

GRINDING CONTRACTS

Getting What you Pay For



More than “Spark Time”

A means to an end:

- Build a complete, quality track system
- Meet Design Goals
- Achieve Asset Life Expectancy



Overview:

- Review of Goals of Grinding
- Factors Affecting Contracts
- How Do We Measure Results?
- Where 0.010” matters



Invest in Grinding to Accomplish:

1. Noise Reduction
2. Optimum WRI: Steering, Hunting
3. Control Rolling Contact Fatigue (RCF)
4. Maximum Rail and Wheel Life
5. Reduce Lateral Forces, Low Rail Rollover
6. Mill Scale Removal
7. State of Good Repair



How Does Grinding Do This?



1. Noise Control:

- WRI to prevent flange contact
- WRI to control corrugation
- Remedial removal of corrugation
- Remedial removal of poor prior grinding marks
- (don't forget friction modifiers)



2. WRI:

- Rail and Wheel Profiles Complementary
- Enhance Conicity for Steering
- Avoid Overstress at Gauge Corner



3. RCF:

- Metal Removal of Fatigue Cracks
- “Magic Wear Rate” (an art)
- Mill Scale: possible crack initiation sites



4. Maximum Rail Life

- Minimize Gauge Face Wear
- Stay Ahead of RCF Crack Formation
- Control Corrugation: Avoid Remedial Grinding



5. Reduce Lateral Forces:

- Optimize Conicity: Steering, Not Flanging
- Control Angle of Attack & Low Rail Rollover
- (don't forget friction modifiers)



6. Mill Scale Removal

- Signal shunting
- Impurities in surface layer=crack initiation



Executive Level Rail Engineering

- Short Term: Flange Noise, Corrugation, Signal Shunting
- Long Term: Rail Life, Wheel Life, Efficiency
- Each Year's Budgets: Short and Long Term
- Knowing Existing Conditions
- Knowing Likely Outcomes



GRINDING IS NOT A COMMODITY

- A Technical Service
- Quality is Critical
- Rely on Specifications and Inspection
- Contracting is Challenging
- Measurement for Pay: Quantity and Quality



ORGANIZING A GRINDING PROGRAM

GENERAL CONCEPTS

- Periodic Surveys, Regular Maintenance
- Issuing a Contract
- Management of a Contract
- Measurement of Results

FOR:

- Meeting Operational Goals
- Life Cycle Maintenance
- Meeting Construction Specifications



Regular Surveys

- Laser Rail Profiles
- Sound Surveys
- Hand Tool Methods
- Maintenance Staff Observations
- Rail Replacement Data
- Building Data for Rail Maintenance Program



Laser Surveys

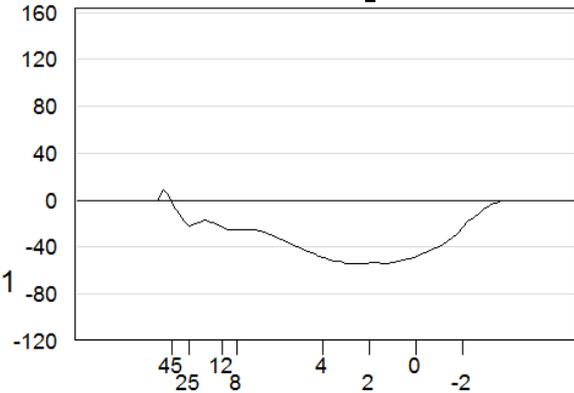
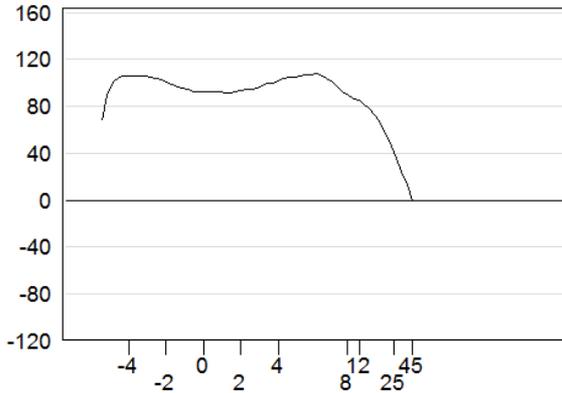
- *Beforehand: to plan and budget*
- *On-Board the grinder: to control the process*
- *(More later)*



Laser Survey



Laser Rail Profile Sample



0.001in

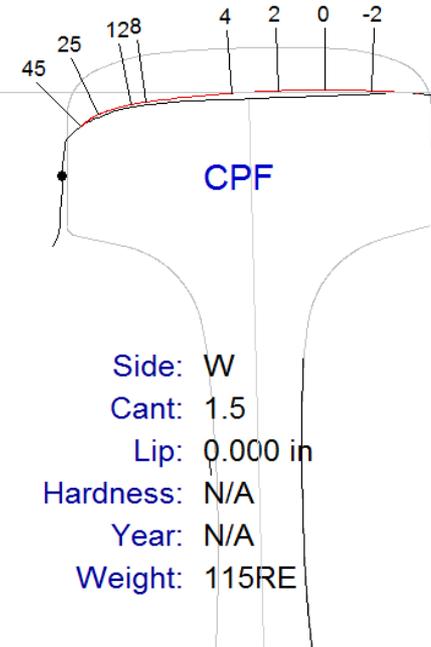
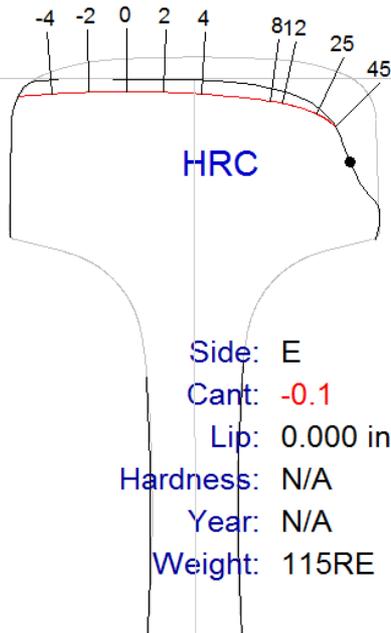
Metal
Removal
(in²)

0.214

0.001

Curvature: 14.1 deg. R
Segment: 240.210 - 245.948

Gauge: 56.88 in
PTP: 56.80 in



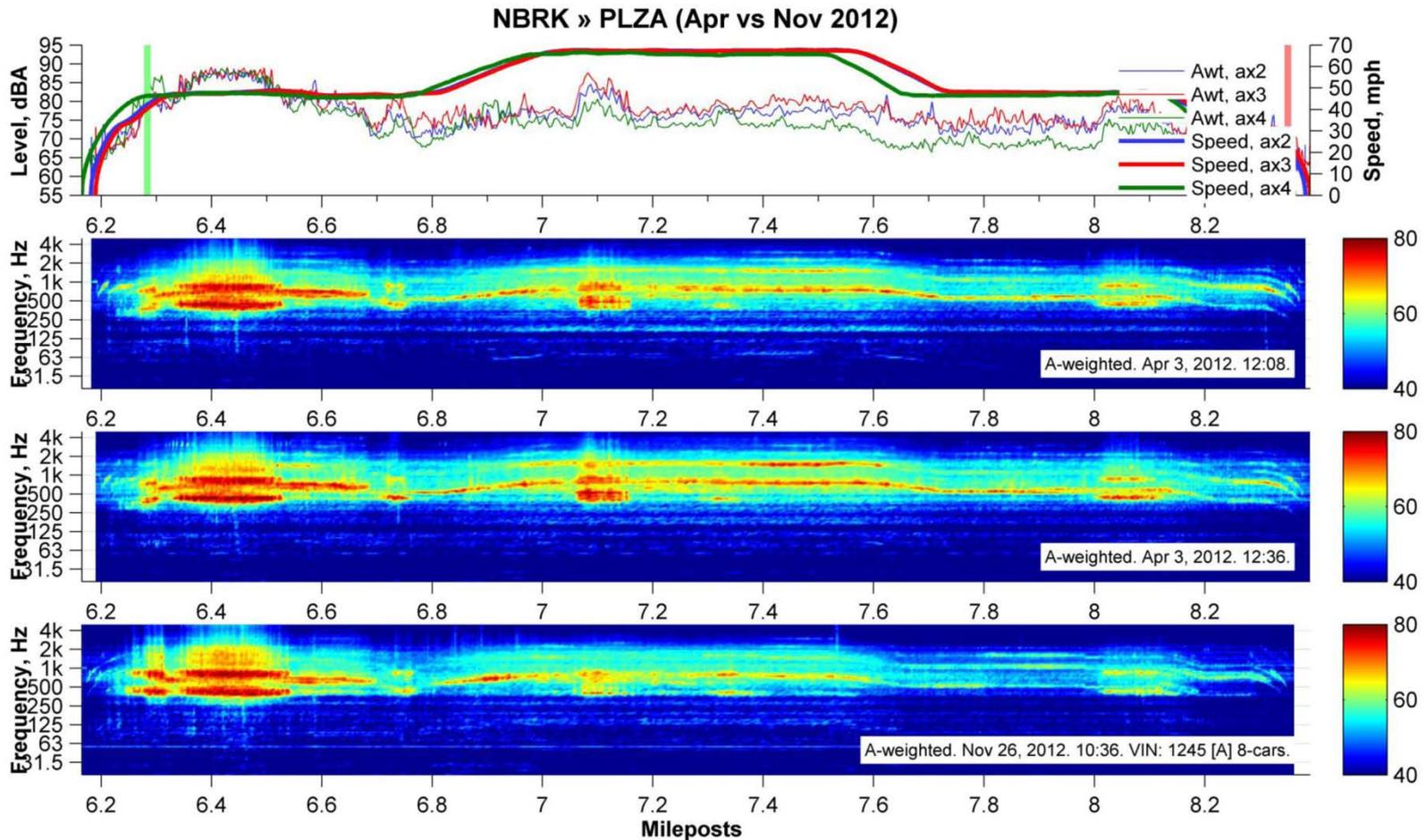
Stn.: 242.408
Sub: ORANGE LINE
Track: SB
Run: 3
Date: Sep 16 2012

S/E: 0.00 in

Side: W
Cant: 1.5
Lip: 0.000 in
Hardness: N/A
Year: N/A
Weight: 115RE



Sound Surveys



Hand Tool Methods

- Profile Plotter (several)
- Star Gauge
- Bar Gauge
- Rail Wear Gauge
- Paint Bands
- **ALL REQUIRE DOCUMENTATION**



Hand Tool: Star Gauge



Hand Tool: Bar Gauge



Hand Method: Paint Bands



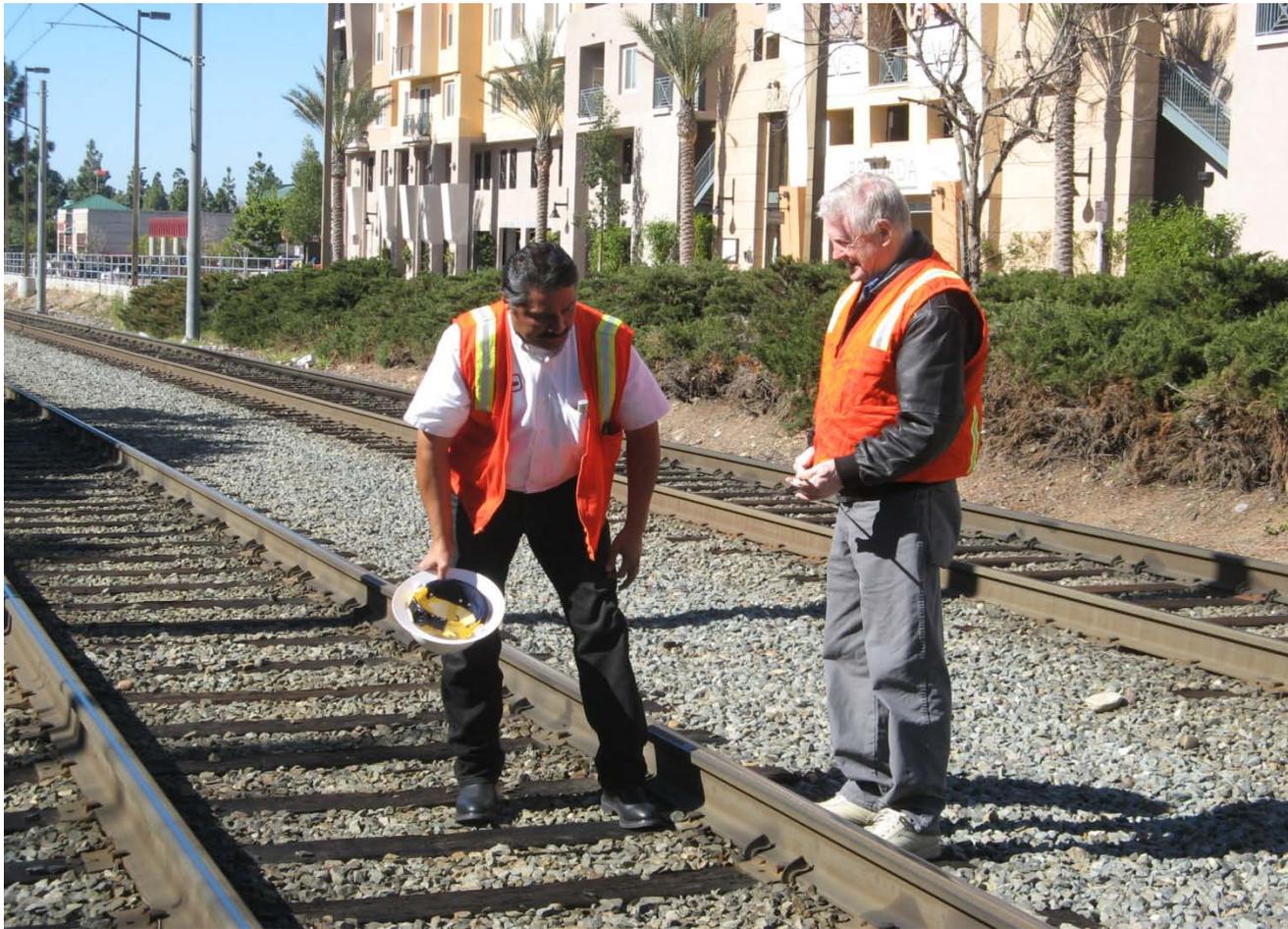
Paint Band: 2-Point High Rail Contact



Paint Band: Corrugation



Staff Observations



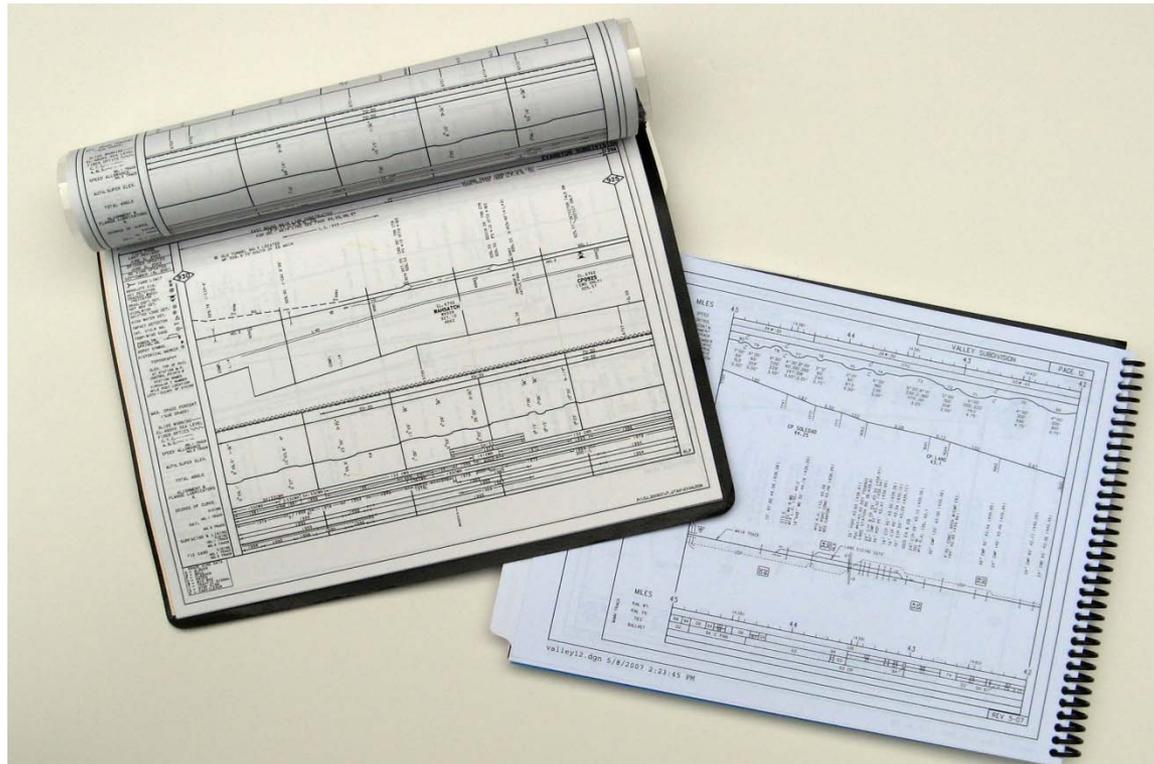
Staff Observation: Corrugation



Staff Observation: Wheel Slips



Rail History: As-Builts or Track Charts



Issuing a Contract

- Public or Private Sectors?
- Contracts must Include:
 - Specifications
 - Owner Support Items
 - Contractor Furnished Services
 - Pay Items and Terms
 - Logistics
 - General Conditions
 - Bidding Terms: Duration, How evaluated



Specifications for Grinding:

Finished Work

Safety

Logistics

Work Plan Development, Adjustment

Measurement for Pay



Finished Rail Specs:

- Target Rail Profiles
- Surface Roughness
- Surface Corrugation
- Metal Removal: RCF even if good profiles, etc.

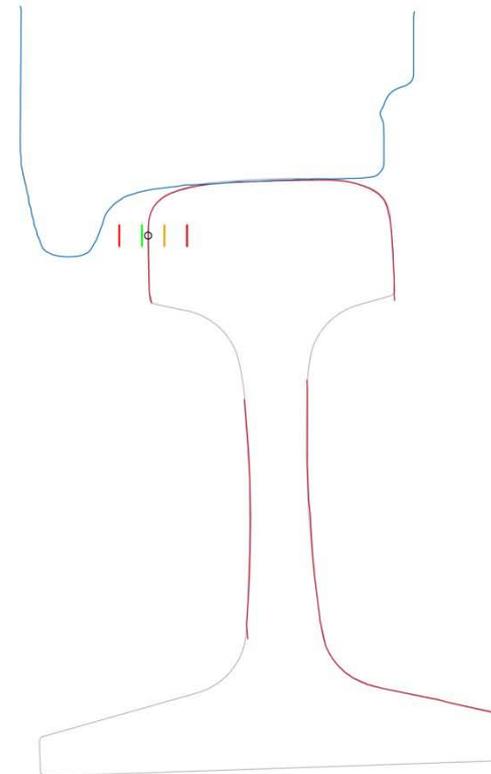
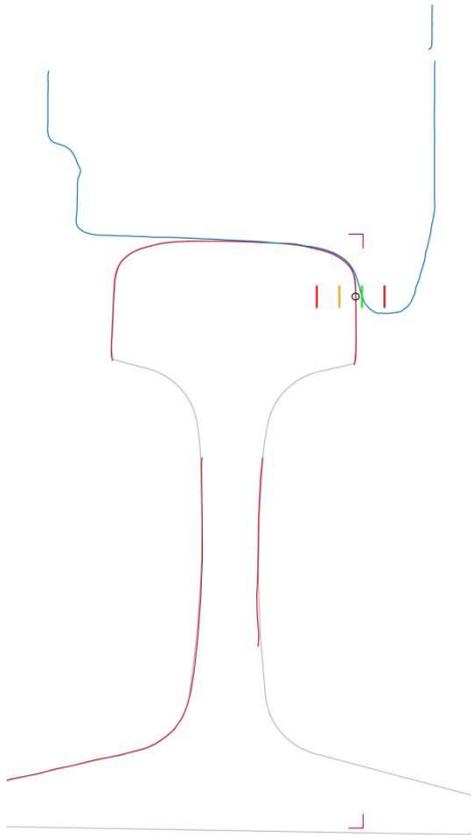


Rail Profiles

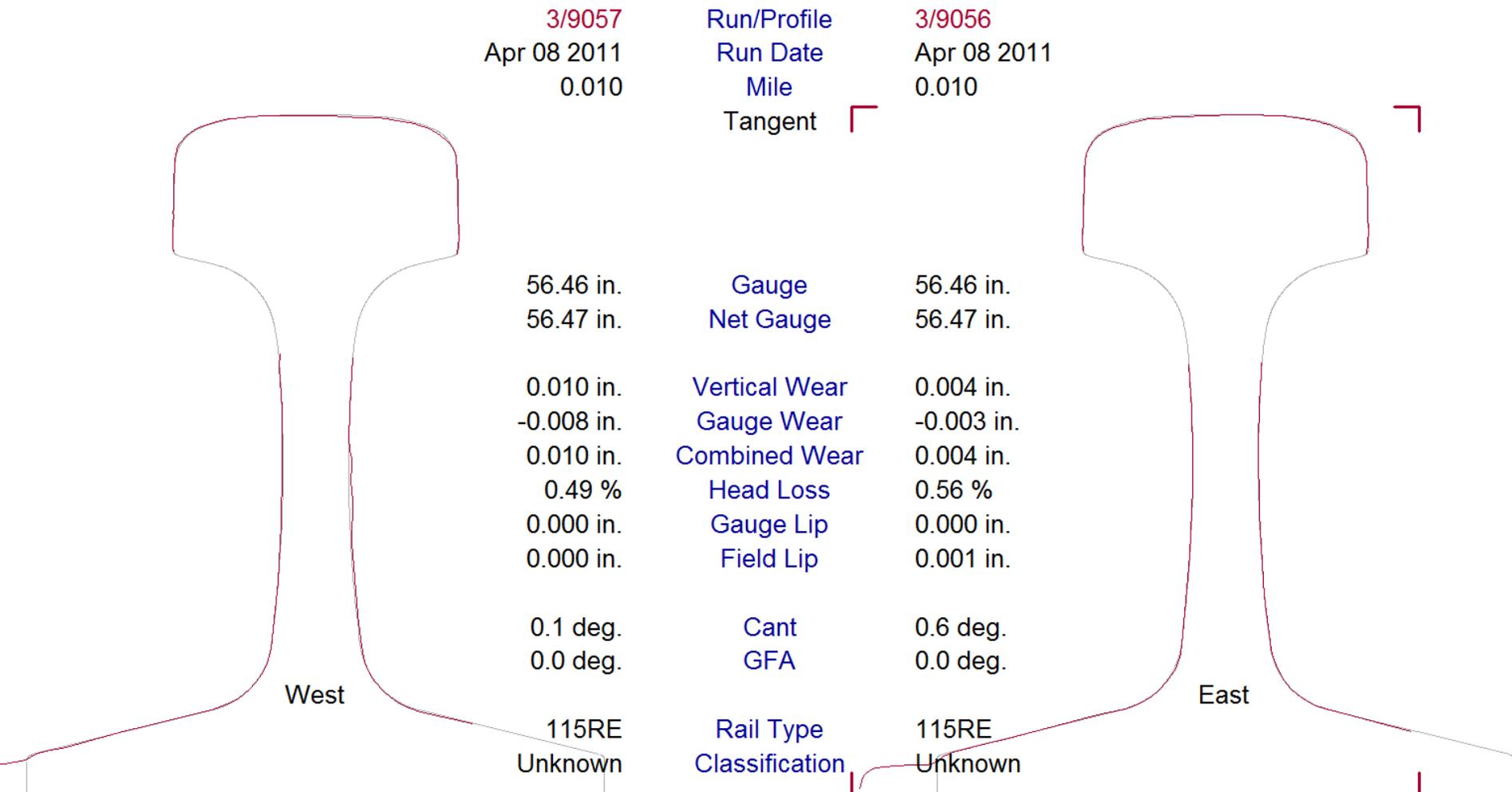
- As Purchased
- Owner's Criteria
- High and Low Rails
- Contractor or Consultant Develops



Wheel and Rail Profiles Match



Rail Profile Examples



Safety

- Worker Qualifications
- Machine Qualifications
- Fire, Smoke, Dust Control
- On-Track Safety Protocols
- Emergency Contacts, Procedures
- Other Factors: Street Track, Road Xings,



Safety Come First

- Address Safety before contractor arrives
- Test and qualify employees before track time
- Inspect equipment before track time (isolated track)
- *NOW* we can go to work



Logistics:

- Equipment Staging Sites
- Mobilization: time, support
- Track Time (adjustments to operations?)
- Consumable Supplies
- Communications



Contract Terms

- Specifications for Finished Work
- Working Conditions
- Pay Items
- Roles of Contractor and Owner Staff
- Liability & Damages
- Special Local Conditions (e.g. Paving Stones)



Pay Items

- Mobilization
- Machine Working Effort:
 - HP Hours (not specifying machine size)
 - “Spark Time” for known HP Machines
- Stand-By Time, Owner Delays
- Minimum Shift
- Re-Work if Profiles or Finish Not Attained



Owner Support Examples

- Staging Areas
- Flagging
- Fire Support
- Roadway Worker Safety Training
- Public Outreach
- Fuel, Water, Security



Special Case: DBOM

- Where All Short and Long Term Costs Come Together
- DBOM Contractor Can Make Business Case for Long Term Benefits
- Start with optimum wheel and rail profiles
- Budget annual maintenance



Measuring for Management

- “To Manage we must Measure”
- Precision Survey of Rail
 - Before and After Profiles
 - Before and After Smoothness
- History of Profiles, Replacements
- Compilation of Annual Work Plan



Construction Contract Parallel

- To Inspect Construction We Use Specialty Inspectors:
- Testing Labs for Concrete, etc.
- Certifications of Materials: Metals, Paint, etc.
- Qualified Inspectors



Laser Rail Profiles

- Basic Knowledge of Before and After
- Develop a History of Conditions
- Software to Visualize and Analyze



Working with Profiles

- Programs to compute grinding effort
- Compilation of grinding by mile/segment
- Priorities
- History: be sure enough metal removal to control RCF

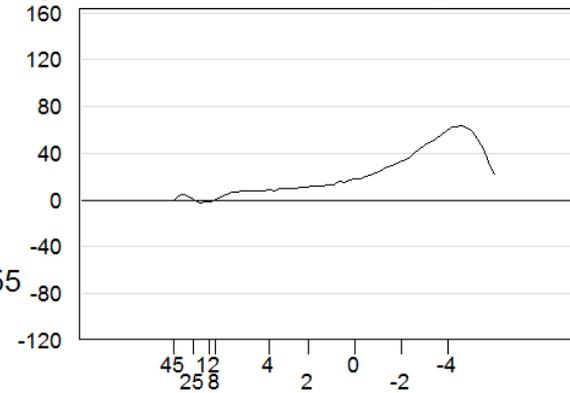
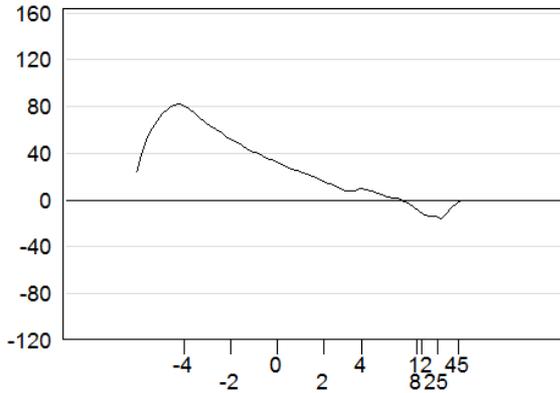


Profile Knowledge

- Records:
 - As-Builts
 - Profiles
 - Rail Replacement History
- Pre-Grind Survey
- Grinder's On-Board Profiles



Laser Rail Survey Example



0.001in

Metal
Removal
(in²)

0.075

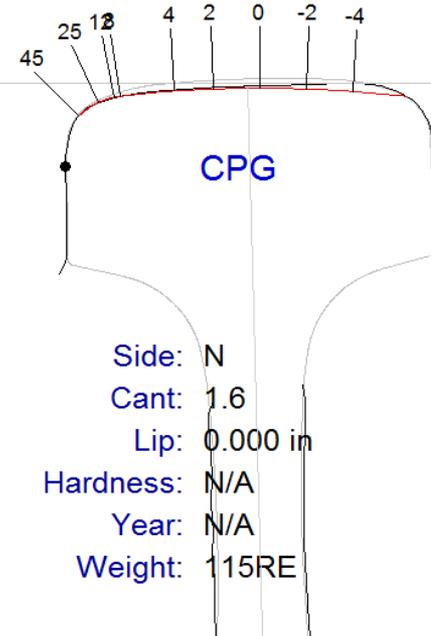
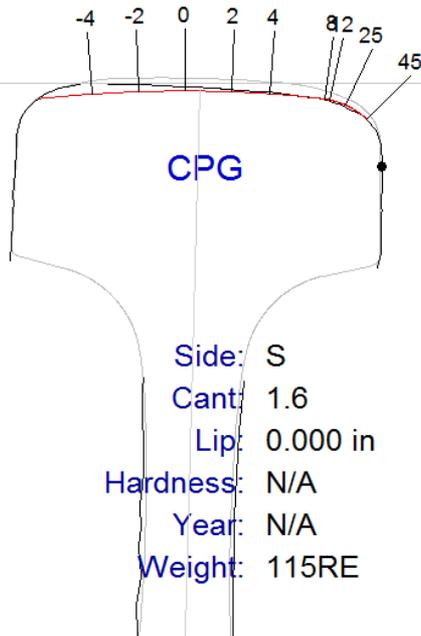
0.055

Curvature: Tangent
Segment: 26.500 - 40.714

Gauge: 56.44 in
PTP: 56.33 in

Stn.: 33.570
Sub: BLINE
Track: EB
Run: 48
Date: Nov 15 2012

S/E: 0.00 in



Rail Surface

- Corrugation:
 - Known Problem Areas: Observations & Complaints
 - Incipient Corrugation Formation
- Rail Surface:
 - Mill Scale
 - Prior Grinding Marks
 - Welds, Engine Burns, etc.



Work Plan

- Number of Passes, Stone Angles to get from existing to target profiles
- Compile work effort by segment, mile, line
- Priorities:
 - Largest Variances from Design Profiles
 - Most Sensitive Areas
 - Skip Short Term Replacement Areas
 - Cover all new rail
 - Surface Defects Removed
 - Be sure sufficient to control RCF



Not so Simple, Eh?

- Different amounts of time per mile
- Different finished profiles
- Finished rail surface



Post-Grind Survey

- Key to Quality:
 - Rail Profiles
 - Rail Surface
 - Metal Removal
- Key to Measurement for Payment:
 - Metal Removal
 - Profile Attainment
 - Finished Rail Surface



Inspection = QC, QA

- Dedicated, Knowledgeable Inspector
- Independent Survey Assures Unbiased Data (but possible to use grinder's laser)
- Alternative Surveys:
 - Laser Profile Surveys
 - “Star” and “Bar” hand gauges
 - Visual (roughness)
- Best: Near Real Time



Measurement for Payment

- No Matter How You Do It, Measure the Result
- Contract Criteria:
 - Profiles
 - Roughness
 - Metal Removal
 - Locations to be Ground
- Work Accomplished:
 - Hours Available
 - Hours Worked
 - Miles Accomplished
 - Profiles Attained



Summary:

- Grinding is a very technical service
- Not a “commodity” easily bid
- Can/Should Be Inspected and Measured
- Contracting Challenges
- Work Plan Challenges
- Budget Limits



Questions?

We want it to look like this:

