Wheel/Rail Interface
A Meeting in St. Louis

Presented by

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MetroLink System Overview

- System Alignment and Background
- Rolling Stock
- Trackwork

Purpose and Need

Wheel/Rail Interface Study

- Initial Conditions and Indicators
- Recommendations
- Implementation
- Results and Projections (so far)

Conclusions

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Metro St. Louis System Alignment

System Alignment & Background

- 46 miles predominantly double-tracked (single track only between two airport stations)
- Red Line is 38 miles long from Lambert Intl. Airport to Scott AFB (comprises phase 1 and phase 2 construction)
- Cross County Branch is 7.6 miles (also referred to as phase 3)
- All stations are high platform
- All dedicated ROW – No shared traffic/street running
- Cab Signal/ATP – Top speed code is 55 mph
- Average system speed is 30 mph

Rolling Stock

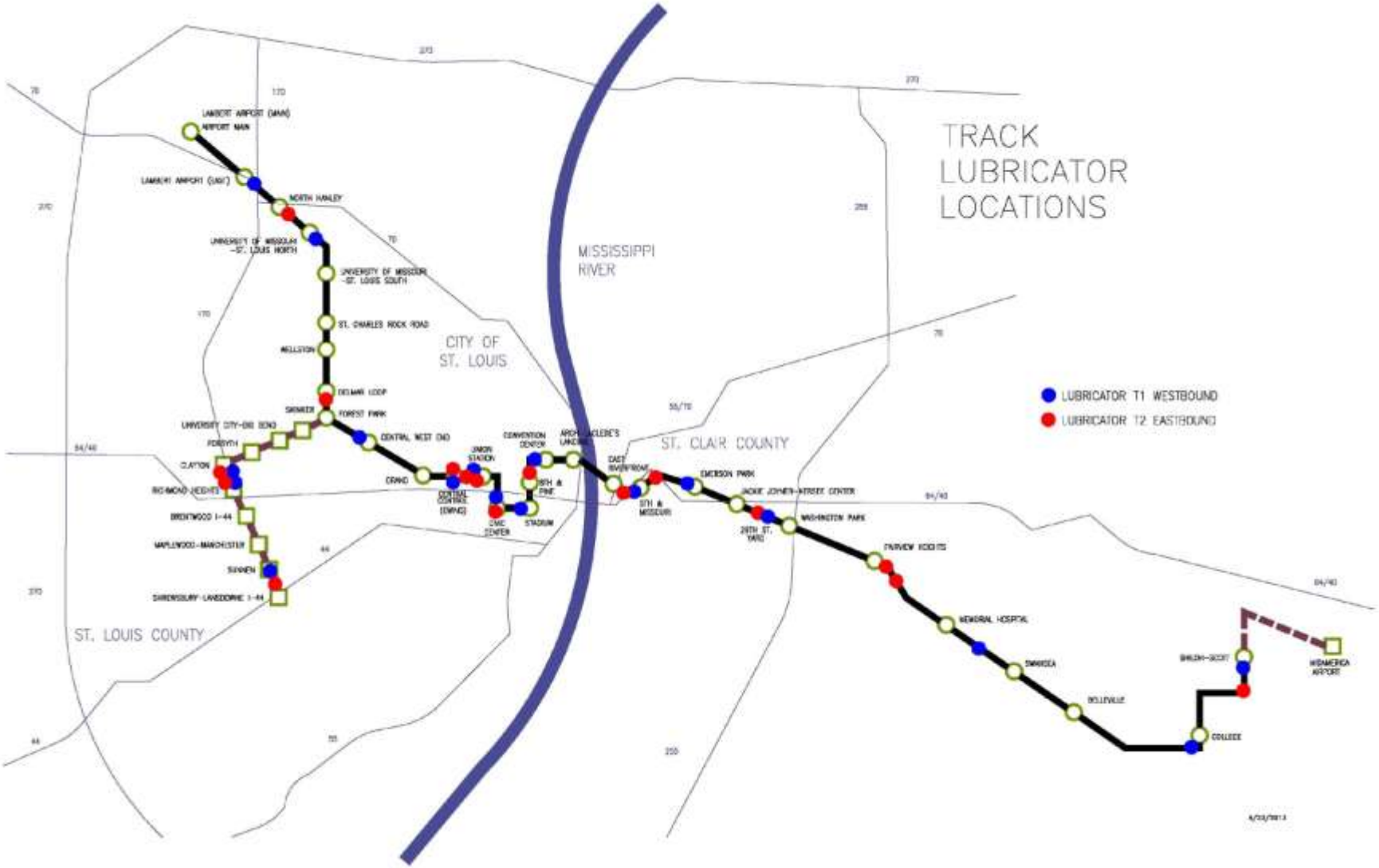
- 87 LRV fleet (all Siemens)
- 31 DC mono-motor LRVs
  - 1000 series delivered 1992-93
  - Accumulated 1.3M miles/LRV
- 56 AC bi-motor LRVs
  - 2000/3000 series delivered 1999-2000 (34)
  - Accumulated 1M miles/LRV
  - 4000 series delivered 2005-06 (22)
  - Accumulated 600K miles/LRV

Trackwork

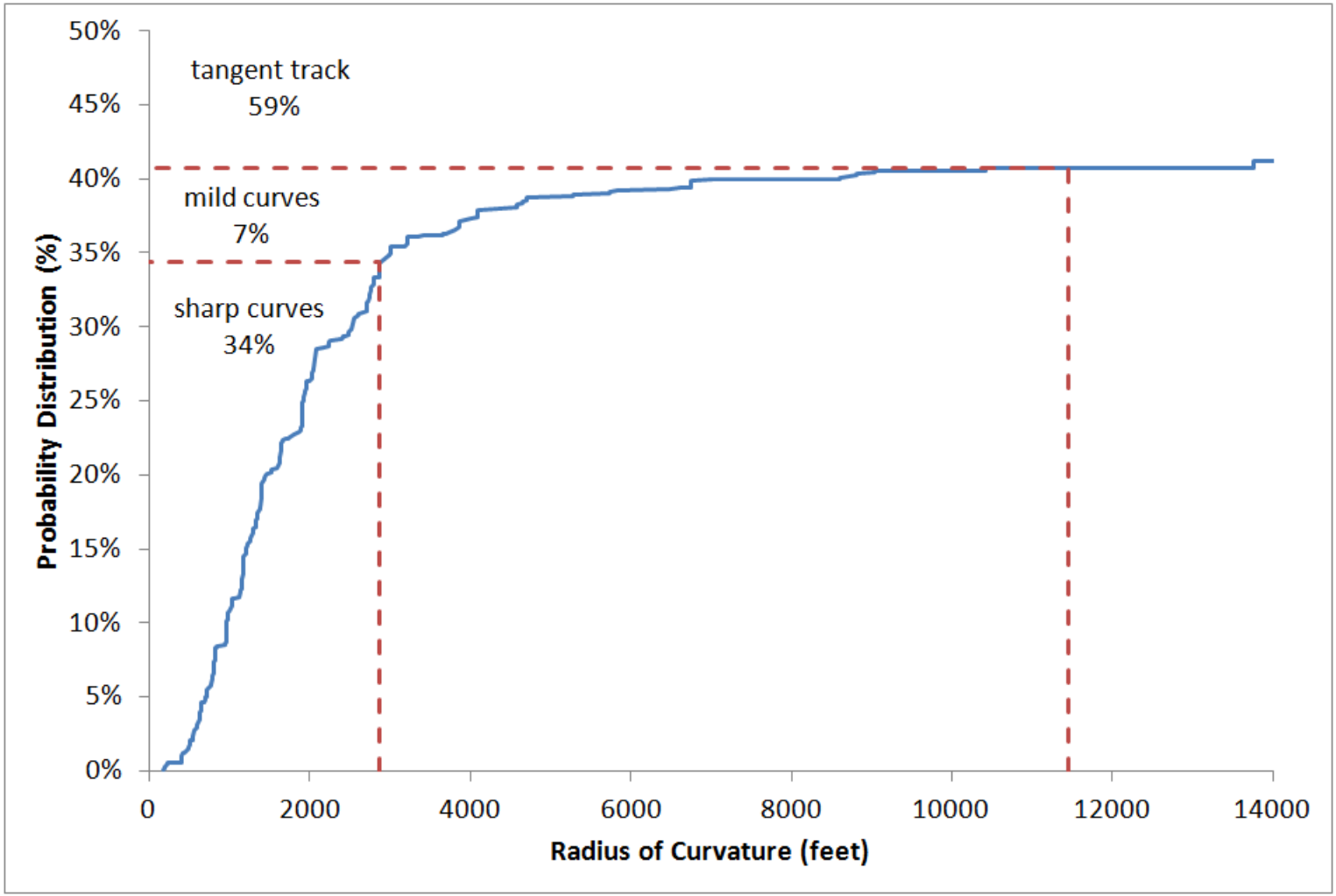
- Phase 1 (Lambert Airport to East St. Louis)
  - Initially used RE132 relay rail and wooden ties
  - Rail being replaced with RE115 and concrete sleepers
- Phase 2 and 3 (rest of the system)
  - Built with new RE115 and concrete ties
- Wayside track lubrication in tight curves
- Rail cant of 1:40

Trackwork by Construction Phase

Wayside Lubricator Locations



Track Distribution



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Purpose and Need

Customer and Operator Issues

- Ride quality perceived to be deteriorating over time
- Qualitative reports of poor ride quality from customers and operators increasing
- Noise levels perceived to be increasing over time

Phase Specific Issues

- Ride quality and noise issues generally more pronounced on the older section of track (Phase 1 construction)
- Ride quality was noted to be an issue in areas of Phase 2 construction as well
- Phase 3 construction did not exhibit ride quality or noise issues

Maintenance Issues

- Regular on-going wheel maintenance consisted of wheel true every 50,000 miles
- System-wide rail maintenance grinding had not been regularly planned – often reactive but good enough
- Recognized the need for developing and implementing a regular rail maintenance grinding program
  - Need to define optimal rail profile(s)
  - Defined optimal wheel profile

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- Recommendations
- Implementation
- Results and Projections (so far)

Initial Conditions & Indicators

- Localized areas with degraded rail conditions - Corrugations

Initial Conditions & Indicators

- Localized areas with degraded rail conditions – Multiple contact paths

Initial Conditions & Indicators

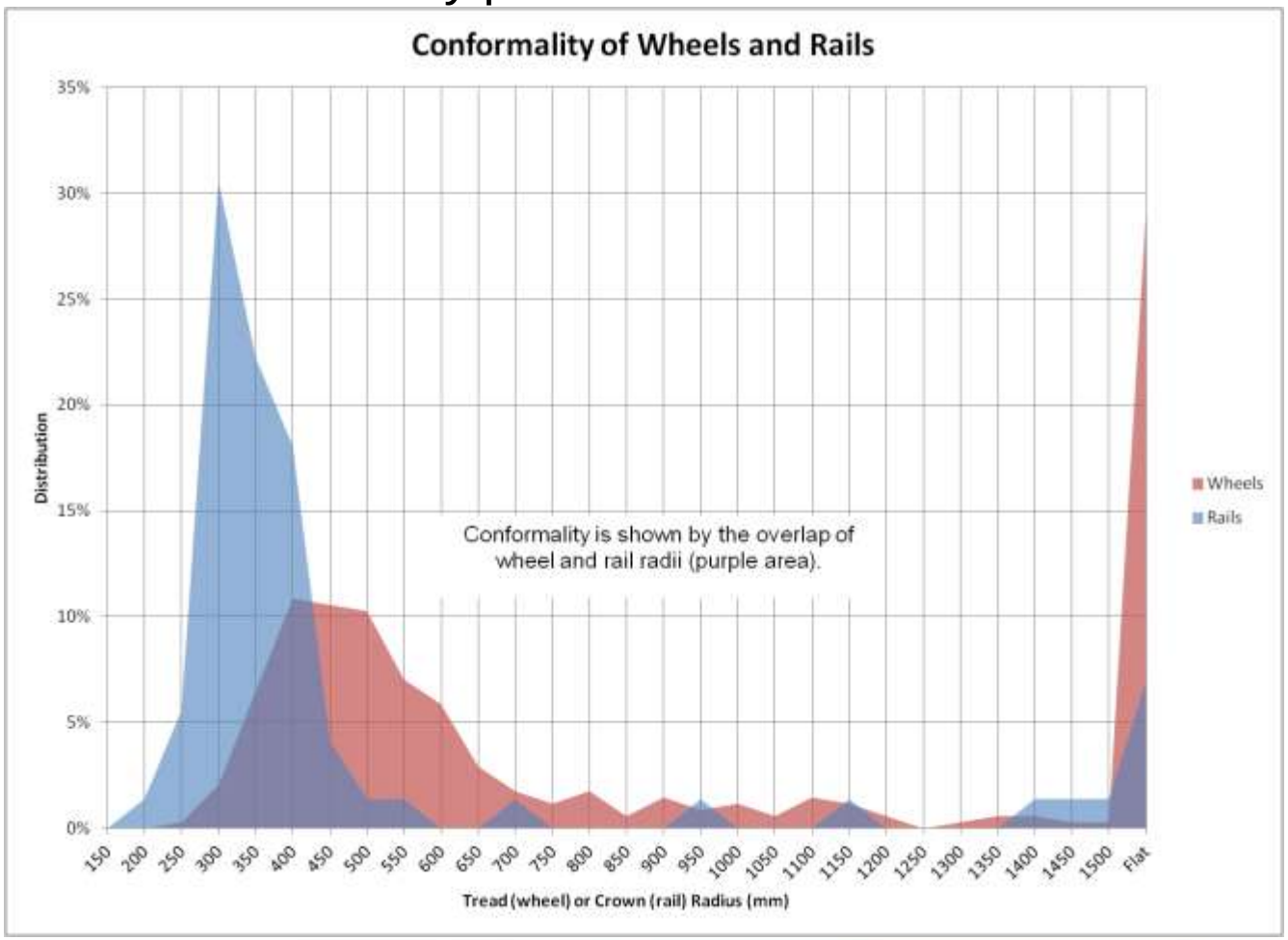
- Single contact path is better, but corrugation is present

Initial Conditions & Indicators

- Localized areas with degraded rail conditions - Corrugations

Initial Conditions & Indicators

- Wheel/Rail Conformality present



Initial Conditions & Indicators

- Tight gage is present both Phase 1 and Phase 2 of the alignment (approximately 38 miles total)
- Approximately 75% of Phase 1 and 2 combined is below 56.5 in.
- In Phase 1, 40% of the track is below 56.5 in.
- All of Phase 2 is under 56.5 in.

Initial Conditions & Indicators

- Noise level readings in cab (in dBA)

	Origination	Destination	A-Wgt Noise (before)
Redline WB Average	Shiloh Scott	Lambert Main Terminal	77.13
Redline WB Avg. Phase 1	5th and Missouri	Lambert Main Terminal	76.63
Redline WB Avg. Phase 2	Shiloh Scott	5th and Missouri	78.11
Redline EB Average	Lambert Main Terminal	Shiloh Scott	77.32
Redline EB Avg. Phase 1	Lambert Main Terminal	5th and Missouri	77.58
Redline EB Avg. Phase 2	5th and Missouri	Shiloh Scott	77.07

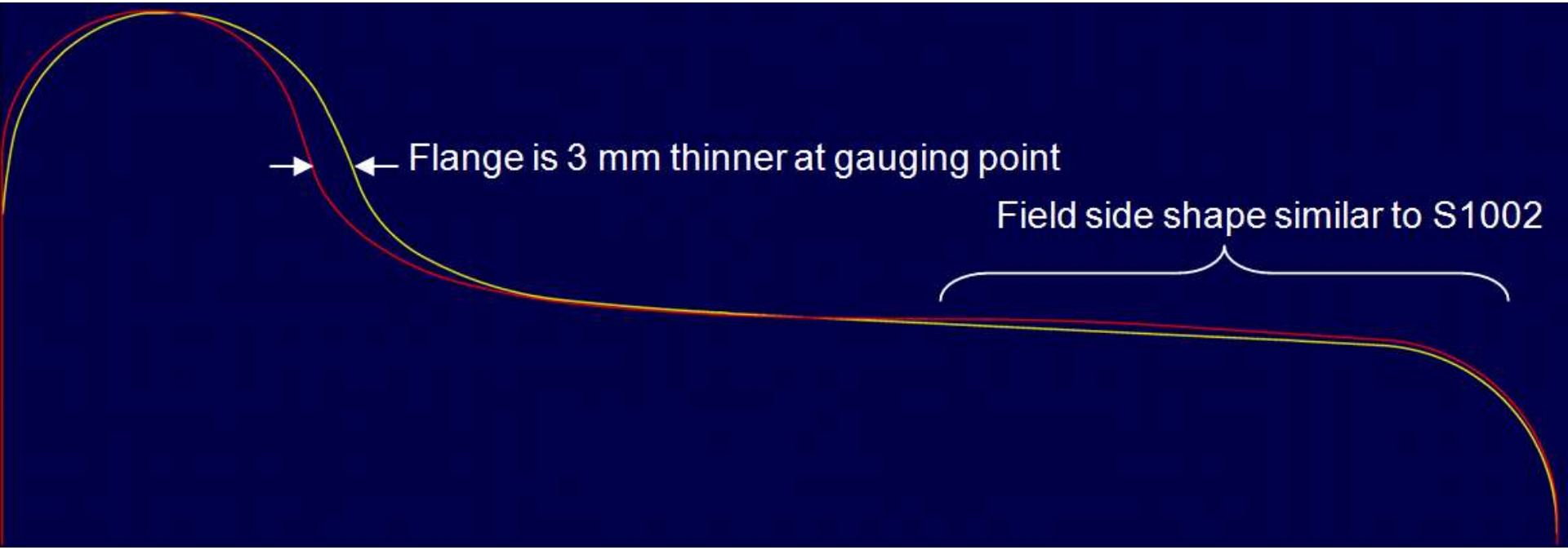
Recommendations

New wheel and rail profiles

- 1 wheel profile and 4 rail profiles
- Address corrugation
- Address hunting
- Improve steering
- Increase wheel and rail life

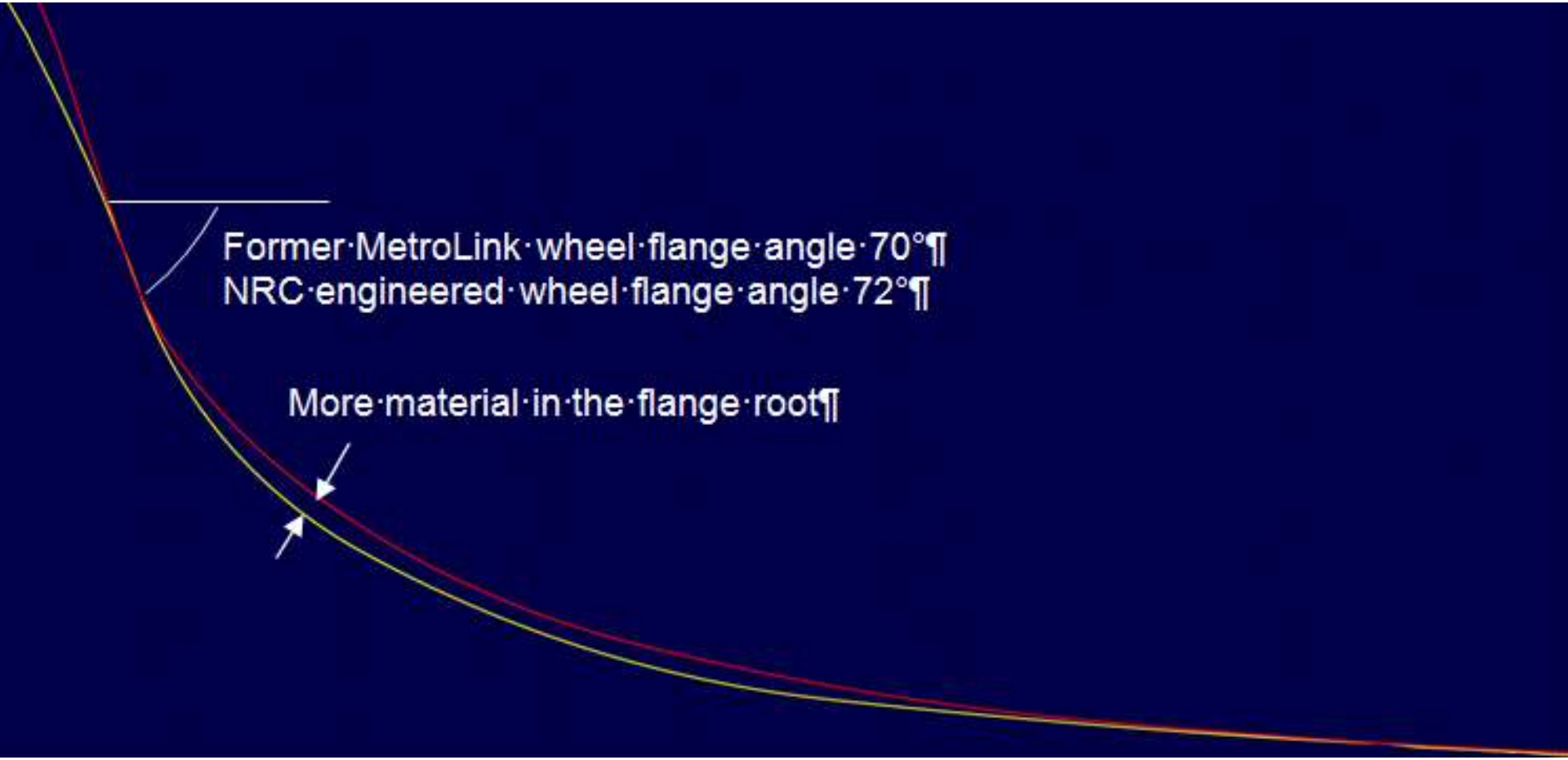
Recommendations

Engineered wheel design



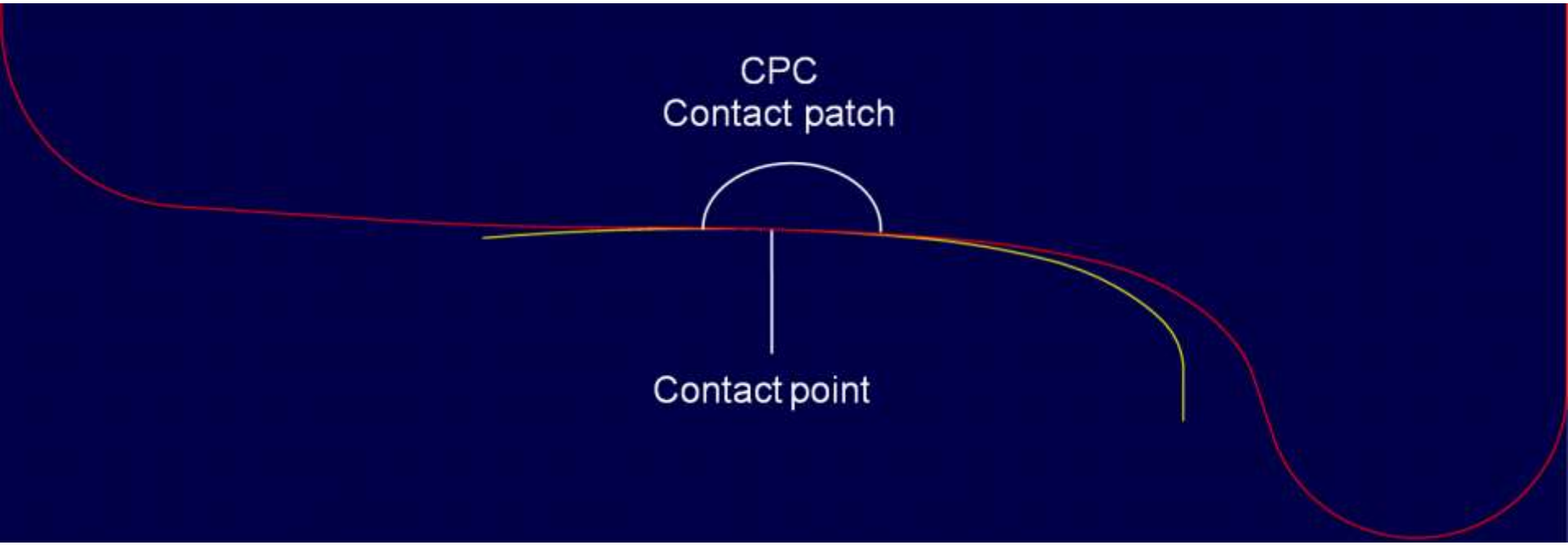
Recommendations

Engineered wheel design



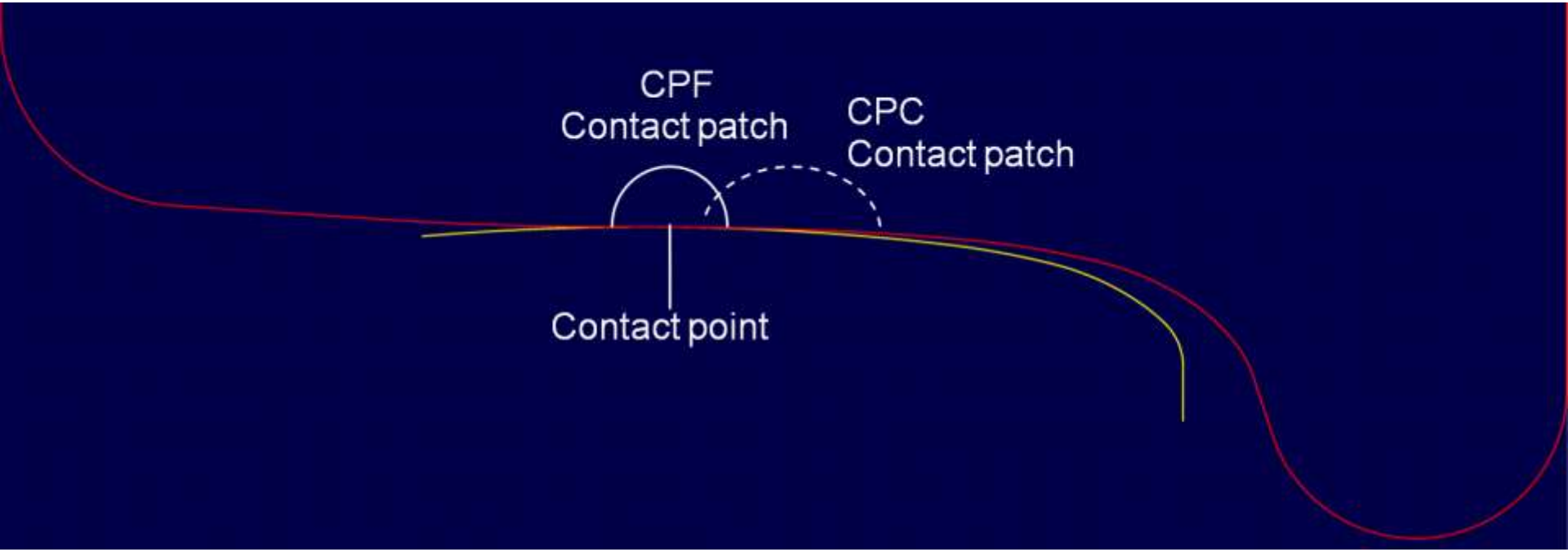
Recommendations

CPC rail profile



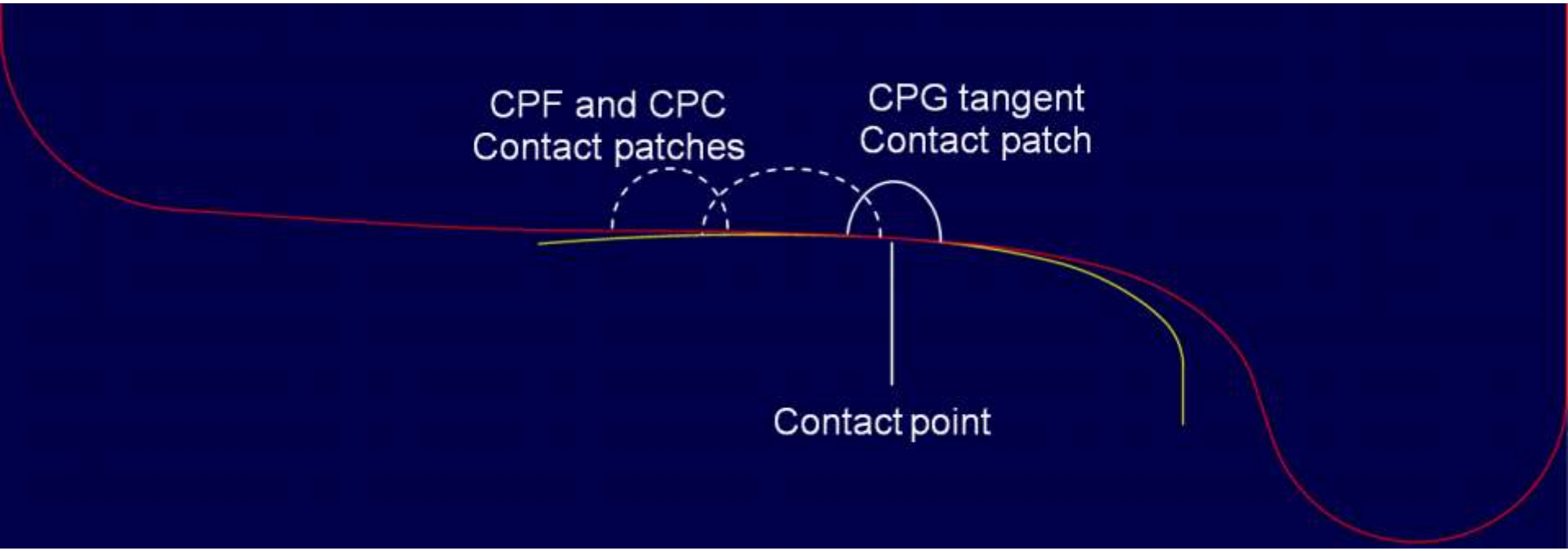
Recommendations

CPF rail profile



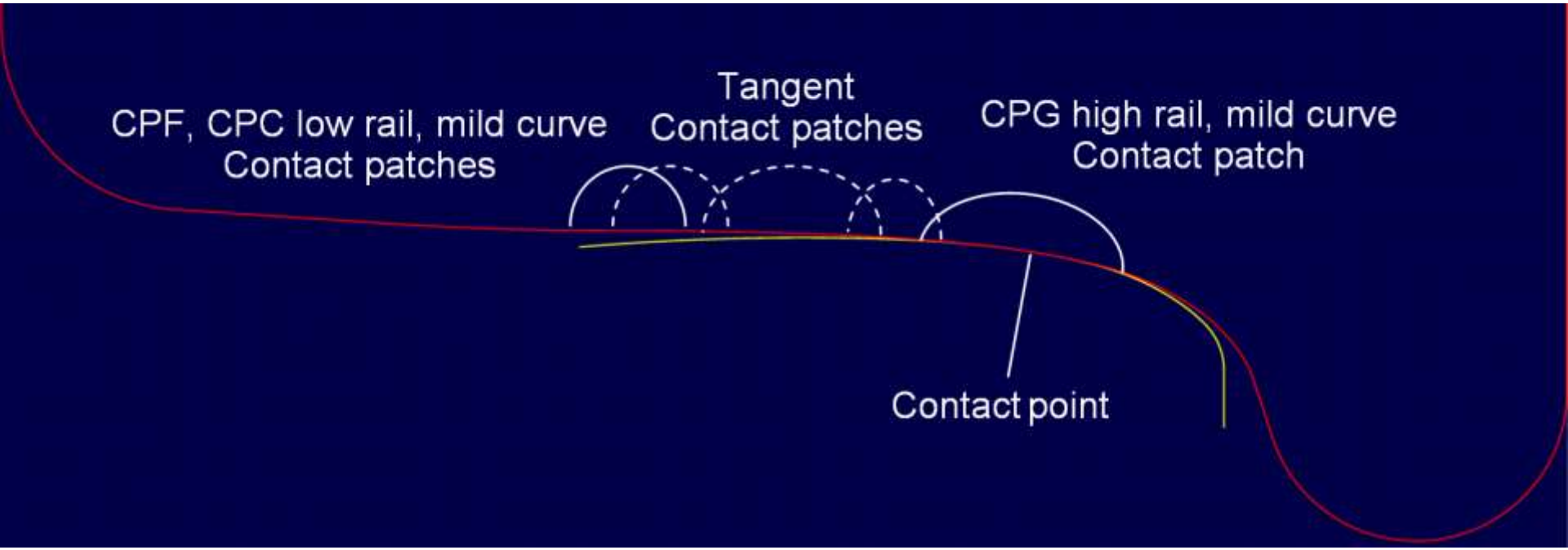
Recommendations

CPG rail profile



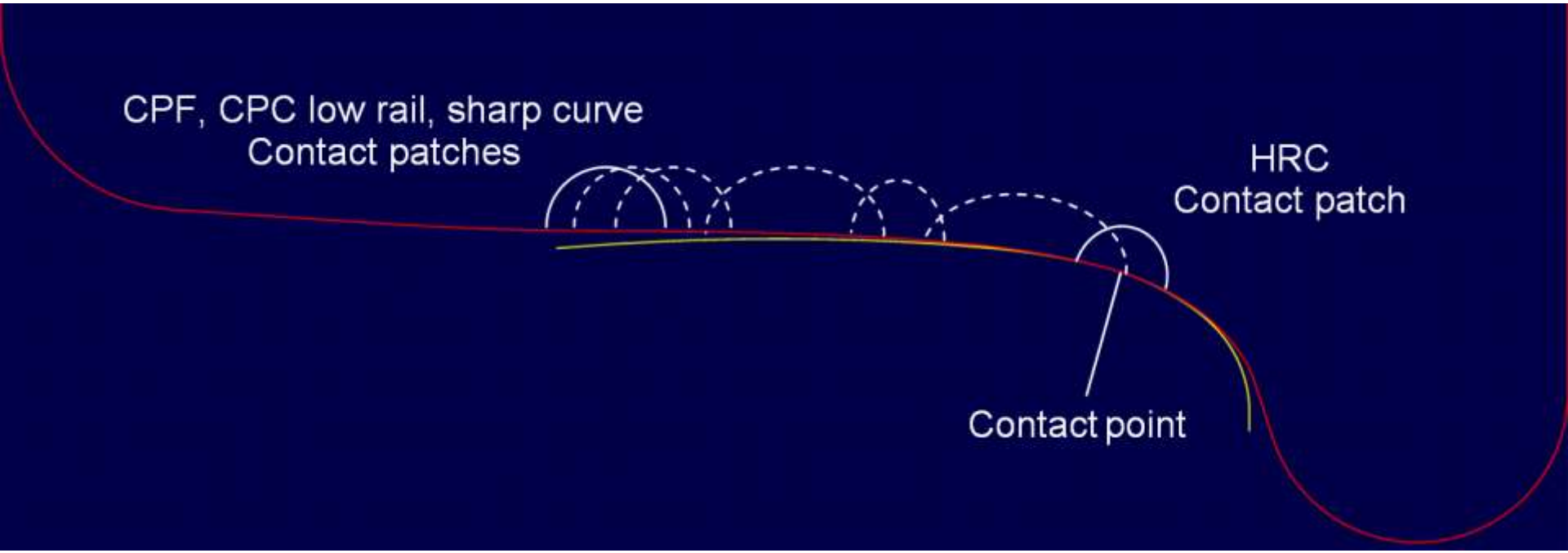
Recommendations

CPG rail profile



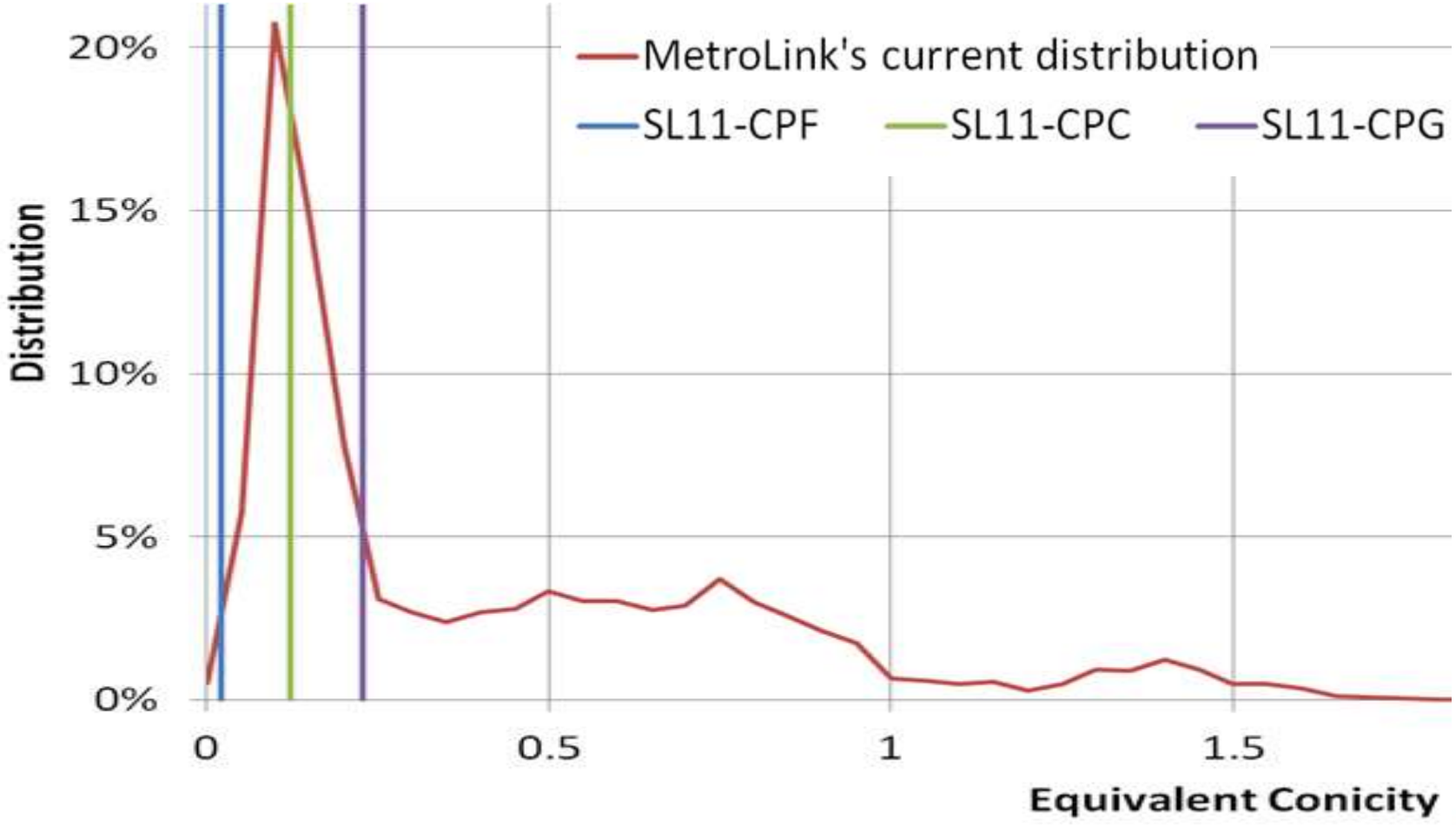
Recommendations

HRC rail profile



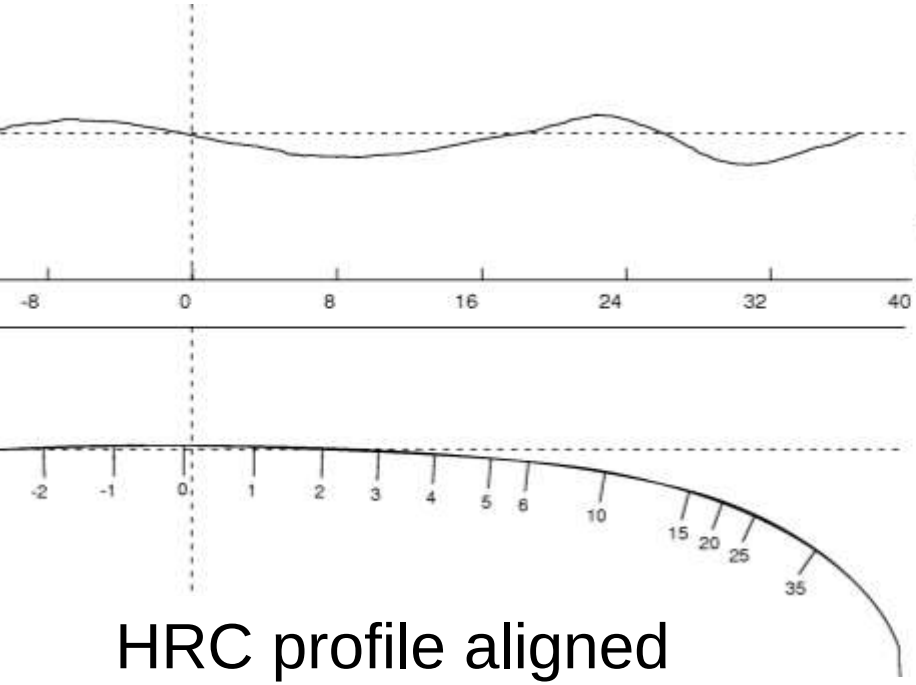
Recommendations

Profile benefits

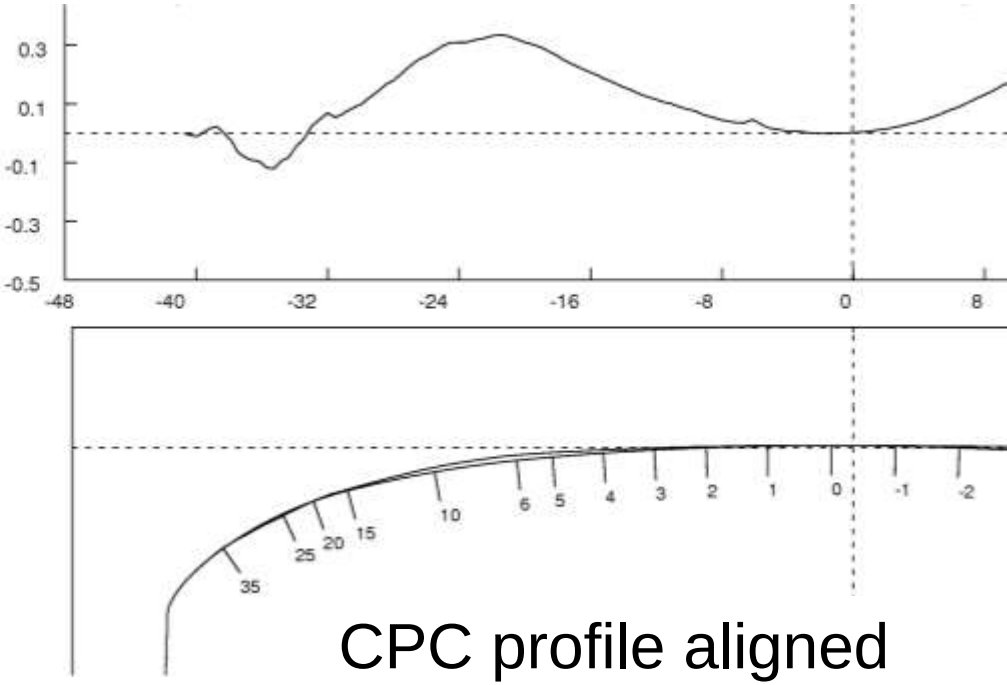


Recommendations

Profile installation



HRC profile aligned to worn high rail



CPC profile aligned to worn low rail

Implementation

- Wheel profiles introduced to all new purchases and re-trued wheels starting in January 2012.
- Rail grinding of Phase 1 and Phase 2 occurred over several months in early 2012.
- Phase 3 rail grinding is planned for next grinding cycle.

Results and Projections (so far)

- Noise measurements in cab (dBA)

	Origination	Destination	A-Wgt Noise (before)	A-Wgt Noise (after)	Noise reduction
Redline WB Average	Shiloh Scott	Lambert Main Terminal	77.13	72.73	4.40
Redline WB Avg. Phase 1	5th and Missouri	Lambert Main Terminal	76.63	72.00	4.64
Redline WB Avg. Phase 2	Shiloh Scott	5th and Missouri	78.11	74.12	3.99
Redline EB Average	Lambert Main Terminal	Shiloh Scott	77.32	73.46	3.86
Redline EB Avg. Phase 1	Lambert Main Terminal	5th and Missouri	77.58	72.91	4.67
Redline EB Avg. Phase 2	5th and Missouri	Shiloh Scott	77.07	74.57	2.50

Results and Projections (so far)

- Tread wear – initial indications project probability of adding 2 – 3 extra truing cycles (essentially increasing wheel life by 100K miles)

Qualitative Results

- Customer complaints have fallen off – none
- Operator complaints have fallen off – none
- Anecdotal reports are positive

Contents

Conclusions

Conclusions

- Wheel/Rail Interface Issue – Lessons learned
  - Wheel maintenance cannot compensate for rail maintenance and vice versa. Must address both as part of a system-wide preventive maintenance program.
  - Emphasize quality initial track installation
- Short term benefits – initial benefits positively affect noise and ride quality

Conclusions

- Long term benefits
  - Planned rail maintenance becomes a more familiar entity
  - Extended wheel life is possible (need more data to confirm)

Credits

- NRC Canada (Alex Woelfle & Robert Caldwell) – Engineering
- ATS Consulting (Andy Wong) – Acoustical evaluation
- Alpha Gamma Transform – Track & metallurgy analysis
- ARM (Gordon Bachinsky) – Program Management

Wheel/Rail Interface
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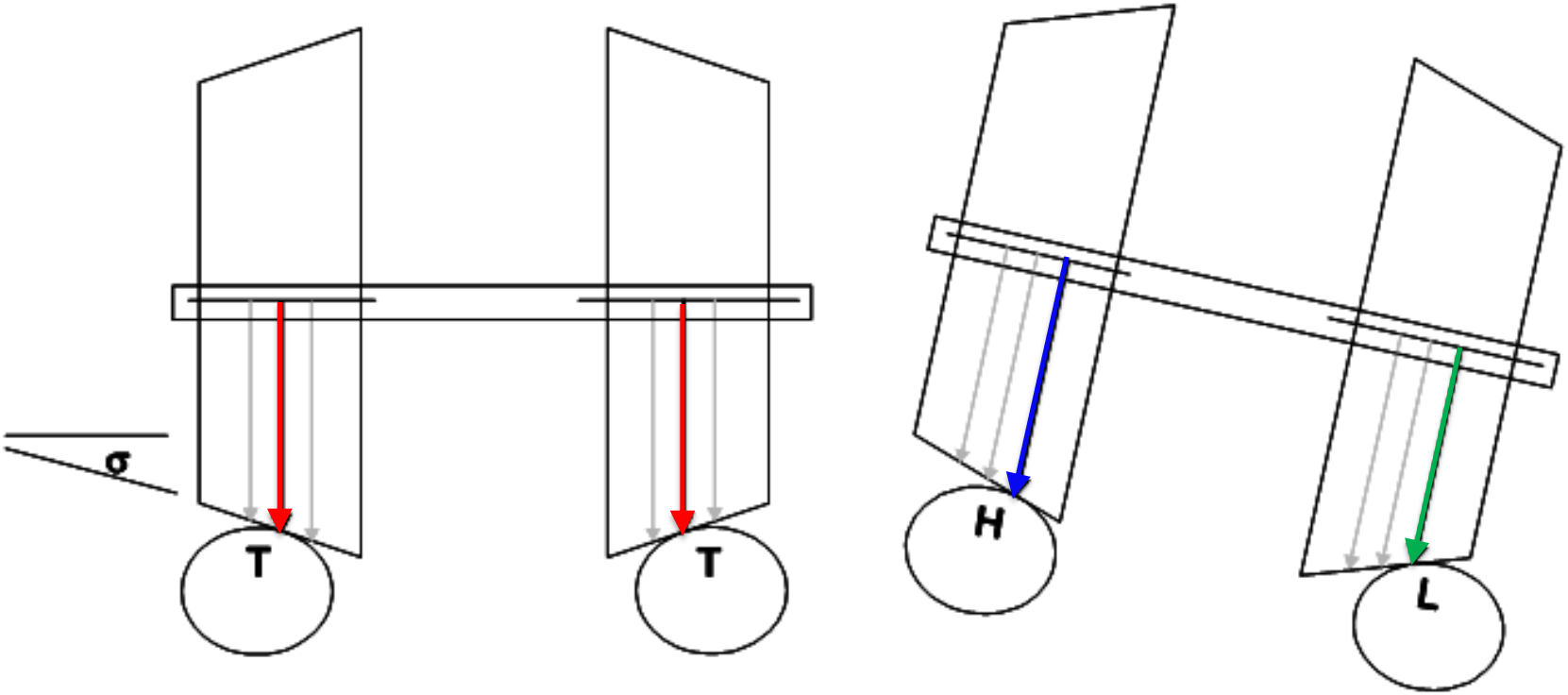
Thank You

Questions

What is rolling-radius difference?



T: tangent H: high rail L: low rail

Initial Conditions & Indicators

- Equivalent Conicity higher in Phases 2 and 3