

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

Simply: “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
- (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, Gauge Widening
- 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
- Hand Tool Methods
- Maintenance Staff Observations
- Rail Replacement Data
- Building Data for Rail Maintenance Program



Laser Surveys

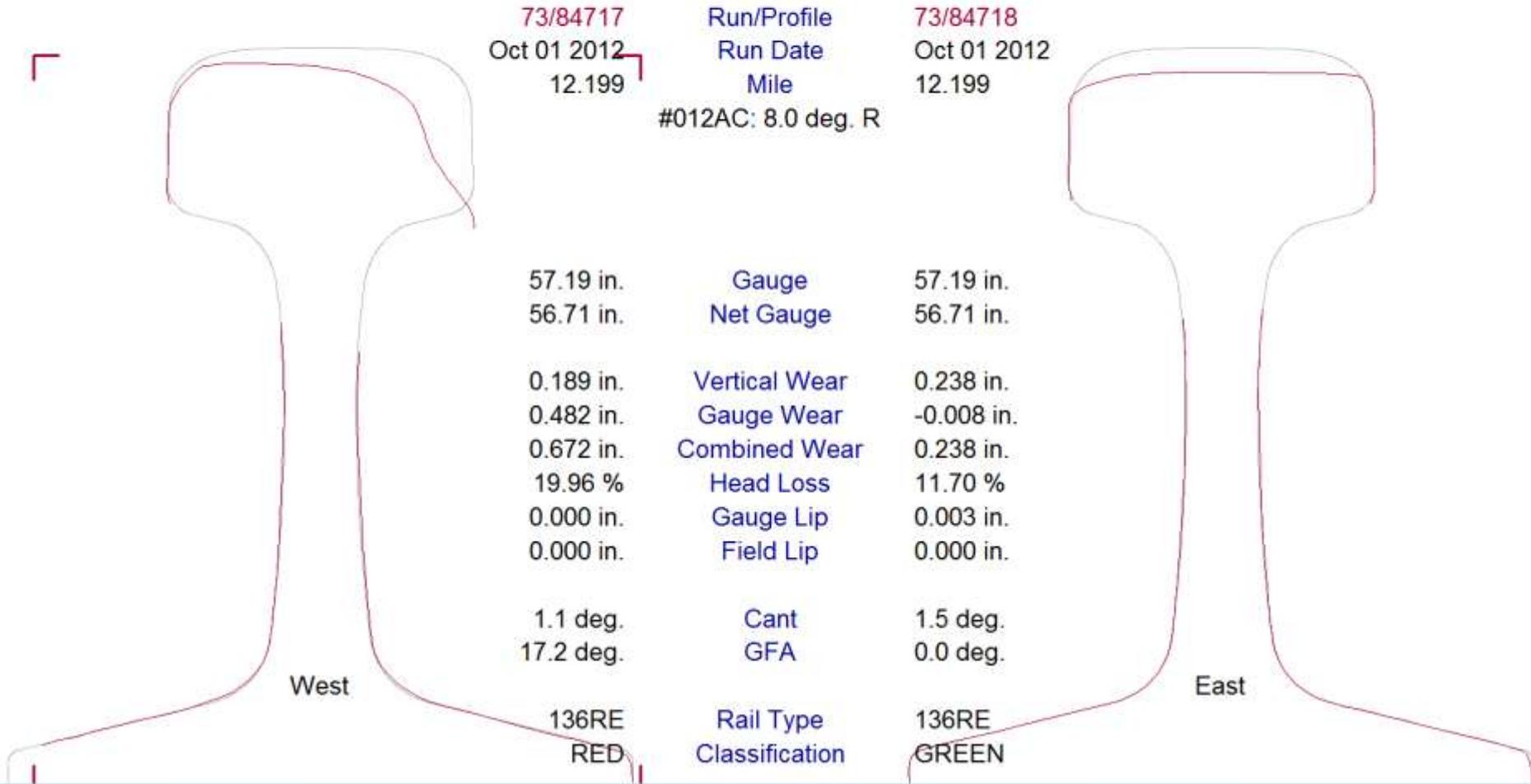
- *Beforehand: to plan and budget*
- *On-Board the grinder: to control the process*
- *(More later)*



Laser Pre-Grind Survey



Sample Rail Profile



Hand Tool Methods

Profile Plotters (several)

Star Gauge

Bar Gauge

Wear Gauges

Paint Bands



Hand Tools: Star Gauge



Hand Tools: Bar Gauge



Hand Tools: Wear Gauge



Paint Bands: High Rail



Paint Bands: Corrugation



Staff Observations: Rail Planning Trip



Staff Observations: Regular Inspections



Staff Observations: Corrugation



Staff Observations: Wheel Slips



Track Charts: Rail History



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.

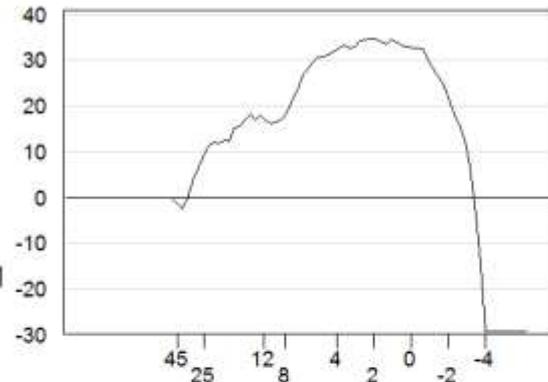
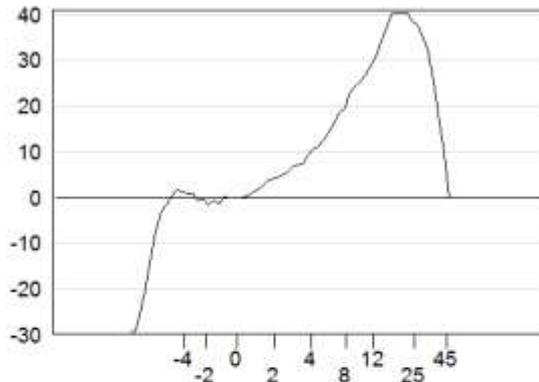


Rail Profiles

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



Rail Profile Examples



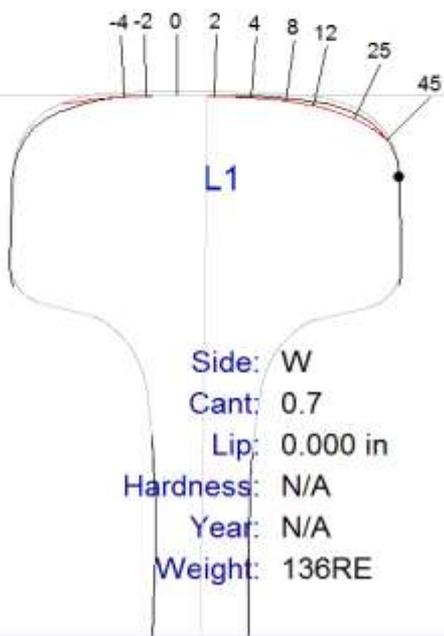
0.001in
Metal Removal
0.032 (in²) 0.051

Curvature: 3.4 deg. L
Segment: 12.270 - 12.343

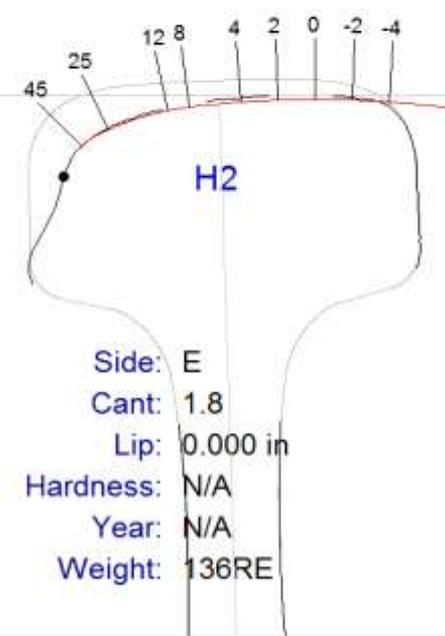
Gauge: 57.10 in
PTP: 56.96 in

Mile: 12.306
Sub: MAIN
Track: MNL
Run: 73
Date: Oct 01 2012

S/E: 0.95 in



Side: W
Cant: 0.7
Lip: 0.000 in
Hardness: N/A
Year: N/A
Weight: 136RE



Side: E
Cant: 1.8
Lip: 0.000 in
Hardness: N/A
Year: N/A
Weight: 136RE



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
- Liabilities & Damages
- Special Local Conditions



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



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

- Previous Records: Profiles, Rail Replacements
- Pre-Grind Survey
- Grinder's On-Board Profiles



Rail Surface (profile may be OK)

- 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



Inspection = QC, QA

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



Post-Grind Inspection

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



Post Grind Inspection: Bar Gauge



Measurement for Payment

- No Matter How You Do It, Measure the Result
- Contract Criteria:
 - Profiles
 - Roughness
 - Metal Removal
- Work Performance:
 - Hours Available
 - Hours Worked
 - Critical Sites Accomplished



Not so Simple, Eh?

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



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:

