WRI Basics: The Rail

VERY Basic

Goals

Methods

Tools

WRI Basics: Rail Goals

Work with wheels:

Compatible profile(s)

Steer axles

Avoid Flange Wear

Avoid/Prevent Rail Corrugation

Long service life

Compatible Profiles:

- Closed System (captive fleet): Design wheel and rail profiles to optimize WRI
- Open System: Design rail profile to accommodate AAR
- High and Low Rails of Curves: Shift Contact Bands to enhance conicity
- Tangents: enhance stability & avoid flanging

Close-Up WRI new wheel

Steering Axles with Rail Profiles

- Tapered wheel treads
- Distance Travelled: Outside Rail is Longer
- Rigid wheel/axle Set
- Effective wheel diameter varies depending on contact band:
  - Closer to flange: larger diameter, travel further each rotation
  - Further from flange, smaller diameter, travel less

Avoid Flange Contact

- Reduce Wear & Noise
- Uniform, mirror image profiles on tangent
- Shift contact band on curves
  - Toward gauge corner on high rail
  - Toward field side on low rail

Fight Corrugation

- Not Fully Understood
- First Symptom may be noise
- Good steering reduces Angle of Attack
- Bad Angle of Attack causes “slip stick”
- Flat profiles have undefined contact bands

Long Service Life of Rail

- Maximize Return on Investment in Rail
- Wear: “Loss of Section”
- Poor Profiles: Excessive grinding to correct
- Deep Corrugation: Excessive grinding
- Fatigue Life & Rail Fractures
  - Grind to remove crack initiation sites
  - Grind to remove surface damage

Costs of Premature Rail Replacement

- Purchase of the rail
- Installation of the rail
- Affect on Systems
- Interruption of Service
  - Quality of Service: Revenues, Competition
  - Public/Political Pressures
  - Constrained, inefficient work periods

Rail Maintenance Tools

- Grinders
- Milling Machines

Rail Grinders: Rail Head Details

- Groups of vertical axis electric drive surface stones
- Groups or individual stones can rotate about longitudinal axis: make any rail profile
- Repeated passes to smooth out facets
- Metal Removal in 0.001” per horsepower
- Must be stable: vibrations = new corrugations

Grinding Head Sample

Rail Grinding

- Contracted or In-House
- Types of Machines
- Management Challenges
- Contracting Challenges
- Multi-Year Strategies

Note spark angles

96 Stone Machine

16-Stone Machine

12-Stone Hy Rail Grinder

In-House Grinding

- Because contract grinding is difficult to specify as to quality and to unit price bidding
- Direct control and adjustments to needs
- Operations, MofW, and Technical groups develop territory and methodology skills
- Predictable Costs

In-House Grinding ?

- “Locked In” to purchased technology
- Sometimes issues with labor organizations
- Appears to be a controllable cost?
- Procurement, hiring, training, and promotion protocols confined to organization’s policies

Contracted Grinding

- Usually best solution for largest and smallest properties
- Large: Can efficiently dedicate months and years duration and mobilization.
- Large: Can use largest, most efficient machines
- Small: Can achieve rail profile maintenance without capital investment

Contracted Grinding ?

- Difficult to Specify Production and Pay Quantities
- Very difficult to procure under public works “low bid” rules
- Requires motivated Engineering Staff to guide contracts through process
- Requires qualified and equipped CM team

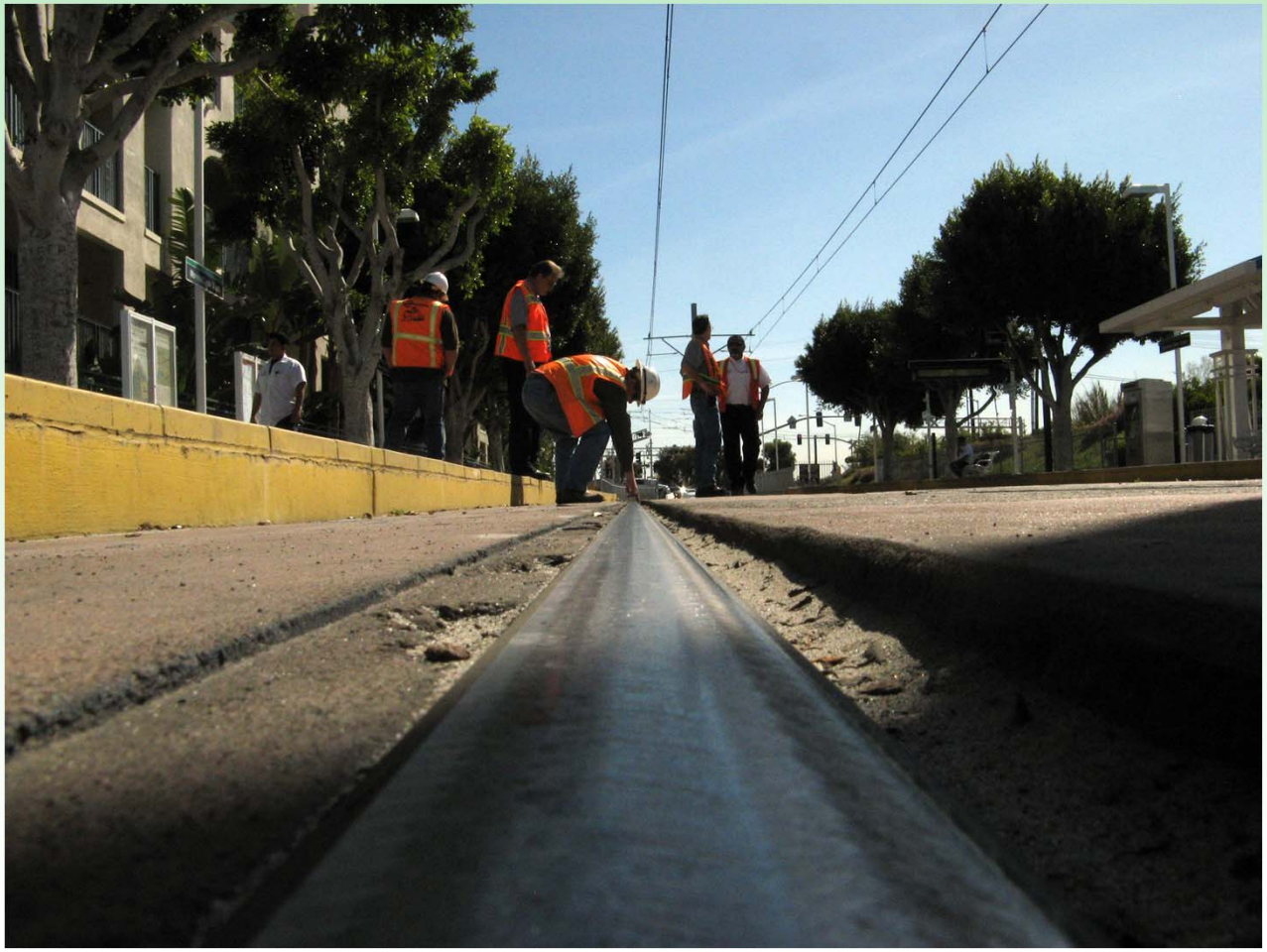
Running a Grinding Program

- Just an overview
- Determining Need
- Physical Realities
- Planning & Coordination
- Hourly Supervision
- QA

Determining Grinding Needs

- Input from direct staff observation and hand instrument data
- Peer Review, prior staff experience
- Public complaints
- Rail Profile Survey
- Rail Survey Data Compilation

Staff Inspection
Hand Tools, Visual



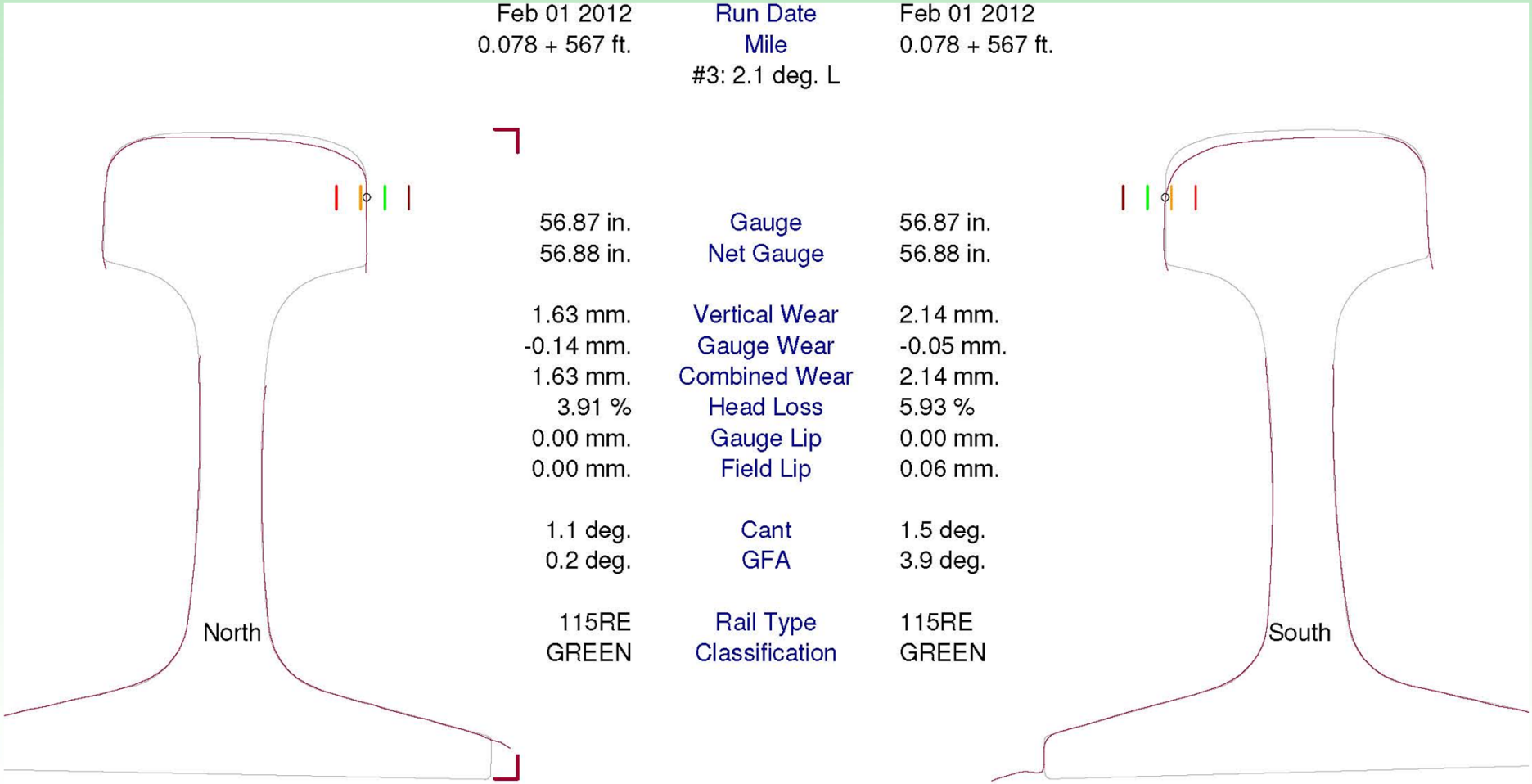
Inspection: Paint on Rail

Inspection: Rail Gauge

Inspection: Head Radius

Optical Rail Scan

Sample Optical Rail Scan



North		South
Feb 01 2012	Run Date	Feb 01 2012
0.078 + 567 ft.	Mile	0.078 + 567 ft.
	#3: 2.1 deg. L	
56.87 in.	Gauge	56.87 in.
56.88 in.	Net Gauge	56.88 in.
1.63 mm.	Vertical Wear	2.14 mm.
-0.14 mm.	Gauge Wear	-0.05 mm.
1.63 mm.	Combined Wear	2.14 mm.
3.91 %	Head Loss	5.93 %
0.00 mm.	Gauge Lip	0.00 mm.
0.00 mm.	Field Lip	0.06 mm.
1.1 deg.	Cant	1.5 deg.
0.2 deg.	GFA	3.9 deg.
115RE	Rail Type	115RE
GREEN	Classification	GREEN

Rail Scan Data by Mile

Realities of Grinding

- Track space to stage, store, and maintain
- Resources: water, fuel, supplies, employee access
- Grinder Impacts:
  - Noise
  - Dust, smoke
  - Sparks: fire risks, public concerns

Engineering Planning & Coordination

- Determine Target Rail Profiles
- Determine exceptions to target rail profiles, by priority locations
- Estimate the amount of work needed
- Determine constraints on equipment, if any
- Estimate time required (depends upon equipment choice and rail condition)
- Special considerations very new, very old rail

System Planning

- Preferred Work Periods, adjustments
- Blackout periods
- Support groups: C&S, Security, Safety
- External Factors:
  - Public notice “no surprises”
  - Public Safety: fire and police
  - Public Regulations: Underground, fire,

Other Details

- Support:
  - MofW Forces “just in case”
  - Communication Links

Safety:

- Training of contractor & consultant staff
- CFR 214 Railroad Workplace Safety
- Territory Qualification: Mountain Grades?

Alternatives to Rail Grinding

- European railroad supply vendors have developed other specialized machines to suit conditions.
- High speed grinding units pulled at track speed to maintain profiles: very light cuts
- Milling machines to remove significant metal depths more efficiently than grinders
- See them for details

Linsinger Milling Machine

“The Third Half”

- Discussion of the WRI is not complete without the “third body”
- Lubricants to reduce flange contact friction
- Friction Modifiers to reduce the effects of slip-stick on low rail without impairing traction
- Can have system efficiency benefits

Gauge Lub and TOR Sites

Questions?