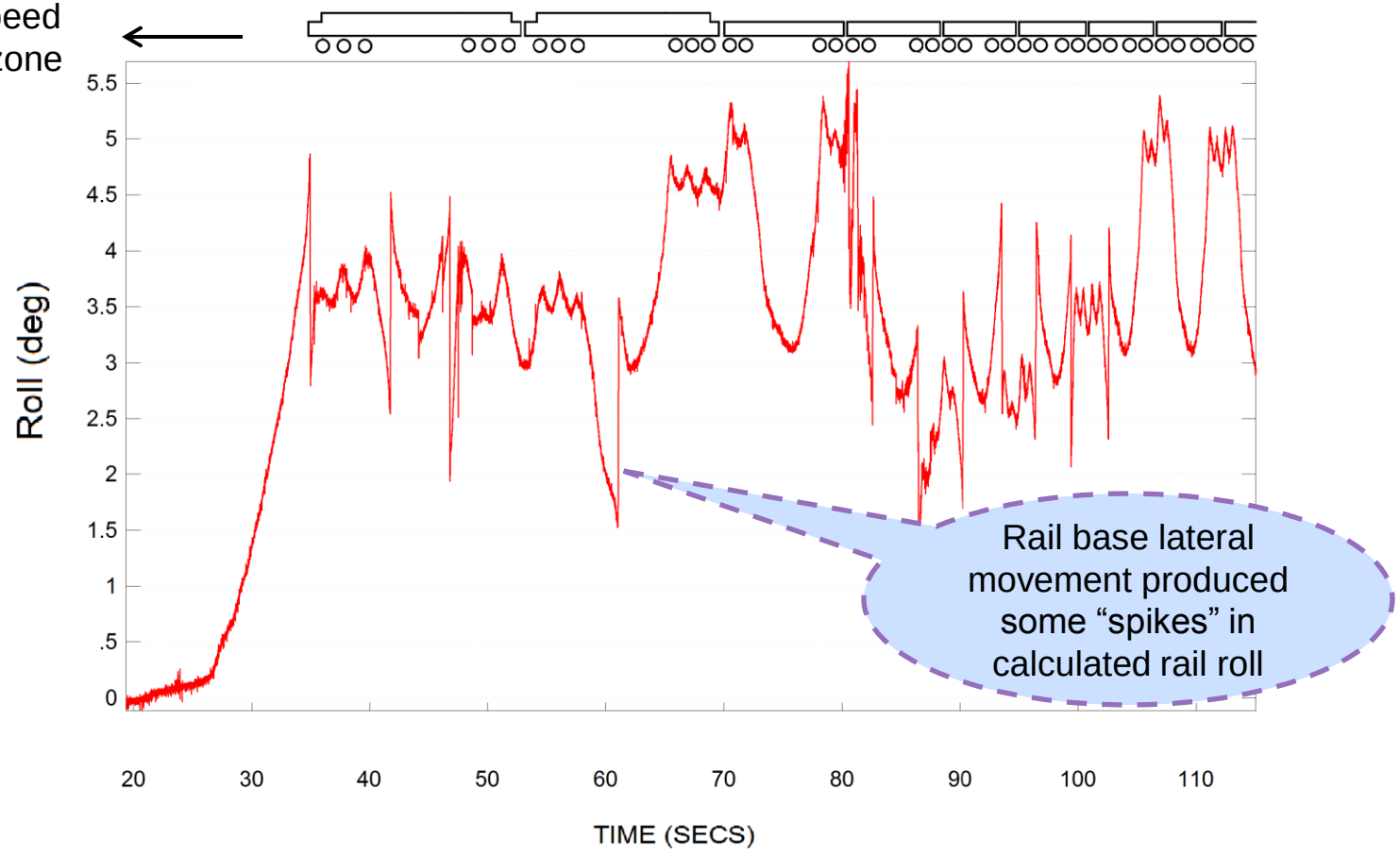
- **Rail profile issues when ground with reverse cant**
- **Rail roll measurement tests**
  - Track geometry car versus actual cants under traffic
  - Tested 3 sites with a variety of fastening systems
    - Wood ties/curve blocks
    - Wood ties/cut spike
    - Wood ties/elastic fasteners



Rail Reverse Cant

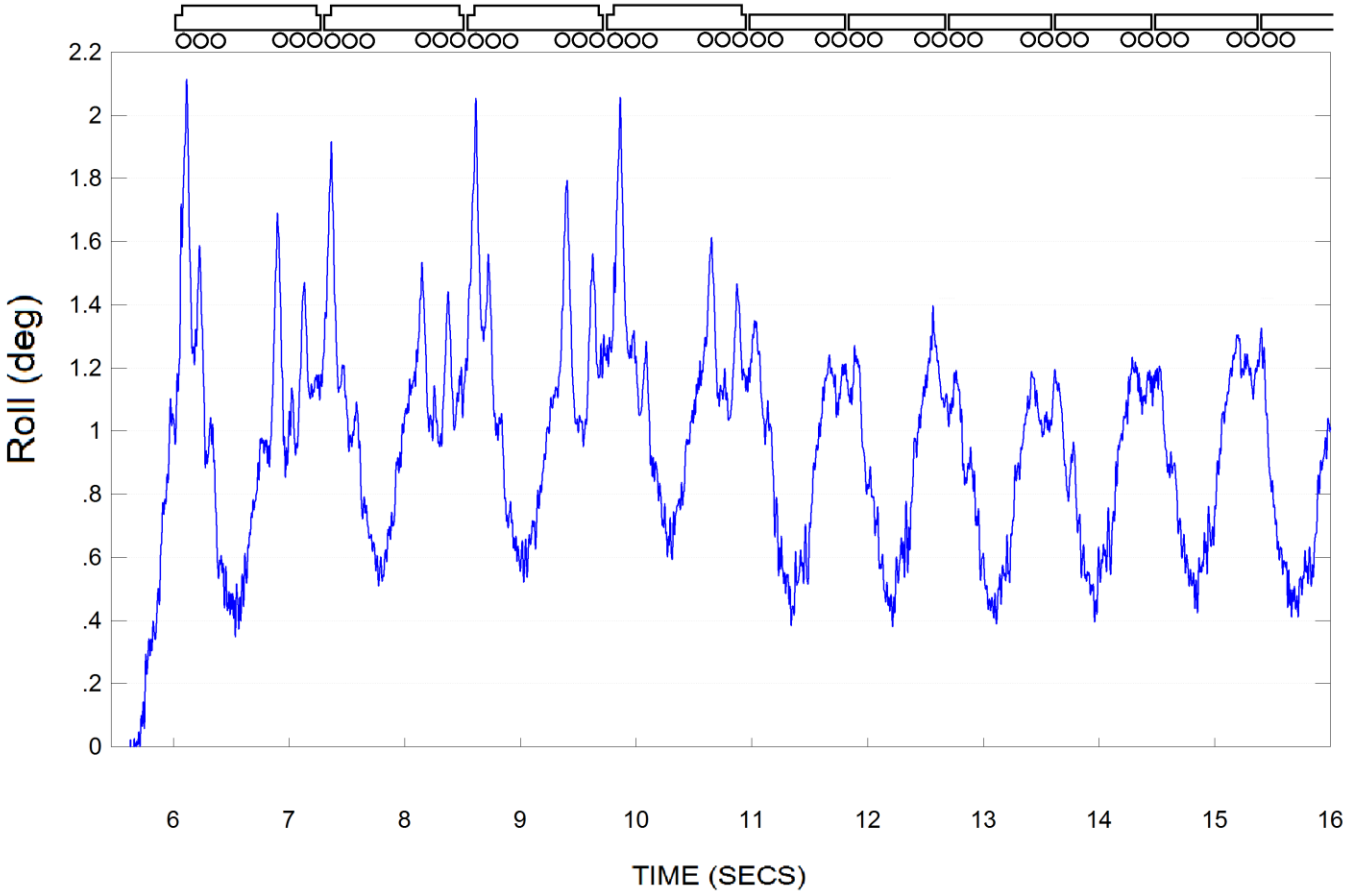
- **Low Rail — wood ties/curve blocks**
  - Track geometry car reported 3.4 degrees
  - Max. test value = 5.3 degrees (-0.4 deg. static + 5.7 deg. dynamic)

Increasing speed through test zone



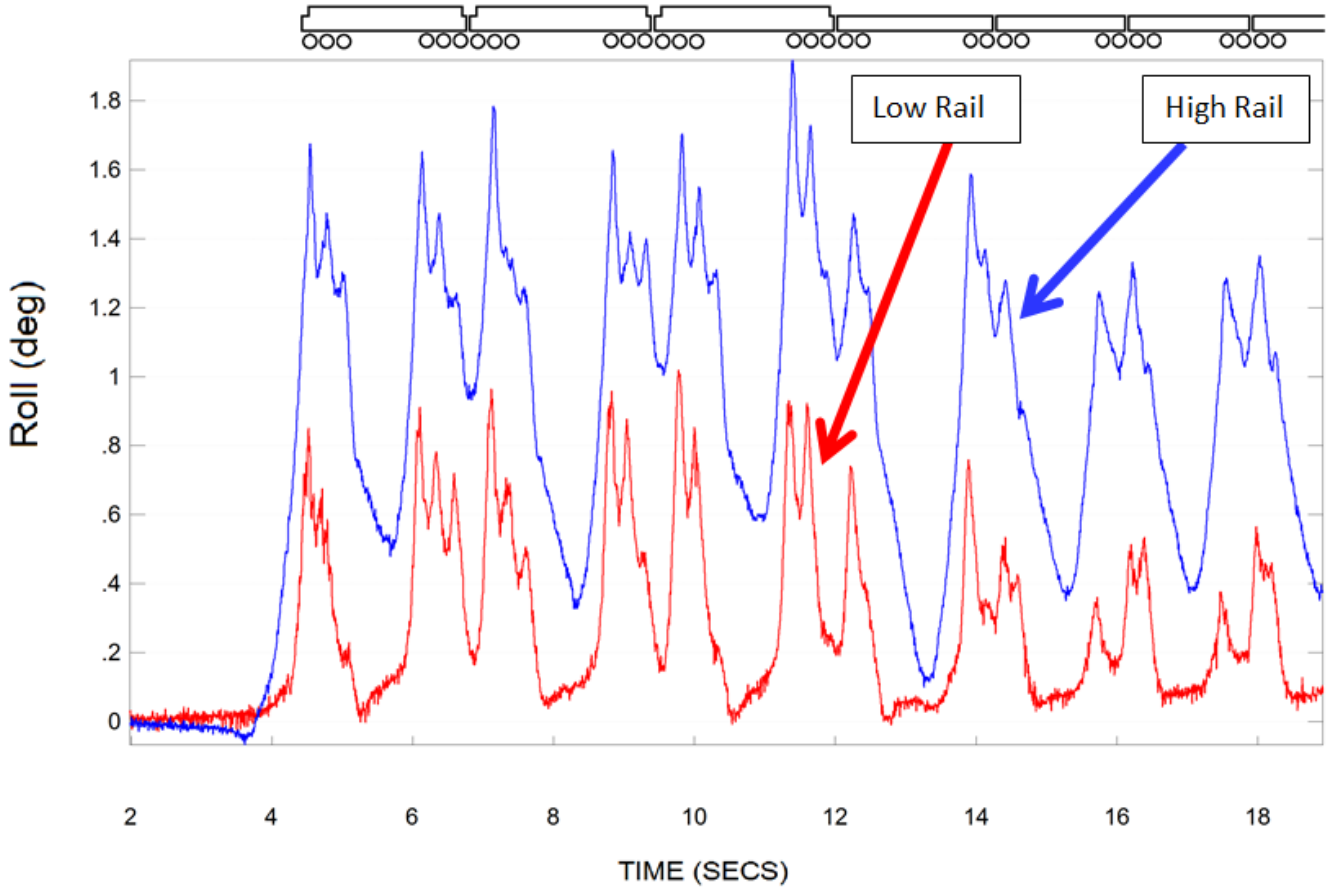
Rail Reverse Cant

- **High Rail — wood ties/cut spikes**
  - Track geometry car reported 3 degrees
  - Max. test value = 4.1 degrees (2.0 deg. static + 2.1 deg. dynamic)



Rail Reverse Cant

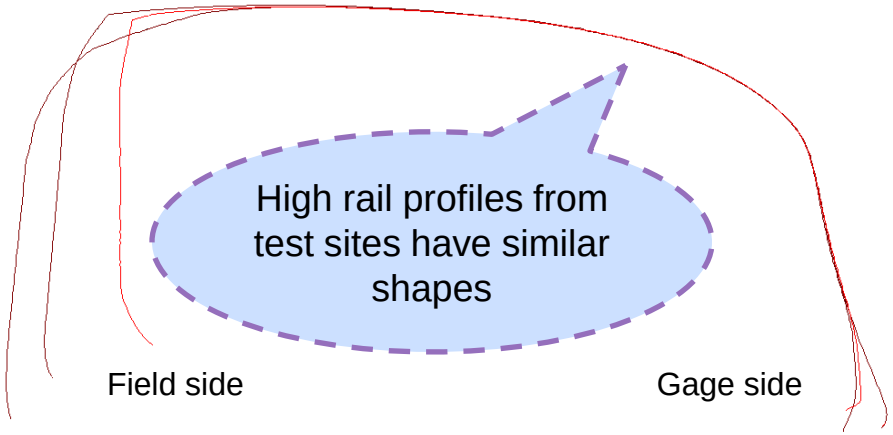
- **High Rail — wood ties/elastic fasteners**
  - Track geometry car reported 3.3 degrees
  - Max. test value = 3.4 degrees (1.5 deg. static + 1.9 deg. dynamic)



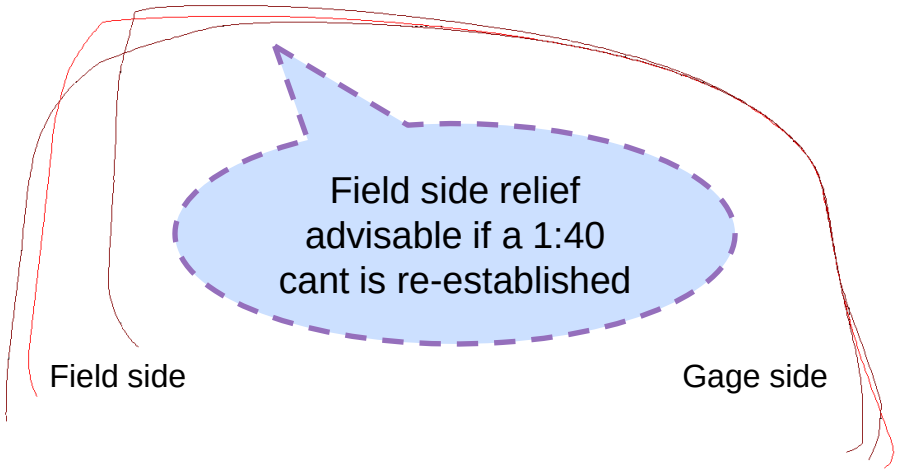
Rail Reverse Cant

- **Summary from three test sites**
  - Tie condition, tie plate cutting, rail seat wear, spike lift
  - Reasonable agreement between maximum measured rail roll and value reported by track geometry car (typically averaged over some distance)
  - Rail profiles showed some indication of repetitive wear and grinding in a canted position

<u>High rail profiles as measured</u>

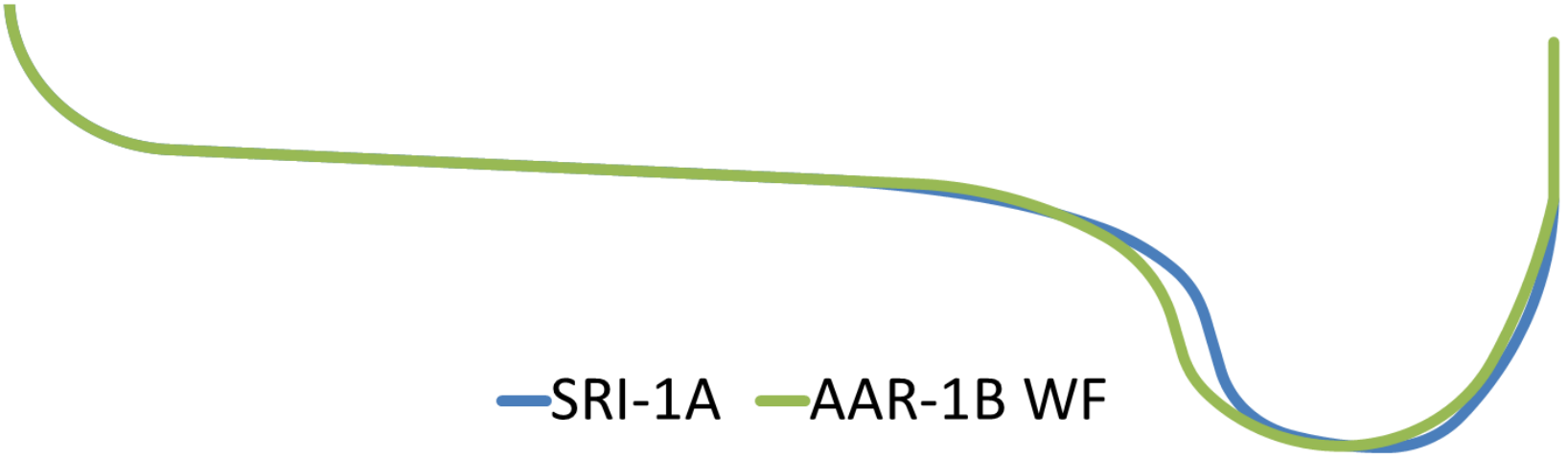


<u>Set upright (1:40 cant)</u>



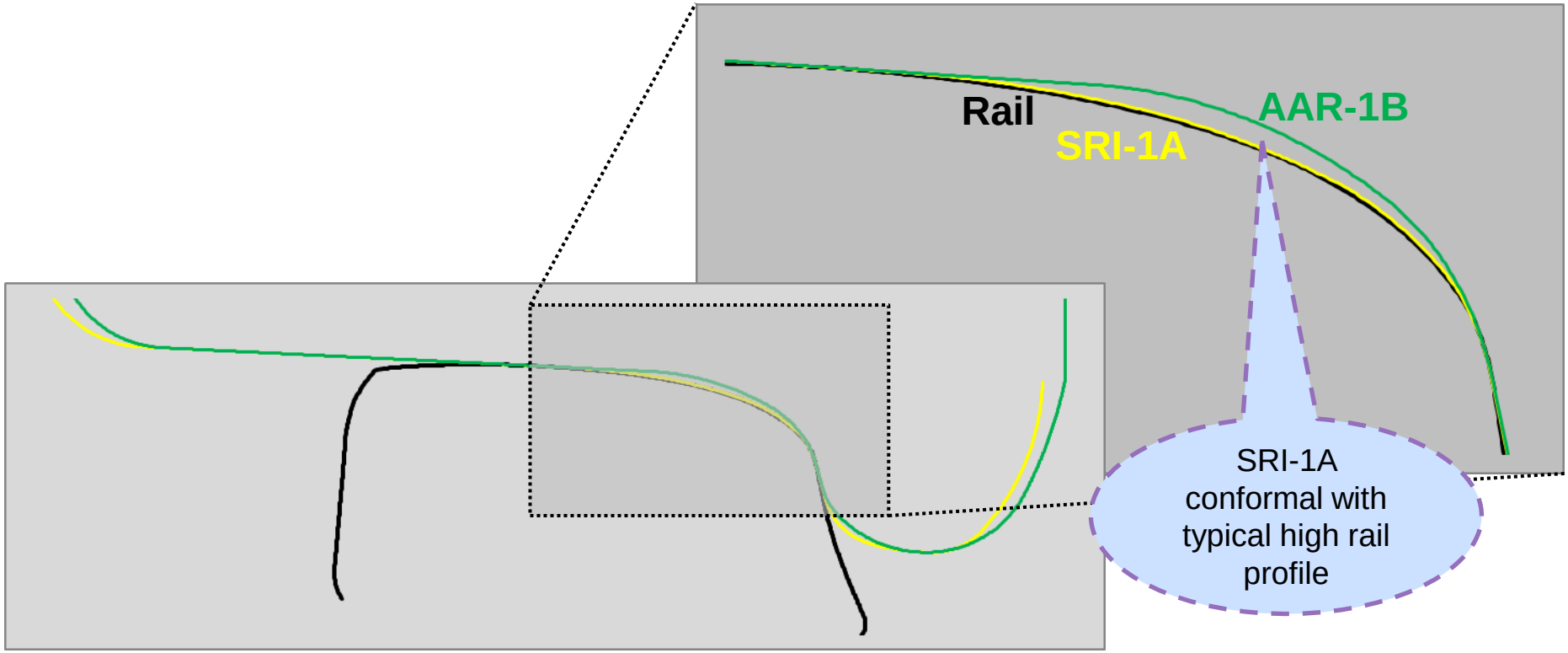
SRI-1A Wheel Profile Implementation

- **SRI-1A Wheel profile = improved steering in curves**
  - Fuel economy
  - Rail wear
  - Rail rolling contact fatigue
  - Wheel rolling contact fatigue



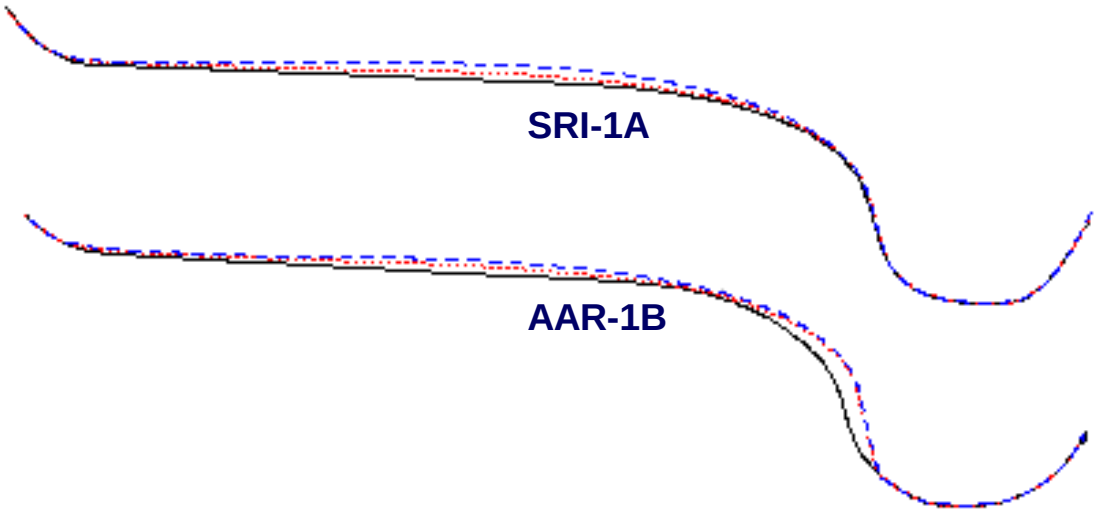
SRI-1A Wheel Profile Implementation

- **SRI-1A starts with a high rail conformal profile**
- **AAR-1B must wear to a high rail conformal profile**
  - Undesirable severe 2-point contact, poor steering



SRI-1A Wheel Profile Implementation

- **Typical wear patterns**
  - SRI-1A little flange wear
  - AAR-1B heavy early flange wear
  - Both profiles wear to a common similar shape



SRI-1A Wheel Profile Implementation

- **Revenue service implementation test**
  - First round
    - One 5-pack intermodal car, ten 110-ton coal cars
    - Found reduced wheel wear and reduced asymmetric wheel flange wear
    - Found reduced wheel-rail forces early in wheel life
  - Second round
    - 75 grain hoppers with SRI-1A (75 comparison cars)
    - 25 grain hoppers with SRI-1A (25 comparison cars)
    - Receiving data from wayside detectors
  - Looking to increase implementation
    - 1,000 car sets of SRI-1A wheel profile approved by Arbitration Committee

Summary and Next Steps

Specific Topic	Finding	Next Step
Derailment of locomotive wheel chamfer at switch point protector	Wheel chamfer size & shape, protector geometry are critical	Follow up with AAR committees and AREMA for changes
Wheel climb at worn yard switch points	Mechanical devices advisable for worst case switches	N/A
Reverse rail cant	Max. cant under train ≥ cant under TG car	Publish results
SRI 1A wheel profile	SRI 1A reduces curving forces and early wear	Progress towards full implementation
Survey of current rail grinding practices	Template age, preventative grinding	Publish results