

# 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

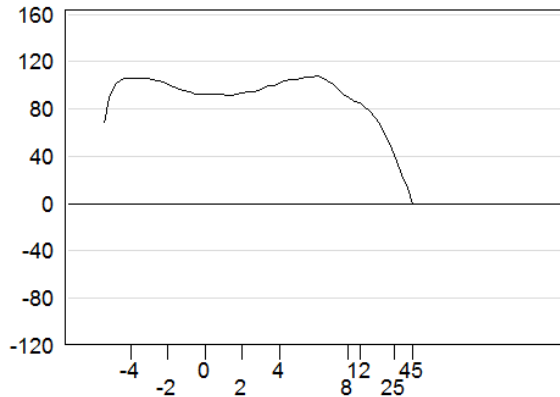
- *Beforehand: to plan and budget*
- *On-Board the grinder: to control the process*
- *(More later)*



# Laser Survey



# Laser Rail Profile Sample

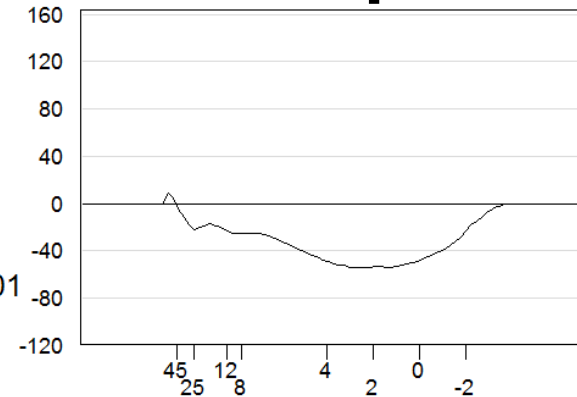


0.001in

Metal  
Removal  
(in<sup>2</sup>)

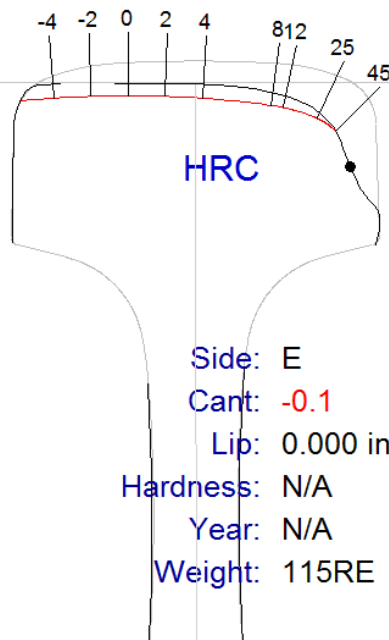
0.214

0.001



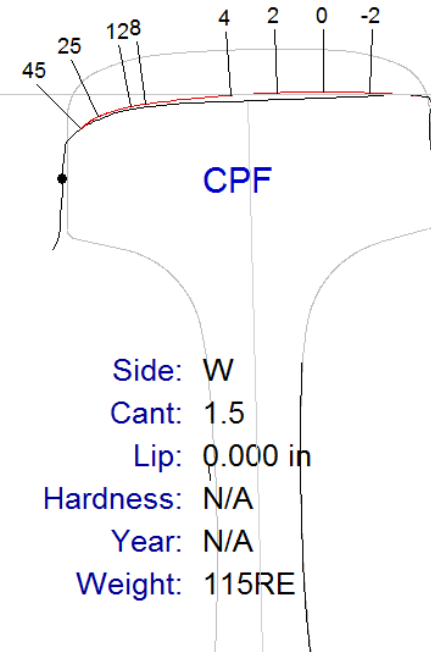
Curvature: 14.1 deg. R  
Segment: 240.210 - 245.948

Gauge: 56.88 in  
PTP: 56.80 in



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

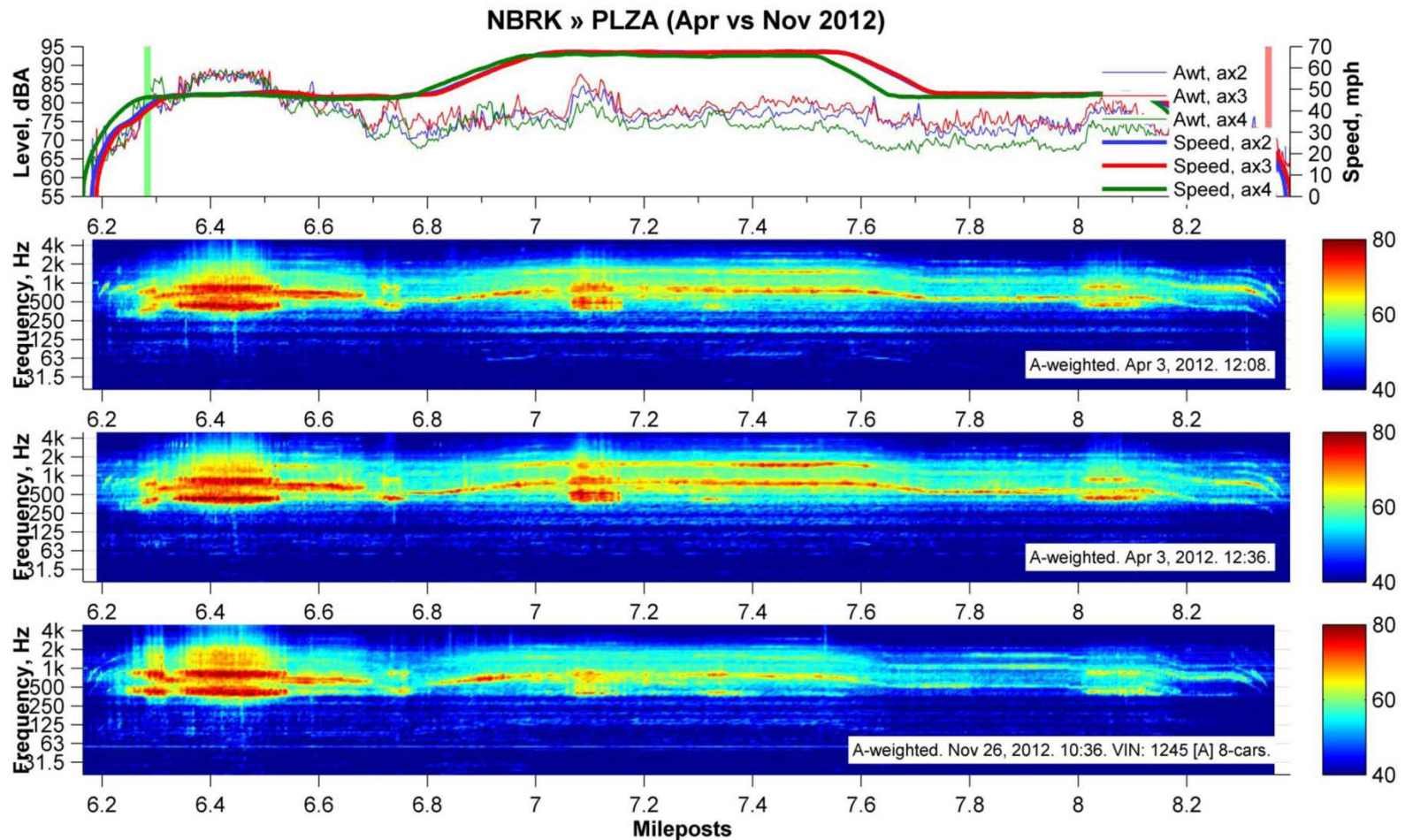
S/E: 0.00 in



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



# Sound Surveys

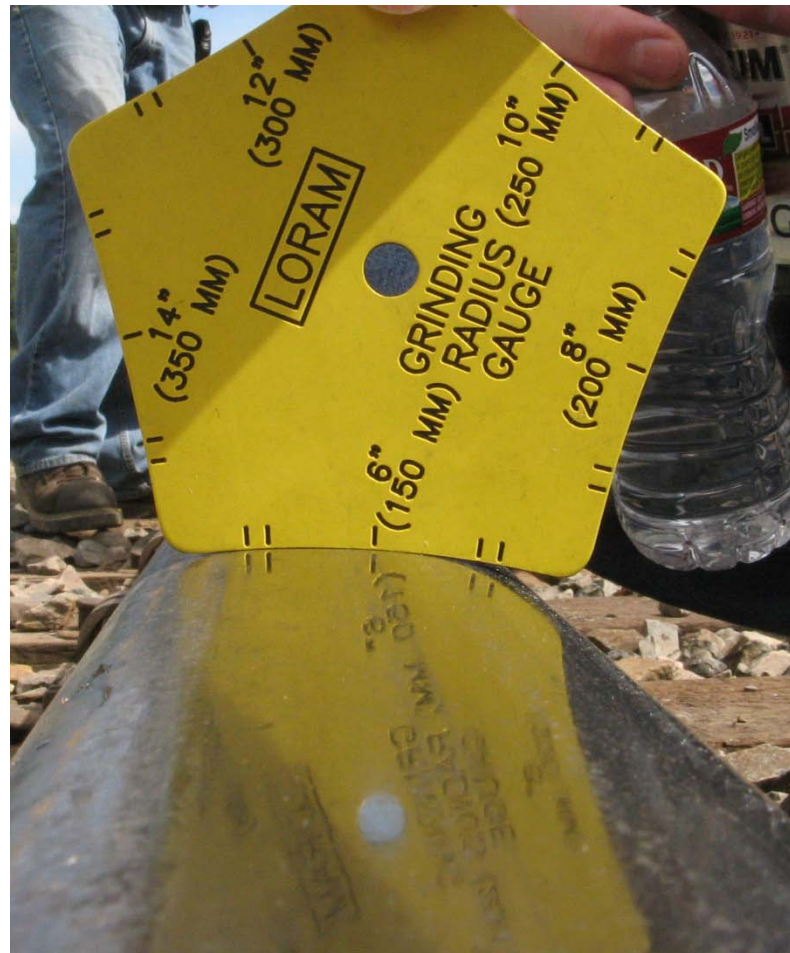


# Hand Tool Methods

- 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



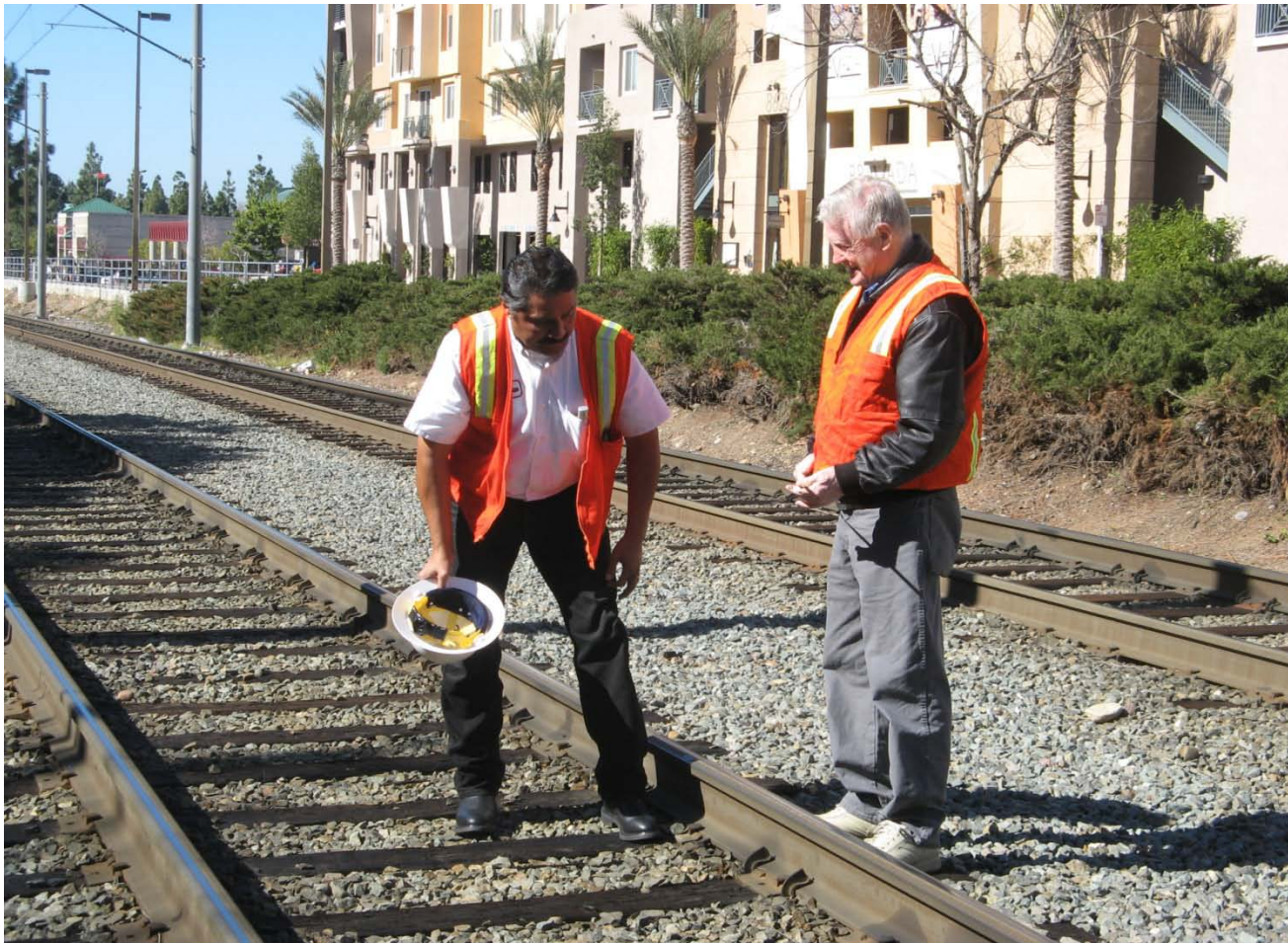
# Paint Band: 2-Point High Rail Contact



# Paint Band: Corrugation



# Staff Observations



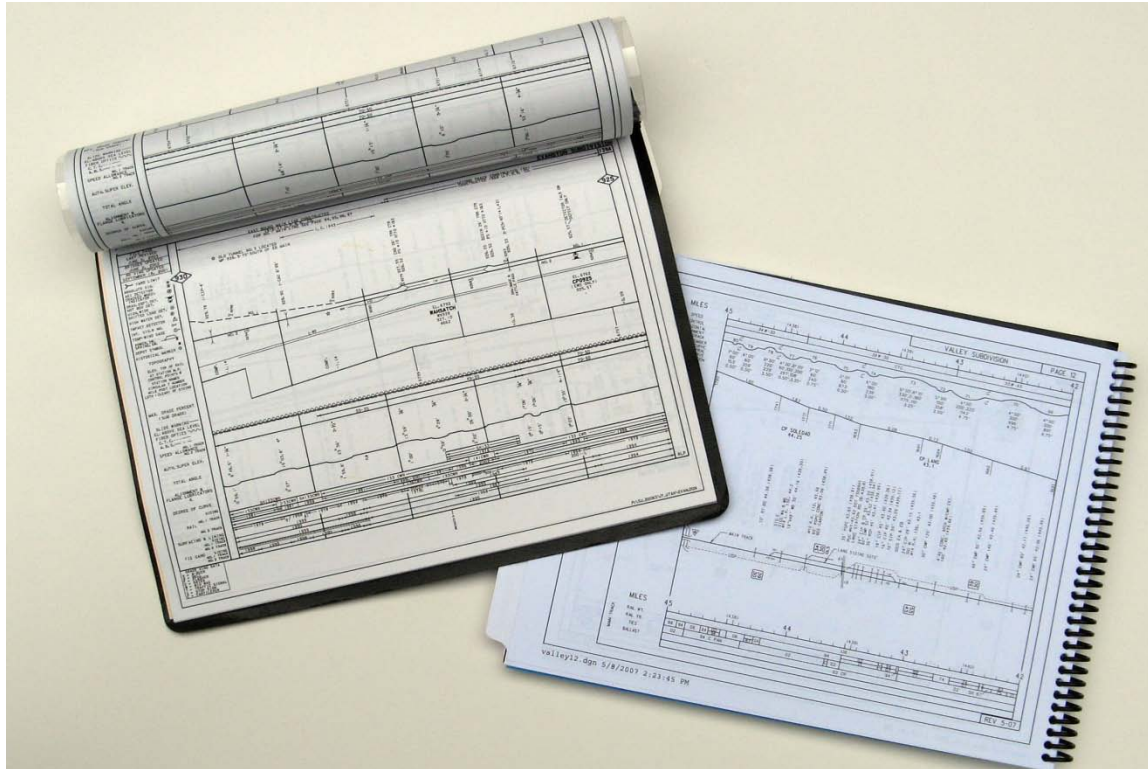
# Staff Observation: Corrugation



# 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.

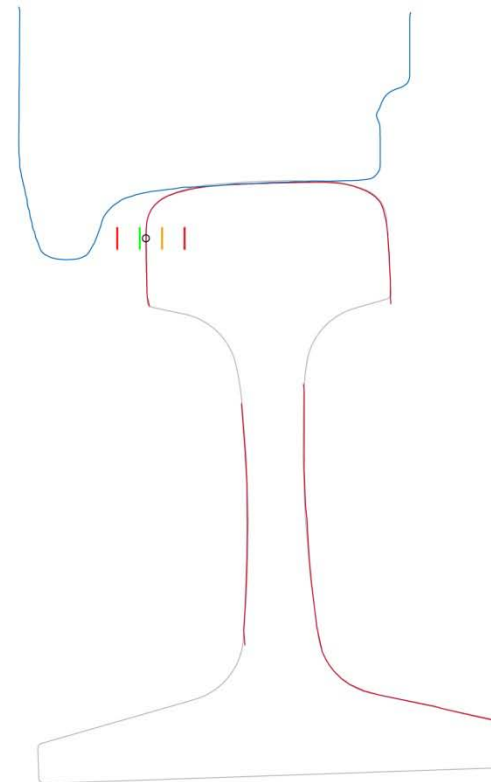
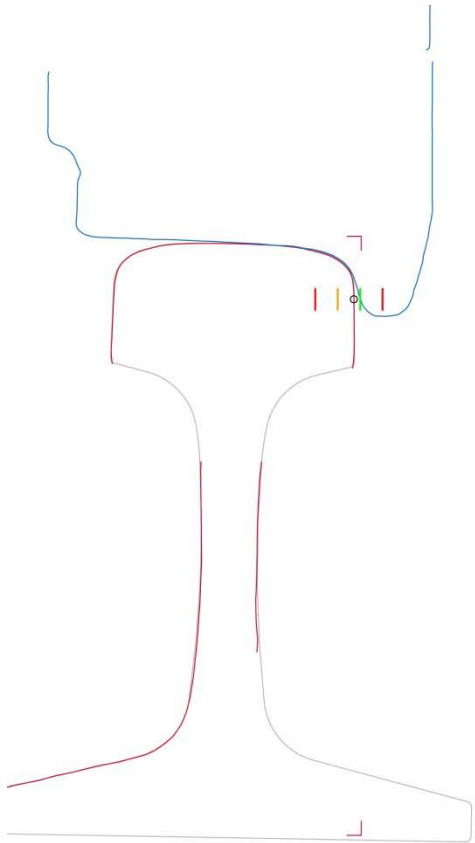


# Rail Profiles

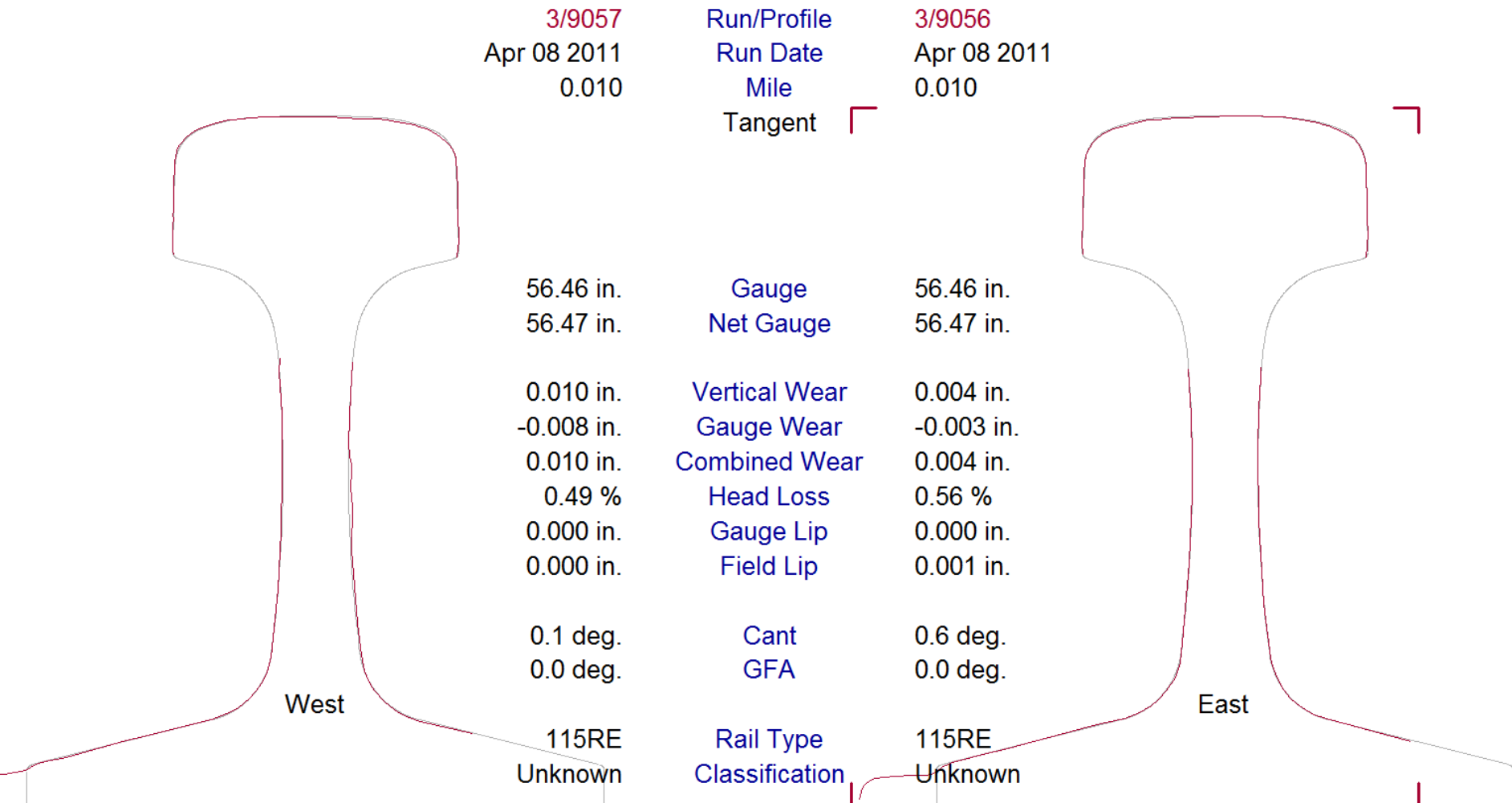
- As Purchased
- Owner's Criteria
- High and Low Rails
- Contractor or Consultant Develops



# 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

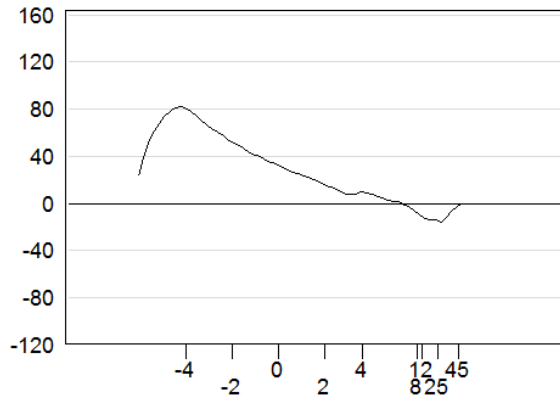


# Profile Knowledge

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



# Laser Rail Survey Example

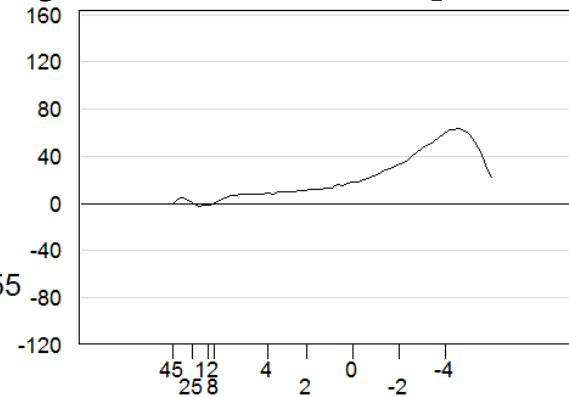


0.001in

Metal  
Removal  
(in<sup>2</sup>)

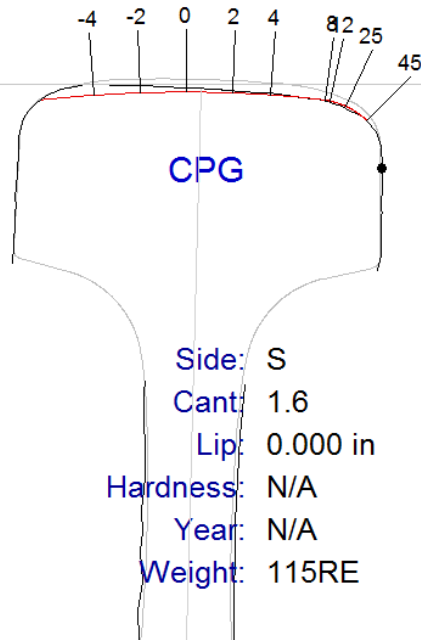
0.075

0.055



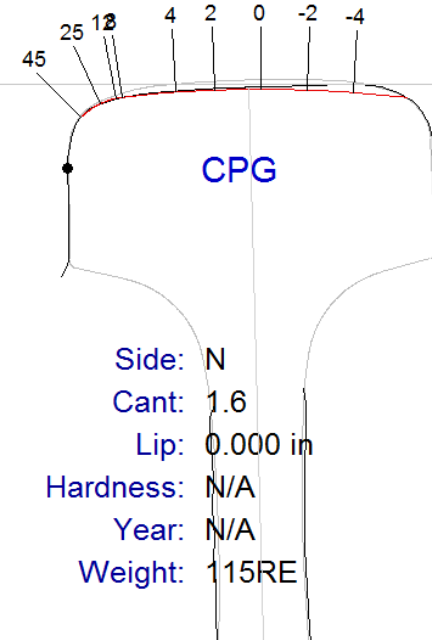
Curvature: Tangent  
Segment: 26.500 - 40.714

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:

