Planning and Executing an Effective Grinding Program: the North American Experience

WRI 2015: Rail Transit Seminar
Charles Rudeen
Transit Project Manager: Loram Maintenance of Way
Outline

Why grind?
Pre-grind inspection
Developing a specification
Plan and execute the grind
Follow up
Why Grind Freight Railroads?

Rolling contact fatigue (RCF)

Rail life savings

-Magic wear rate

Reduce transverse defects
Why Grind Transit Systems?

- Corrugation
- Noise concerns
- Ride quality
- Mill scale
- Mill scale
- Ride quality
- Rail wear
- Wheel wear
Outline

Why grind?

Pre-grind inspection

Developing a specification

Plan and execute the grind

Follow up
Pre-Grinding Inspection

Transverse profile shape (basic tools)

1. Star/Radius gauge
2. Bar gauge

Star/Radius Gauge

Bar Gauge
Pre-Grinding Inspection

Transverse profile shape (advanced tools)

Store a digital record to allow comparison between pre/post-grind and against a target template

1. Handheld device

2. Laser based equipment mounted profile measurement systems
Pre-Grinding Inspection

Wheel/Rail interface (running band location)

1. Visually determine where the wheels and rails interact
2. Rolling contact fatigue development

High Rail Pre-Grind

Field

Low Rail Pre-Grind

Gauge
Pre-Grinding Inspection

Longitudinal profile (corrugation) measurements

1. Ride quality
2. Straight edge
3. Noise study
4. Hand operated trolley
5. Hi-Rail or grinder mounted
Pre-Grinding Inspection

Surface condition issues

1. Manual inspection
2. Camera systems
Outline

Why grind?
Pre-grind inspection
Developing a specification
Plan and execute the grind
Follow up
Grinding Specification

Transverse profile templates

1. Specify target template shape
2. Different templates for tangent, high or low rails
3. Specify which track sections require which templates, i.e., by track and curvature
**Transverse Profile - Templates**

Options for designing templates

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

*Note:* Important to monitor how templates affect rails and wheels once they are implemented
Transverse Profile - Templates

Transverse Profile Validation

1. Determine if the position and size of resulting running band is as expected

2. Track over time to gauge effect on rail surface condition and wheel wear
Transverse Profile - Templates

Other examples

Pre-Grind Tan Rail

Post-Grind Tan Rail

Pre-Grind Low Rail

Post-Grind Low Rail
Grinding Specification

Transverse profile tolerances

1. +/- tolerance; profile in relation to target template
Grinding Specification

Longitudinal profile (corrugation) tolerances

1. When is grinding needed/corrugation relieved.

2. Wavelength ranges, tolerances and % exceeding limits

<table>
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<th>Comparison RMS: 2.7µm Exceedence: 1% (0.001km) &gt;10µm</th>
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Grinding Specification

Surface roughness

1. Typically measured using the arithmetic mean surface roughness (Ra) value
2. Basic standard is 10µm
3. Transit systems with lighter axle loads could target a lower value
Grinding Specification

Re-Profiling range (angle range field to gauge)

1. Open rail range may be different than embedded rail or specialty track work

2. Range may vary depending on template and railroad requirements

![Diagram showing angle range from -10° to +45°](image)
Grinding Specification

Re-Profiling range (clearance restrictions)

-Similar metal removal still achievable but in a limited angle range
Grinding Specification

Depth of cut requirements

Pre/Post Grind Profiles Aligned

Residuals Between the Two
Grinding Specification

Facet width

1. Define maximum width depending on location on railhead

2. Facets should be consistent longitudinally along the rail
Outline

Why grind?
Pre-grind inspection
Developing a specification
Plan and execute the grind
Follow up
Grind Planning

Transverse profile compared to template

+ Depth of cut to remove defects

= Metal removal needs
Grind Planning

Grinding patterns to address a variety of needs

Increasing Gauge Concentration

Decreasing Ball Concentration

Increasing Field Concentration

Increasing Ball Concentration
Grind Planning

- Location of grind stones to achieve profile
- Depth of cut to remove damaged surface metal
Grind Planning

Existing rail shape greatly affects the metal removal and depth of cut of a grinding pattern

- Tangent rail
- Flat low rail
- Worn high rail
Grind Planning

Software tools
Grind Planning

Results in a detailed work plan

<table>
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<tr>
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<th>Planned Grind</th>
<th>Work Time</th>
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<th>Control Point</th>
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<th>Right Rail Pattel</th>
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Grind Planning

Expected productivity rates (8 stone machine)

1. Mill scale removal – 2500’ to 3000’ per hour
   - 0.006 inch Depth at center, 0.015 in² metal removed

2. Profiling – 1500’ to 2000’ per hour
   - 0.006 inch Depth at center, 0.025 in² metal removed

3. Severe corrugation removal – 750’ to 1000’ per hour
   - 0.025 inch Depth at center, 0.060 in² metal removed
Executing the Grind

Scheduling track time

1. One time or multi-interval approach
2. Make the most of available track windows

Quality assurance

1. Have a grinding specification and templates in place
2. Document post-grind measurements (transverse and longitudinal profile) to use as baseline for future years
Follow Up

Schedule a post-grind inspection

6 month to 1 year intervals

- Inspect running bands
- Inspect for RCF and corrugation development
- Develop a timeline for the next grind cycle(s)
Conclusions

Key points

1. Pre-Grind inspections are important
2. Specification helps ensure benefits are realized
3. Optimize available grinding windows
4. Follow-up to determine future grinding needs
Thank You For Your Time