Planning and Executing an Effective Transit Grinding Program

WRI 2019: Rail Transit Seminar

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Loram Maintenance of Way
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Outline

Why grind transit systems?

System rail health review

Developing a grinding specification

Grind planning

Execute the grind

Follow-Up

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Why Grind Transit Systems?

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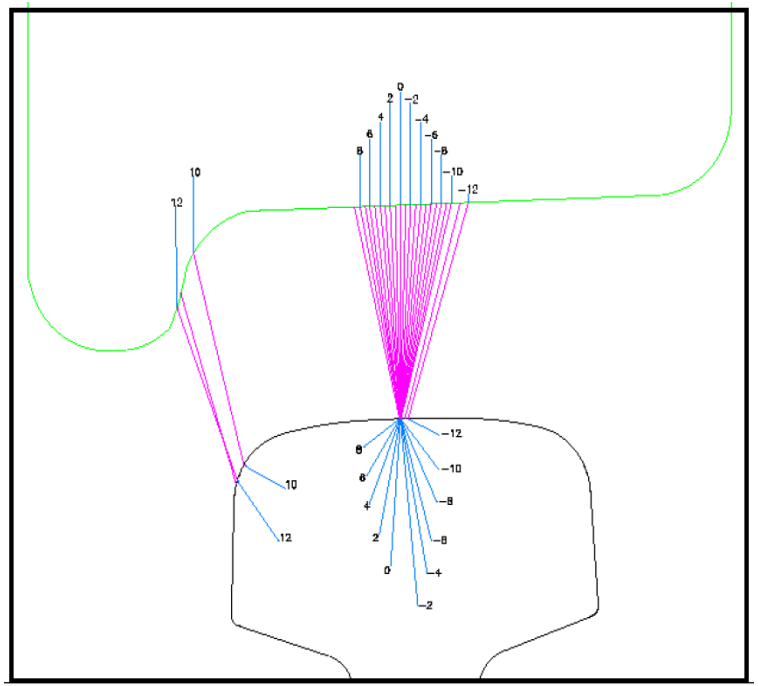
Why Grind Transit Systems?

Wheel/Rail Interaction



Mill Scale Removal

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Why Grind Transit Systems?

Corrugation

- **Ride quality**
- **Noise concerns**

Rail Wear

Wheel Wear

Rolling Contact Fatigue (RCF)

Corrugation

Gage Corner Checking

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System Rail Health Review

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System Rail Health Review

Items to consider/measure

1. Transverse profile shape
2. Wheel/Rail interface (running band width & location)
3. Corrugation (Longitudinal profile)
4. Rail surface condition issues

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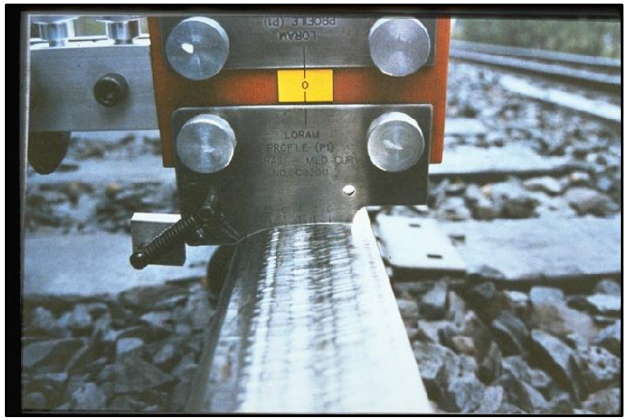
System Rail Health Review

Transverse profile shape (basic tools)

1. Star/Radius gauge

2. Bar gauge



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System Rail Health Review

Transverse profile shape (advanced tools)

Provides a digital record of the pre/post-grind to the target rail profile

1. **Laser based vehicle mounted**
2. **Handheld device**

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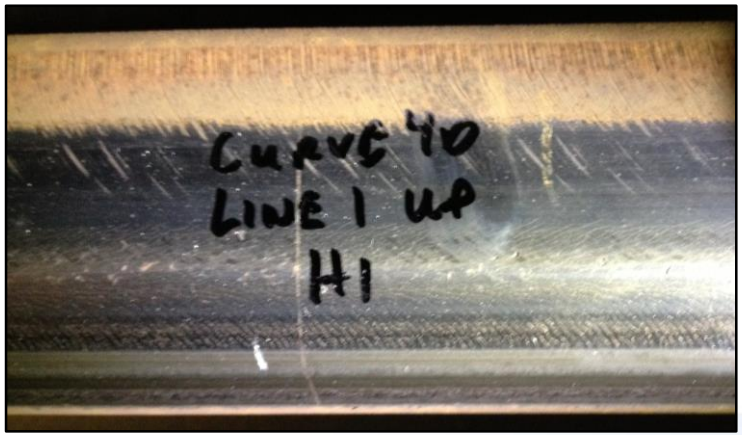
System Rail Health Review

Wheel/Rail Interface (running band width and location)

1. Indicates how the current wheel and rail profile shapes interact with each other



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System Rail Health Review

Corrugation (longitudinal profile) inspection

1. Observed ride quality
2. Straight edge
3. Hand operated trolley
4. Noise Study

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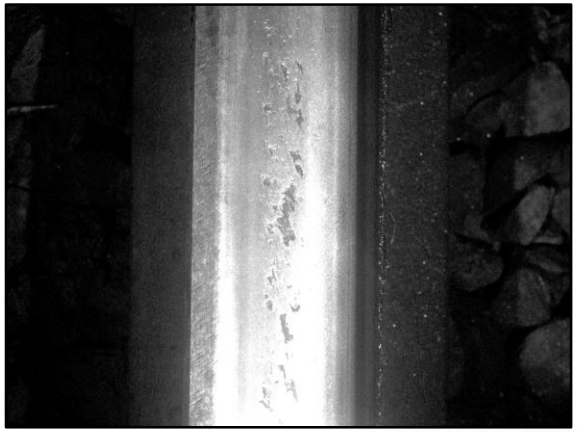
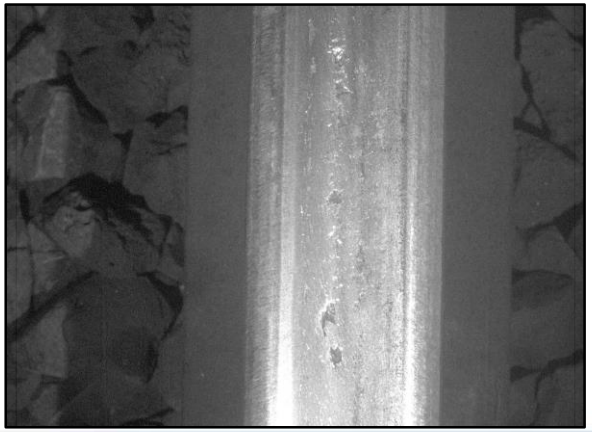
System Rail Health Review

Rail surface condition issues, typically RCF

1. Manual inspection
2. Camera systems
3. Rail crack measurement systems, trolley or vehicle mounted





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System Rail Health Review

Other items to consider

1. Track Structure (Gauge, Curve Radius, Fixation, Restraining Rail, etc…)
2. Track Obstacles and Clearance Envelope
3. Revenue Vehicle Information (Axle Weight, Annual Tonnage, etc…)

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Developing a Grinding Specification

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Developing a Grinding Specification

Develop the specification to address the issues that are being experienced on the transit system:

1. **Transverse profile templates and tolerances**
2. **Longitudinal profile tolerances**
3. **Rail Surface Finish**
4. **Re-Profiling range (angle range field to gauge)**
5. **Facet width**

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Developing a Grinding Specification

Transverse profile can be used to address wheel and rail wear

1. **Specify the target rail profile shape (template) to achieve through grinding**
2. **May specify Tangent, High, or Low rail templates**
3. **Assign templates to specific track sections, i.e. by milepost and curve**

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Developing a Grinding Specification

Options for designing transverse profile templates

1. System wide wheel/rail interaction study
2. Defined rail head radius
3. Practical implementation of appropriate running band
4. New rail shape (i.e. 115 RE)

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Developing a Grinding Specification

Transverse profile tolerances

1. Typically given in terms of +/- tolerance for post-grind profile in relation to target rail profile
2. Current Reference Standard: EN 13231-3:2012

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Developing a Grinding Specification

Corrugation and noise issues may be addressed with longitudinal profile tolerances

1. Specify wavelength ranges, amplitude tolerances, and the % exceeding limits.
2. Tighter tolerances reduces the re-growth rate of corrugation but it requires additional grinding effort.
3. Current Reference Standard: EN 13231-3:2012

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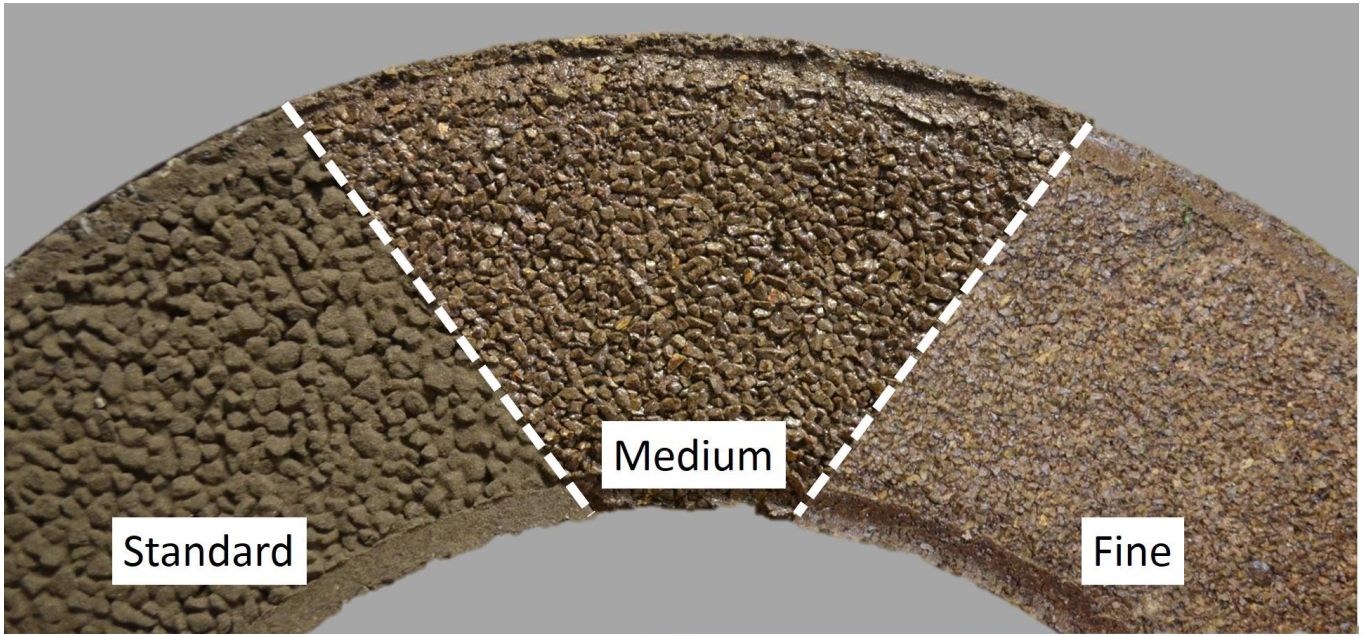
Developing a Grinding Specification

Post grind noise and vibration may be addressed with rail surface finish

(Available stone types)



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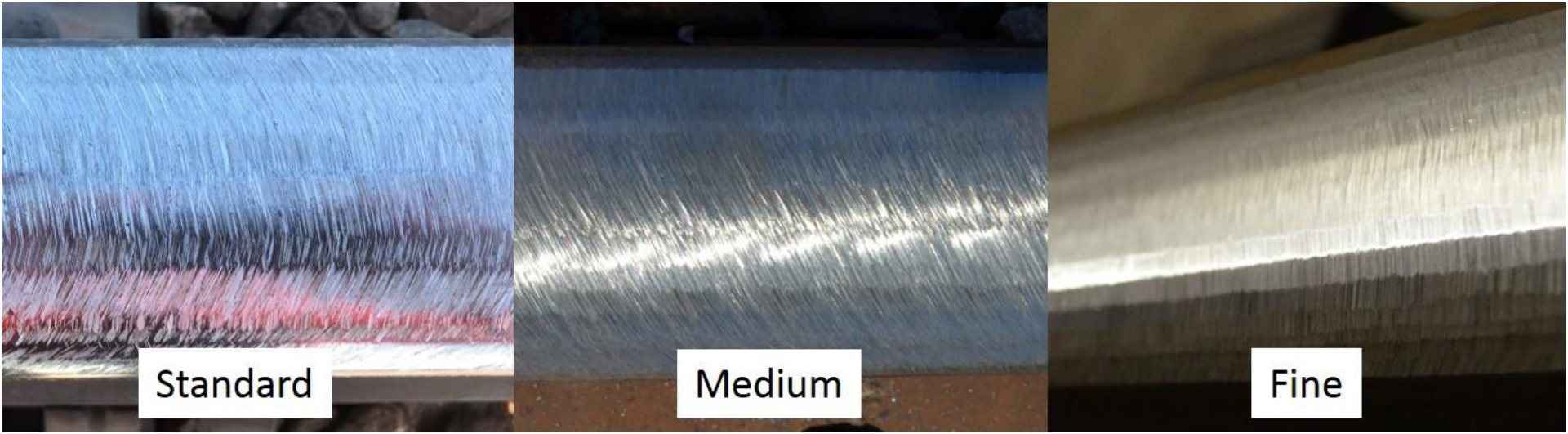
Developing a Grinding Specification

Post grind noise and vibration may be addressed with rail surface finish (Rail Finish Examples)



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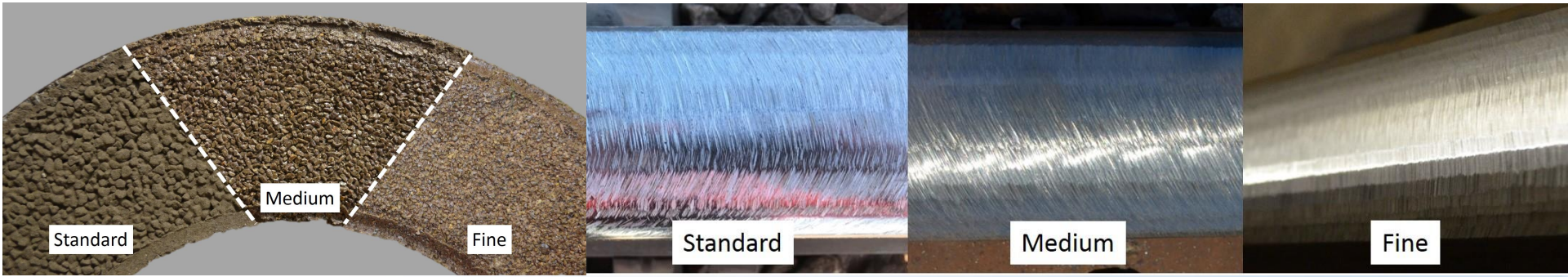
Developing a Grinding Specification

Post grind noise and vibration may be addressed with rail surface finish

1. Measured with a stylus and outputs the ‘Ra’ value
2. Transit systems with lighter axle loads may target a finer finish
3. Current Reference Standard is 10µm from EN 13231-3:2012



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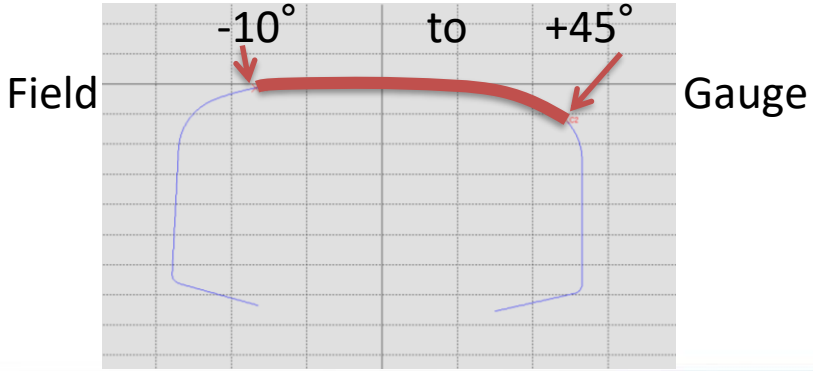
Developing a Grinding Specification

Re-Profiling range (angle range field to gauge)

1. Range may vary depending on template and railroad requirements
2. Open rail angle range may be different than embedded rail or specialty track work



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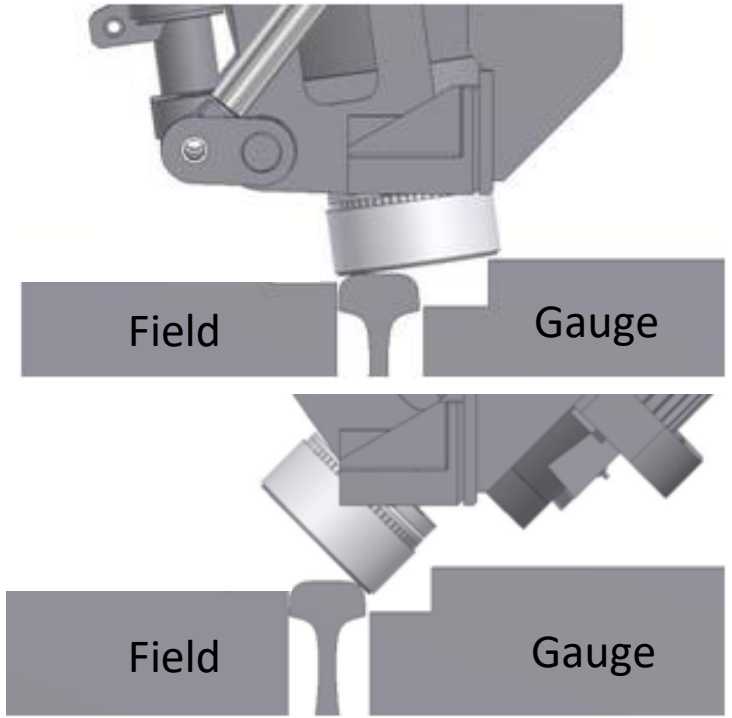
Developing a Grinding Specification

Re-Profiling range

(clearance restrictions)

Similar metal removal achievable but in a limited angle range



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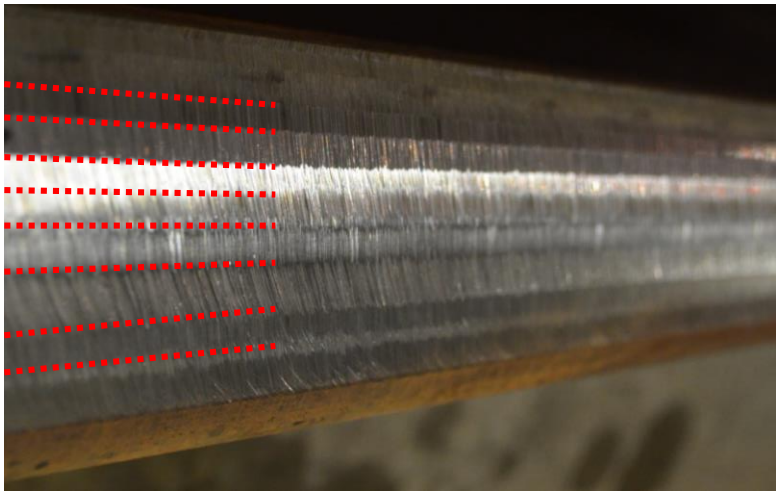
Developing a Grinding Specification

Facet width

1. Define maximum width depending on location on railhead
   a. Current Reference Standard: EN 13231-3:2012
2. Facets should be a consistent width longitudinally along the rail
3. Too few facets leads to undesirable sharp peaks between facets



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Grind Planning

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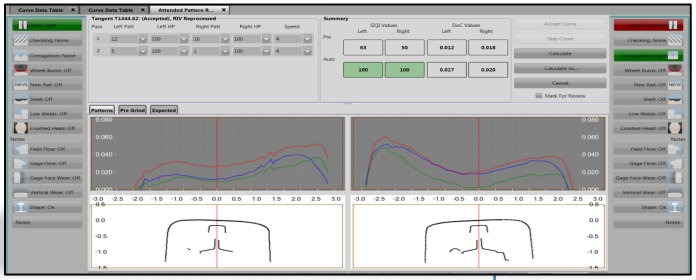
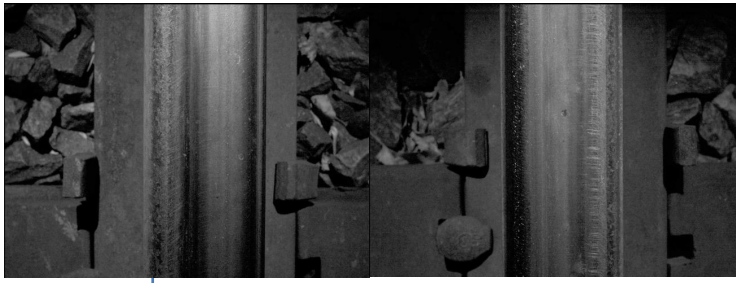
Grind Planning

Rail Measurements

Rail Health Review





Machine Setup Info

Customer Requirements

Knowledge (Algorithms)

Grind Plans

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Grind Planning

Pre-Grind Inspection

1. Rail surface damage
2. Transverse Profile review
3. Longitudinal Profile review
4. Depth of cut needs

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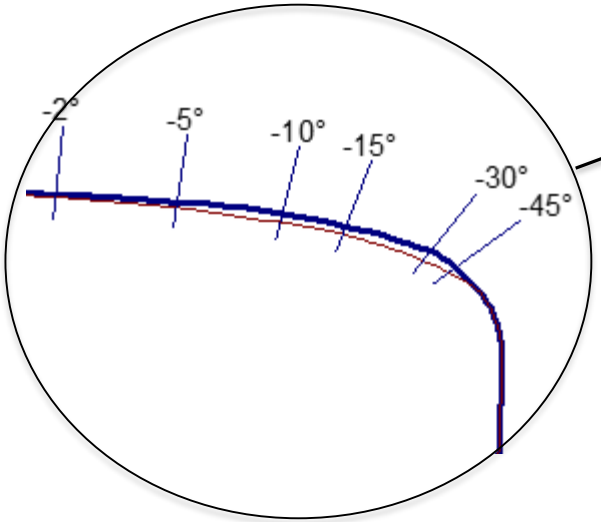
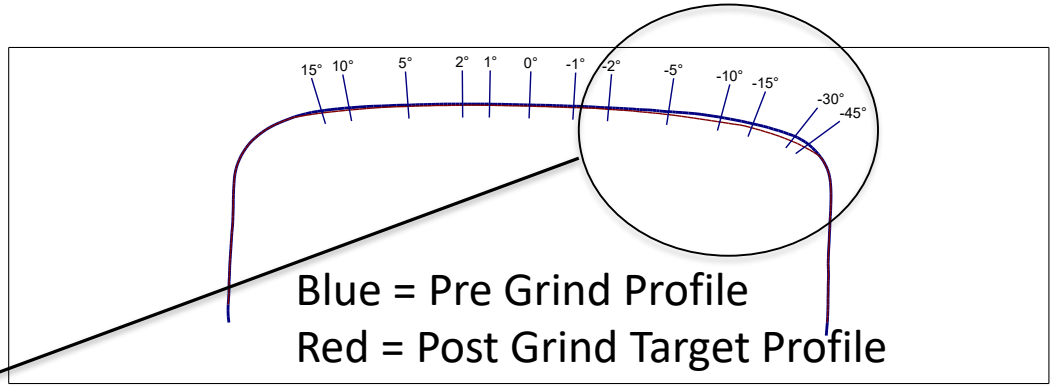
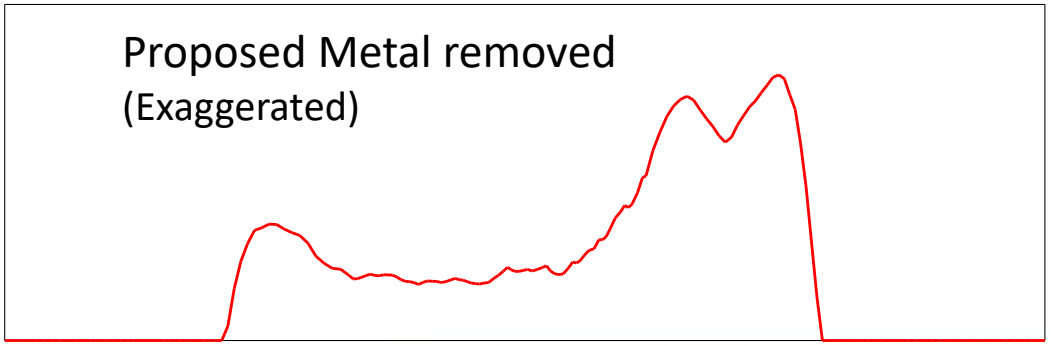
Grind Planning

Depth of cut requirements driven by the Target profile



Loram Metal Removal Plot





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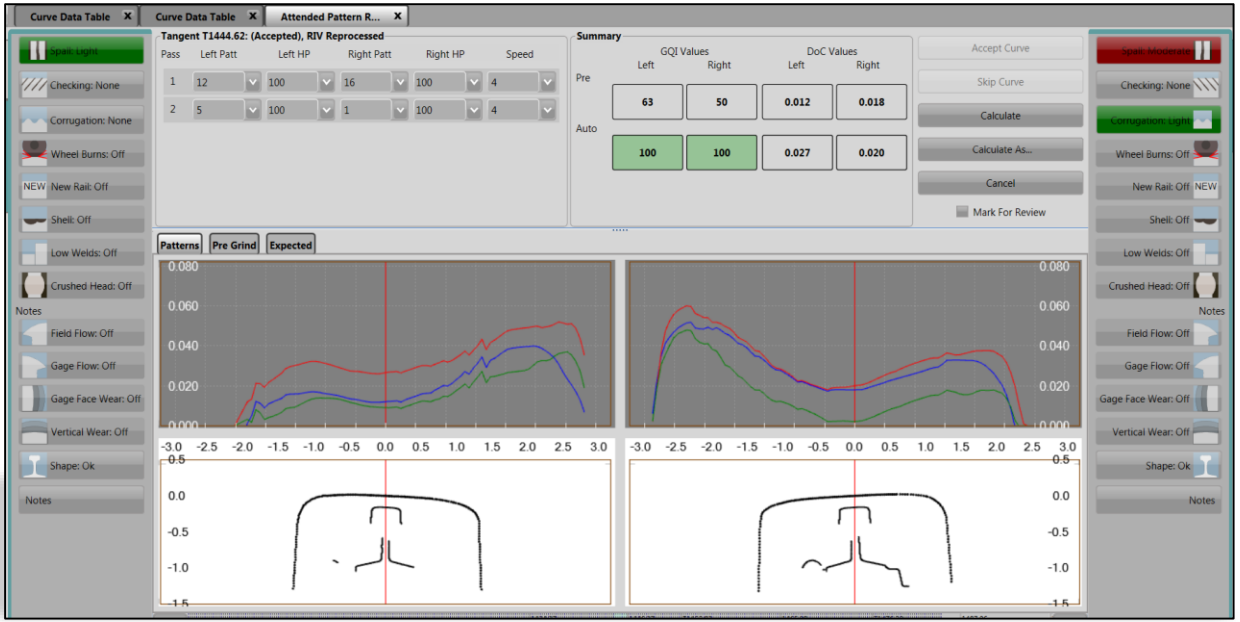
Grind Planning

Software Tools to select Grind Patterns

1. Rail surface damage
2. Desired target rail profiles

Output: Grind Pattern and Speeds



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Grind Planning

Results in a detailed work plan

Track location, grind pattern, # of passes, and grind speed

Track Information								Planned Grind							Work Time		
Chain Fro	Chain To	Trac	Curve Nar	Degree of Curv	Direc tio	Length (cha	Features	Left Rail Patte	Right Rail Patte	Left Rail Passe	Right Rail Passe	Spe	Additional Passes	Comments	Work Time (min)	Total Time (min)	Control Point
311.4	317.6	1	311.39	2.00	L	6.21		13	18	15	15	7	14/18 at 7 mph, 4/1 at 7 mph	Left: mod corr/Right: mod corr	44.7	45	
359.1	371.3	1	359.12	2.00	R	12.21	Sensor @ MP362.99, Xing @ MP363.70	24	14	10	10	7	7/4 at 7 mph,	Left: light corr/Right: light corr	49.1	95	
372.8	375.9	1	372.78	2.00	L	3.10		14	23	15	15	7	25/24 at 7 mph, 4/10 at 7 mph	Left: mod corr/Right: mod corr	29.6	125	
380.6	387.4	1	380.59	2.00	R	6.77	Sensor @ MP385.50	24	14	10	10	5	8/4 at 5 mph,	Left: mod corr/Right: mod corr	40.3	166	
387.4	396.9	1	387.72	2.00	L	9.56		25	18	15	15	7	14/11 at 7 mph, 5/9 at 7 mph	Left: mod corr/Right: mod corr	61.1	228	
424.6	432.7	1	424.62	2.00	L	8.12	Sensor @ MP427.49, Sensor @ MP431.12, Xing @ MP431.74	25	23	15	15	7	14/24 at 7 mph, 5/8 at 7 mph	Left: mod corr/Right: mod corr	54.0	283	
458.4	463	1	458.45	2.00	L	4.52		14	7	10	5	6	4/X at 6 mph,		26.6	310	
463	485	1	T462.97	0.00		21.98	Xing @ MP468.95, Xing @ MP470.03, Xing @ MP471.79, Xing @ MP473.89, Xing @ MP478.42	11	17	10	10	6	5/7 at 6 mph,	Left: mod corr/Right: mod corr	92.8	403	
310.4	317.8	2	310.43	2.00	L	7.41	Xing @ MP311.36, Sensor @ MP311.89	13	23	15	15	7	14/19 at 7 mph, 4/7 at 7 mph	Left: mod corr/Right: mod corr	50.6	454	
380	387.6	2	379.96	2.00	R	7.66	Sensor @ MP385.64	5	5	5	5	6		Right: light corr	19.0	474	
456.6	462.1	2	456.65	2.00	L	5.46	Sensor @ MP459.83	14	7	10	5	5	2/X at 5 mph,	Left: light corr/Right: light corr	34.3	509	

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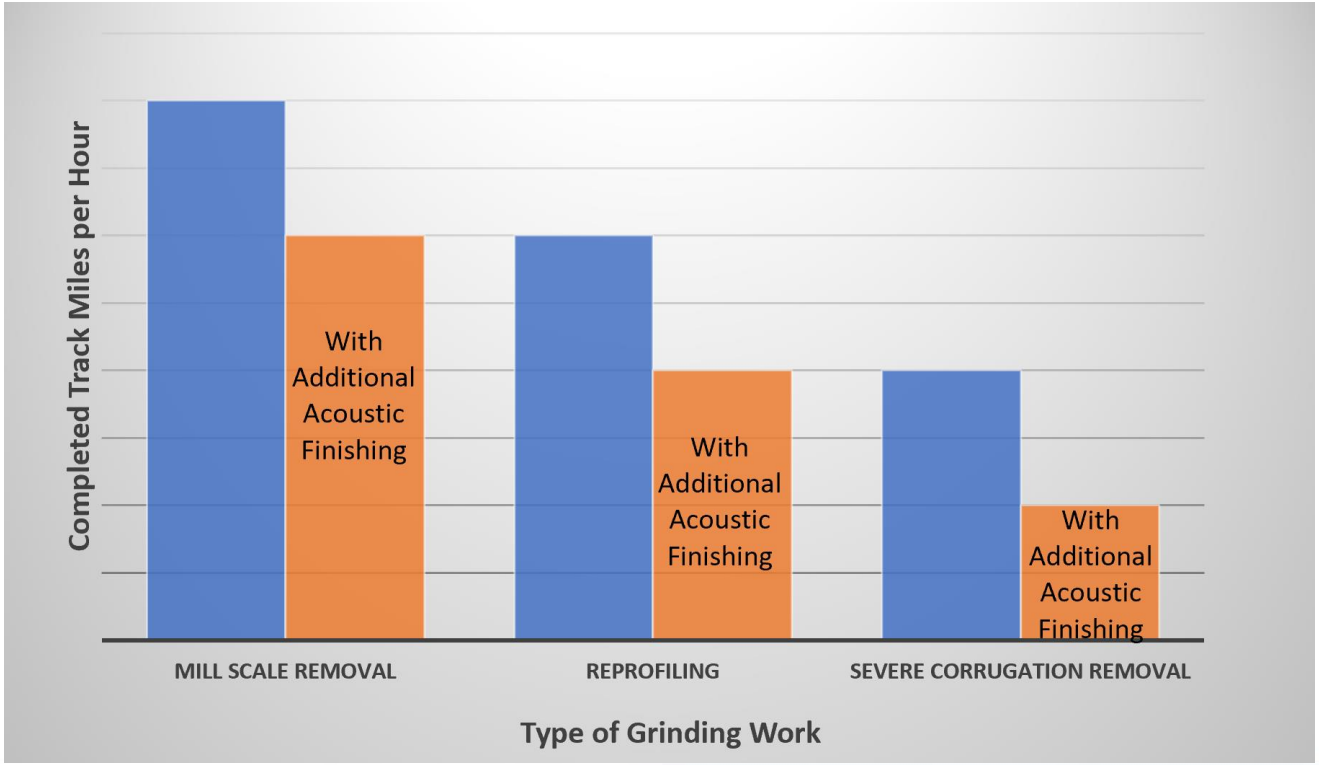
Grind Planning

Grind productivity comparison



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Executing the Grind

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Executing the Grind

Scheduling track time and support staff

1. Short term corrective or long term preventive program
2. Make the most of available track time
3. Review support staff requirements for the project
4. Review logistics of deploying the grinder to the transit system and specific work locations

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Executing the Grind

Perform the work per the plan, per the grinding specification, and gather quality assurance data

1. **Collect post-grind measurements to document the quality of the work performed and to use as baseline**
   a. **Transverse profile**
   b. **Longitudinal profile**
   c. **Surface finish**
   d. **RCF**

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Follow-Up

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Follow-Up

Schedule additional post-grind inspections, for example at 6 month to 1 year intervals

1. **Inspect running bands**
2. **Inspect for RCF**
3. **Inspect for corrugation development**
4. **Develop a timeline for the next grind cycle(s)**

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Conclusions

Key points

1. System rail health review and pre-grind inspections will optimize the work to be performed
2. Grinding specification helps ensure benefits are realized
3. Plan the work for the available track time
4. Periodically follow up to determine system health and future grinding needs
5. Grinding is flexible enough to address a wide range of issues and requirements

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Thank You For Your Time