Profile Rail Grinding & Optical Rail Measurement

San Diego Trolley

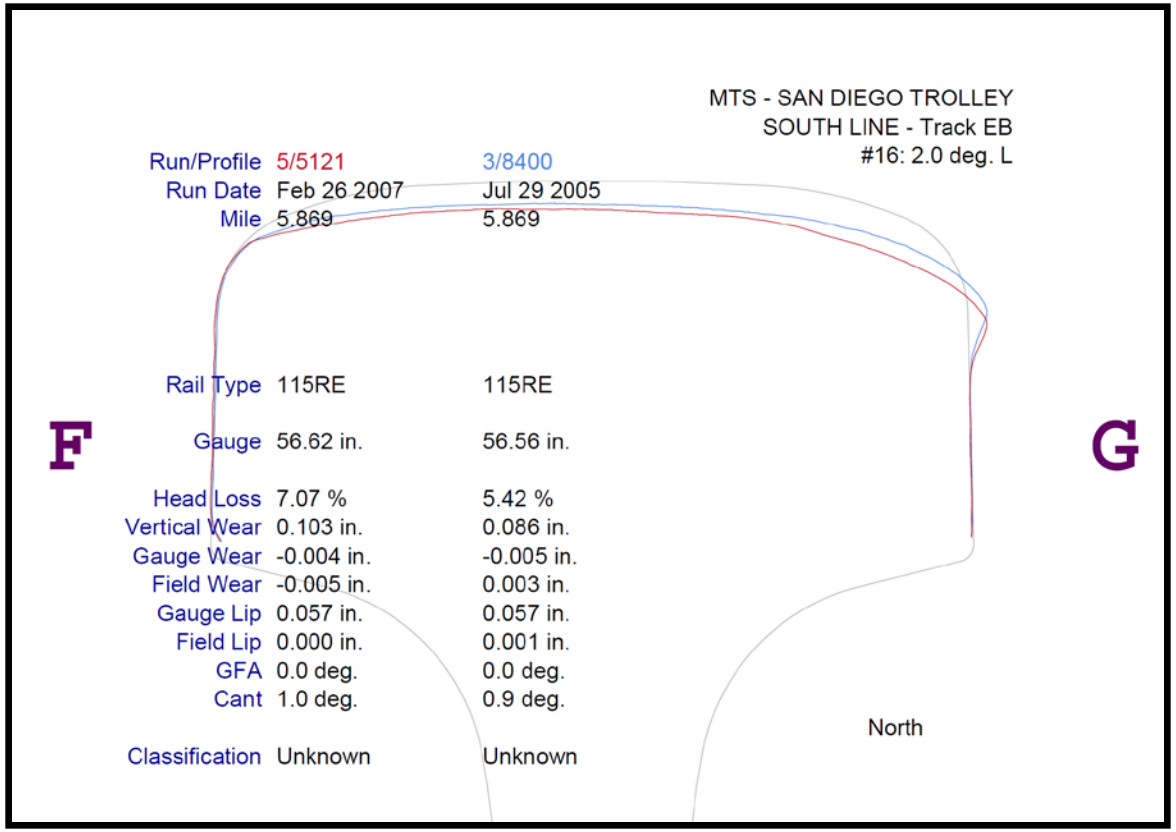
San Diego Trolley – System Map

Profile Rail Grinding

SPENO INTERNATIONAL SA

LORAM
SPEED PERFORMANCE RELIABILITY

Optical Rail Measurement

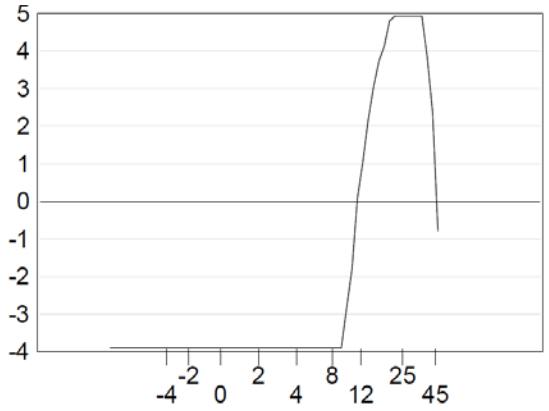


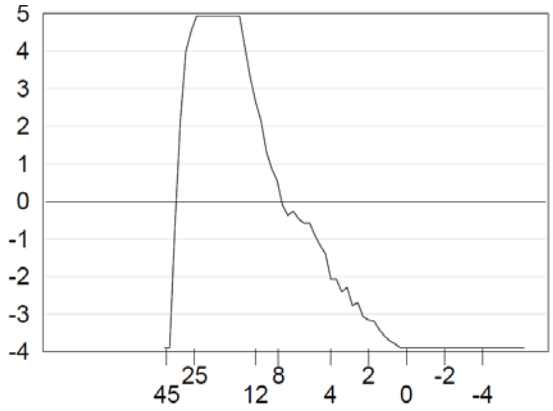
KLDLABS
MEASUREMENT TECHNOLOGIES

Holland

INDUSTRIAL METRICS
DIVISION OF HOLLAND LP

Optical Rail Measurement





0.1mm

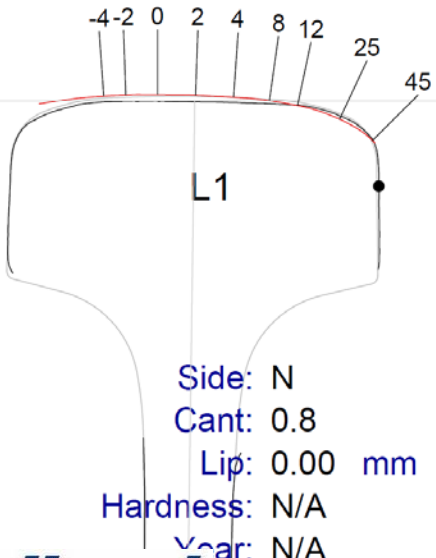
Metal Removal

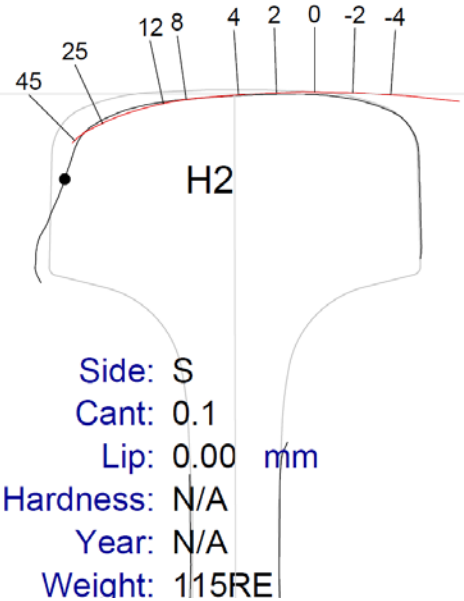
6.796 (mm²) 8.411

Curve: 4.00 Left

Gauge: 56.88 in

PTP: 56.6 in





Run: 3
Sub: SOUTH LINE
Track: EB
Mile: 0.539
Date: Jul 29 2005

S/E: 0.00

Side: N
Cant: 0.8
Lip: 0.00 mm
Hardness: N/A
Year: N/A
Weight: 115RE

Side: S
Cant: 0.1
Lip: 0.00 mm
Hardness: N/A
Year: N/A
Weight: 115RE

Holland

INDUSTRIAL METRICS DIVISION OF HOLLAND LP

History of ARM on San Diego Trolley

- *Initial discussions and demonstrations started around 2005 (optical measurement, demo grind programs)*
- *Progressive increase in work in both areas from 2006-2008*
- *ARM awarded 5-year turn-key Rail Management services contract in Nov. 2008*
- *Utilized Loram during first two years, Speno in years 3-4*

Profile Rail Grinding

Embedded track

Open track

Why Perform Rail Grinding ?

- ***Control Surface Defects***
  - ***Remove microcracks to control contact fatigue***
  - ***Remove shells, spalls***
  - ***Remove corrugations***
  - ***Extend rail life***

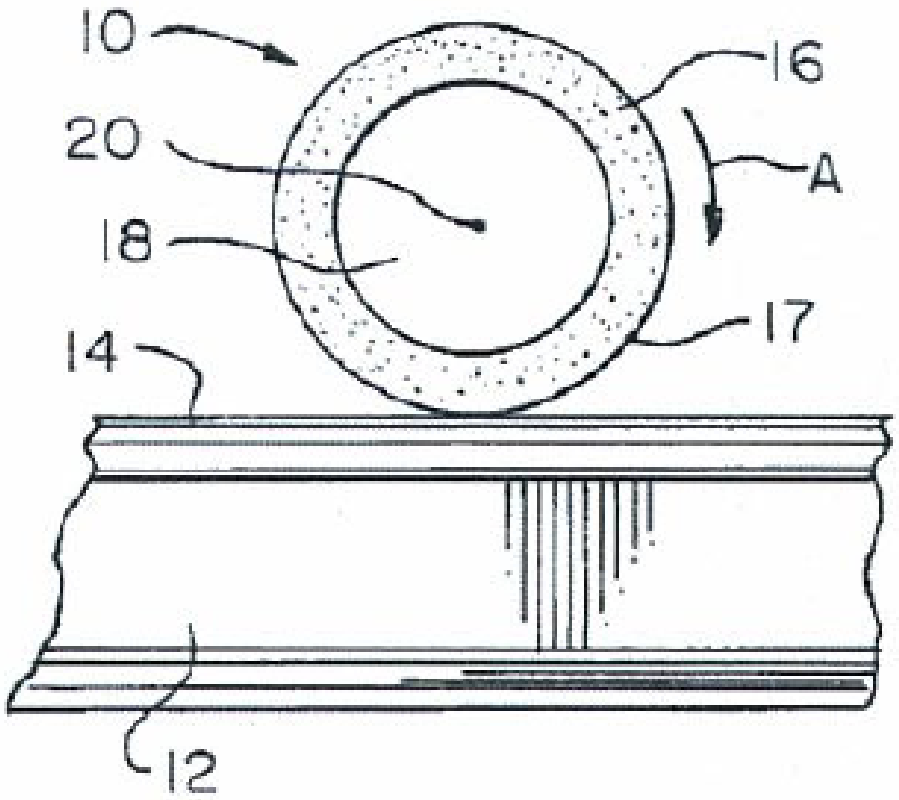
Why Perform Rail Grinding ?

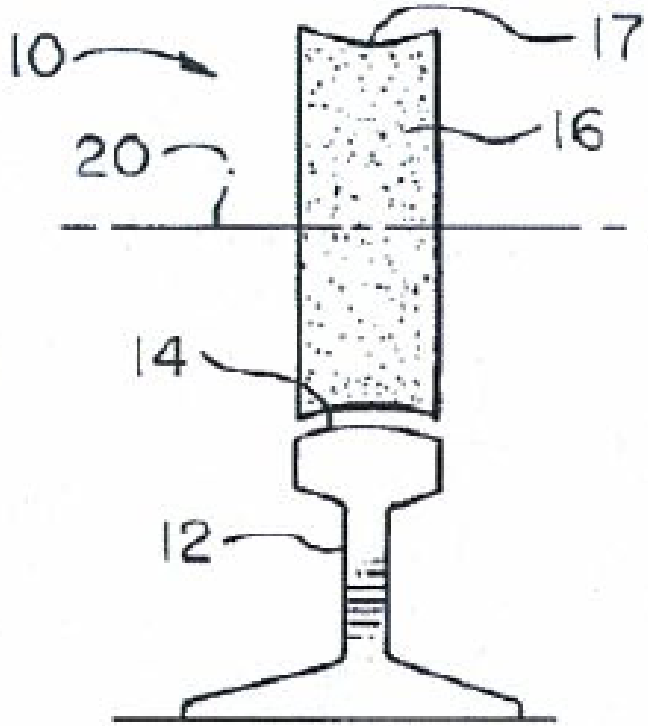
- ***Improve Wheel/Rail Interaction***
  - ***Reduce contact stress***
  - ***Improve wheelset steering***
  - ***Reduce lateral forces & gauge wear***
  - ***Improved ride quality***
  - ***Reduce noise levels***
  - ***Reduce fuel consumption***

Unique Grinding of Embedded Truck

Type 1 grinding

(no longer used – used in 1990s)

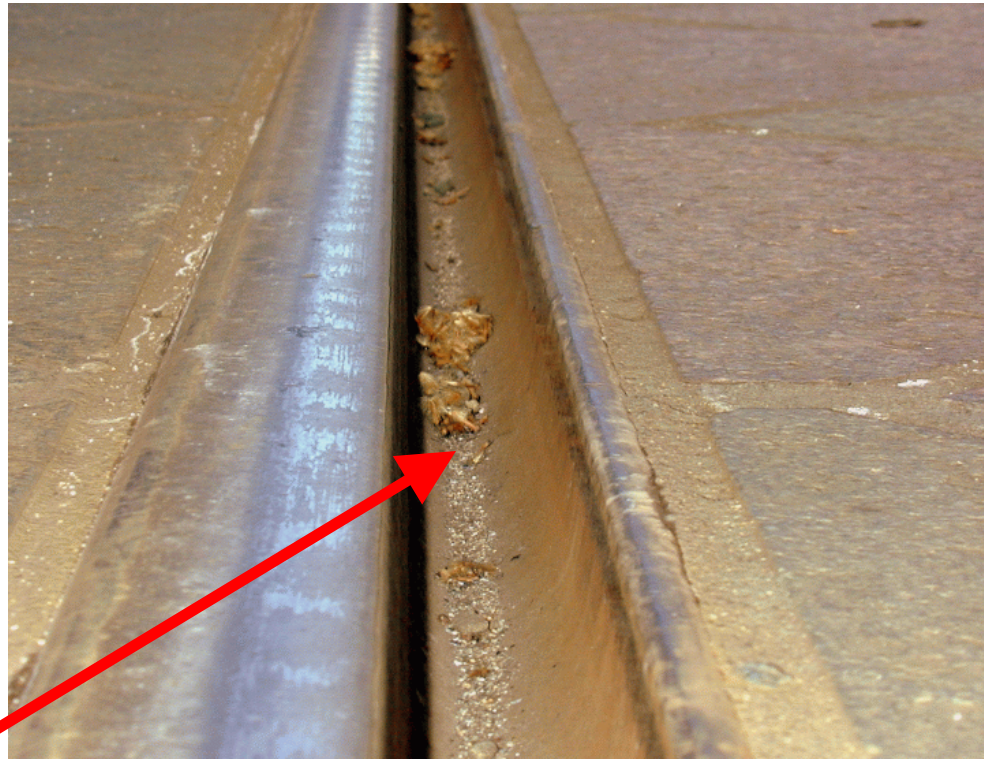




Type 2 grinding
(conventional method for open track)

Uses bottom of stone

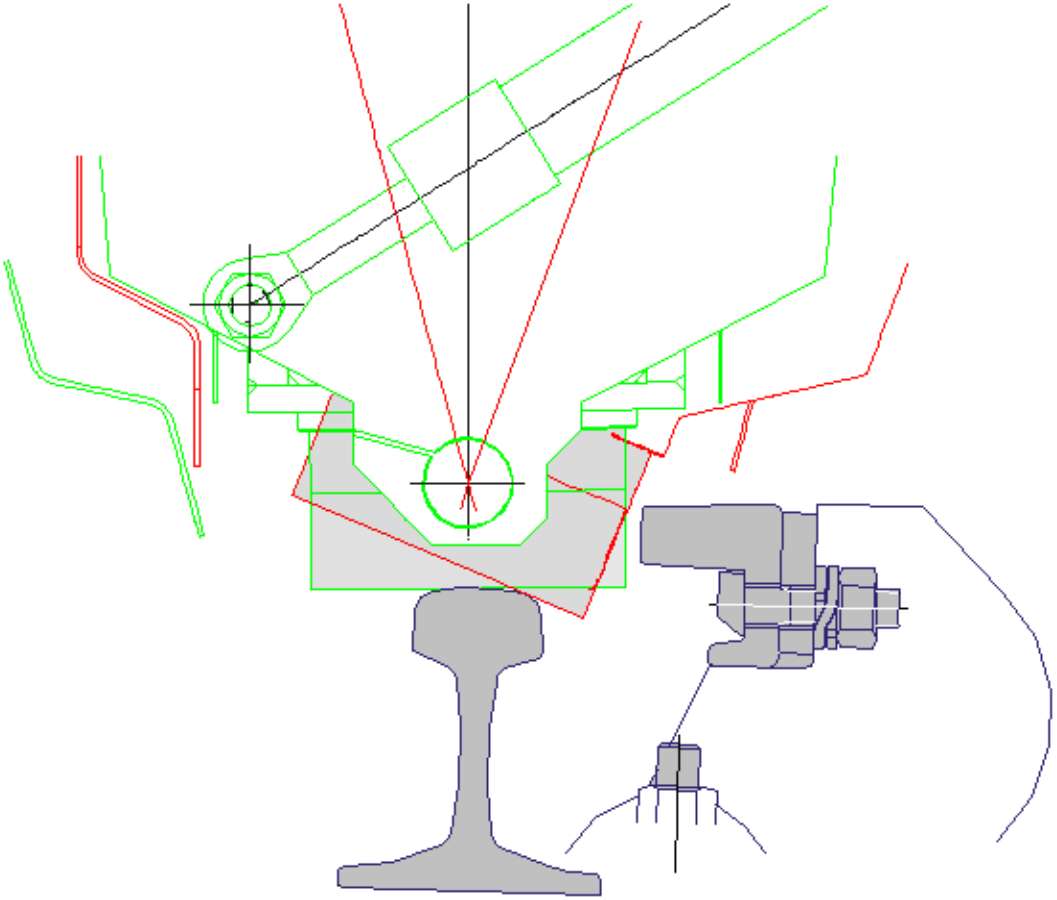
Type 2 grinding



Type 2 grinding fouls embedded track

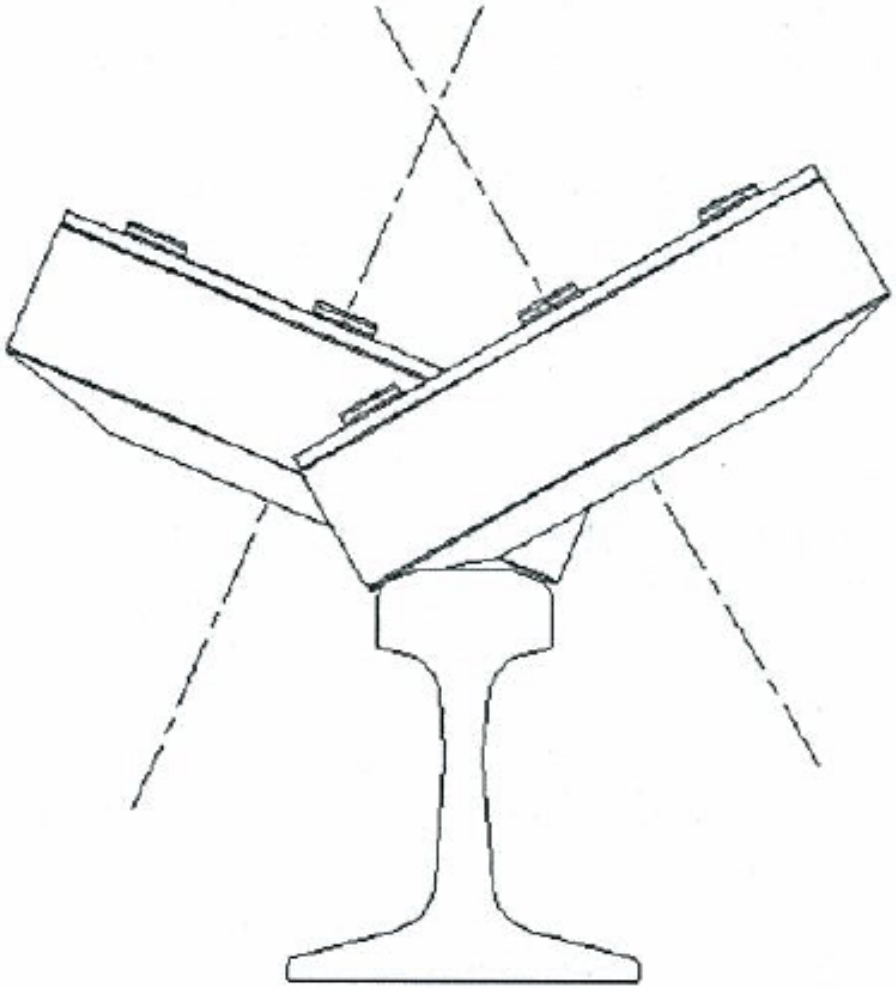
Obstacles restrict conventional type 2 grinding strategy being used in Embedded Track

Existing Grinding Strategy in Embedded Track



Type 3 offset grinding

(used in embedded track, road crossings)

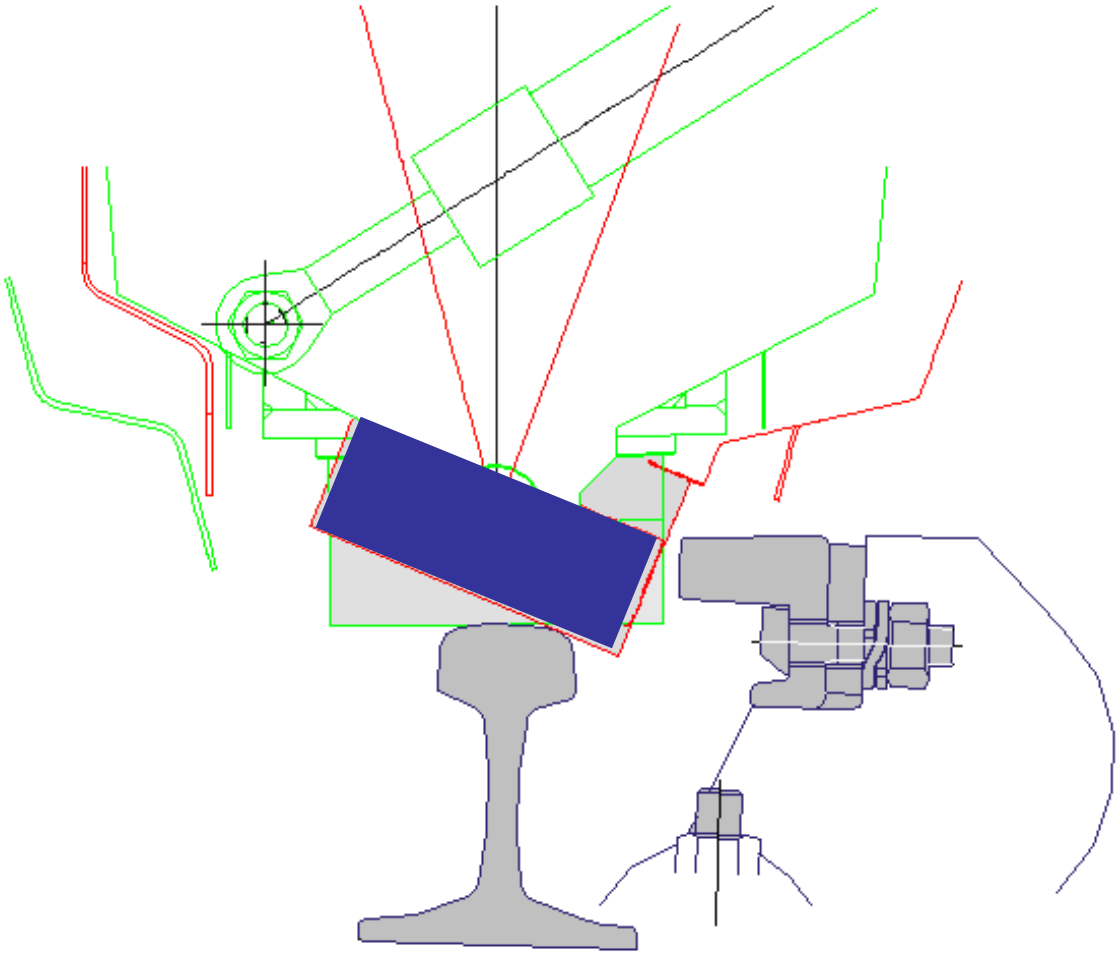


Rail Grinding Embedded Rails

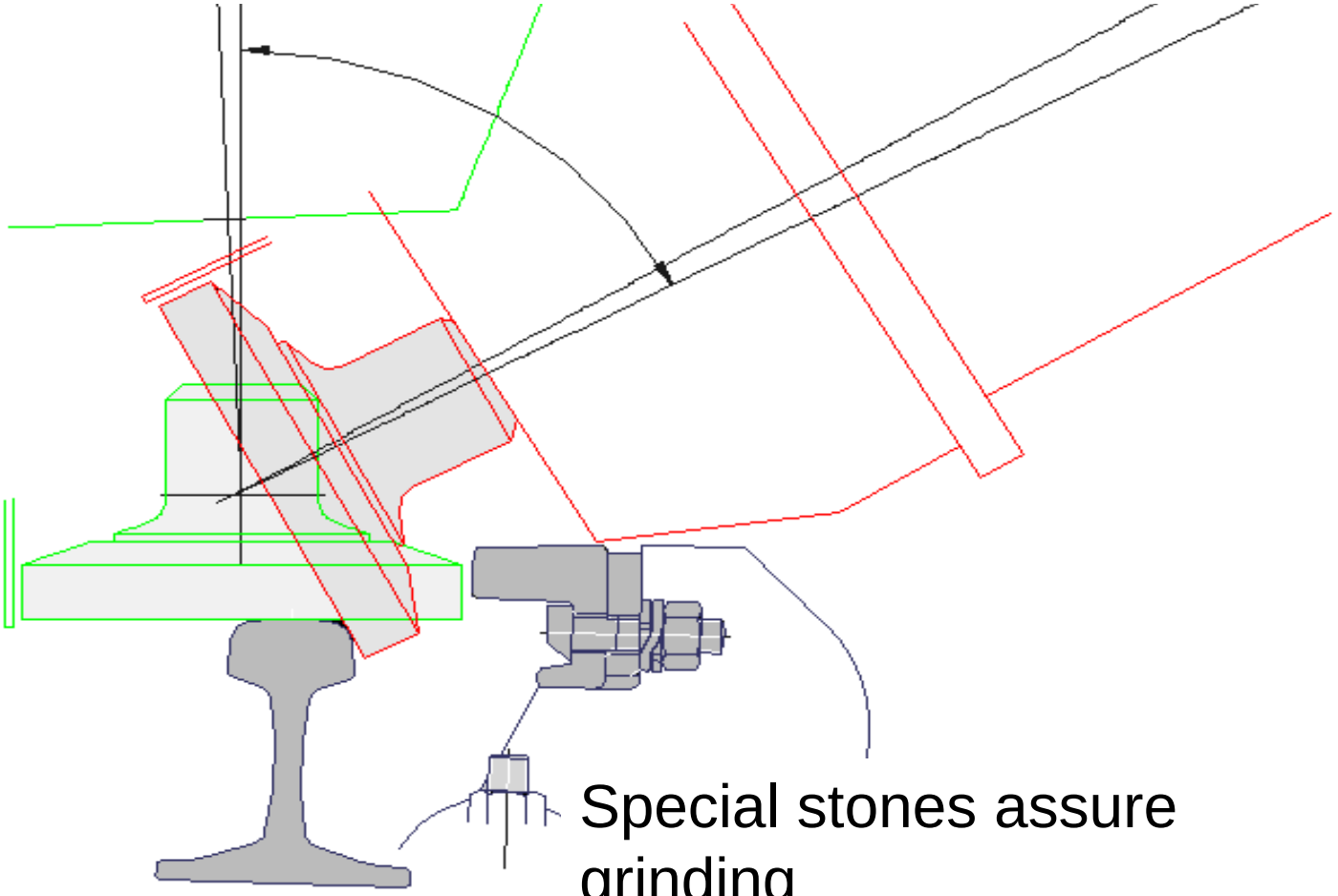
In the past, embedded track was very challenging to grind, and full profile grinding was not possible.

- ***grinding equipment not able to orient grinding stones in the "normal" position used in open track due to clearance restrictions – stones were too big***
- ***tight clearances (flangeway, girder rail, pavement)***
- ***problems navigating tight radius curvature***

Existing Grinding Strategy in Embedded Track



New Grinding Strategy in Embedded Track



Special stones assure grinding
of the gauge corner down to -70°

Speno SRR16-M4

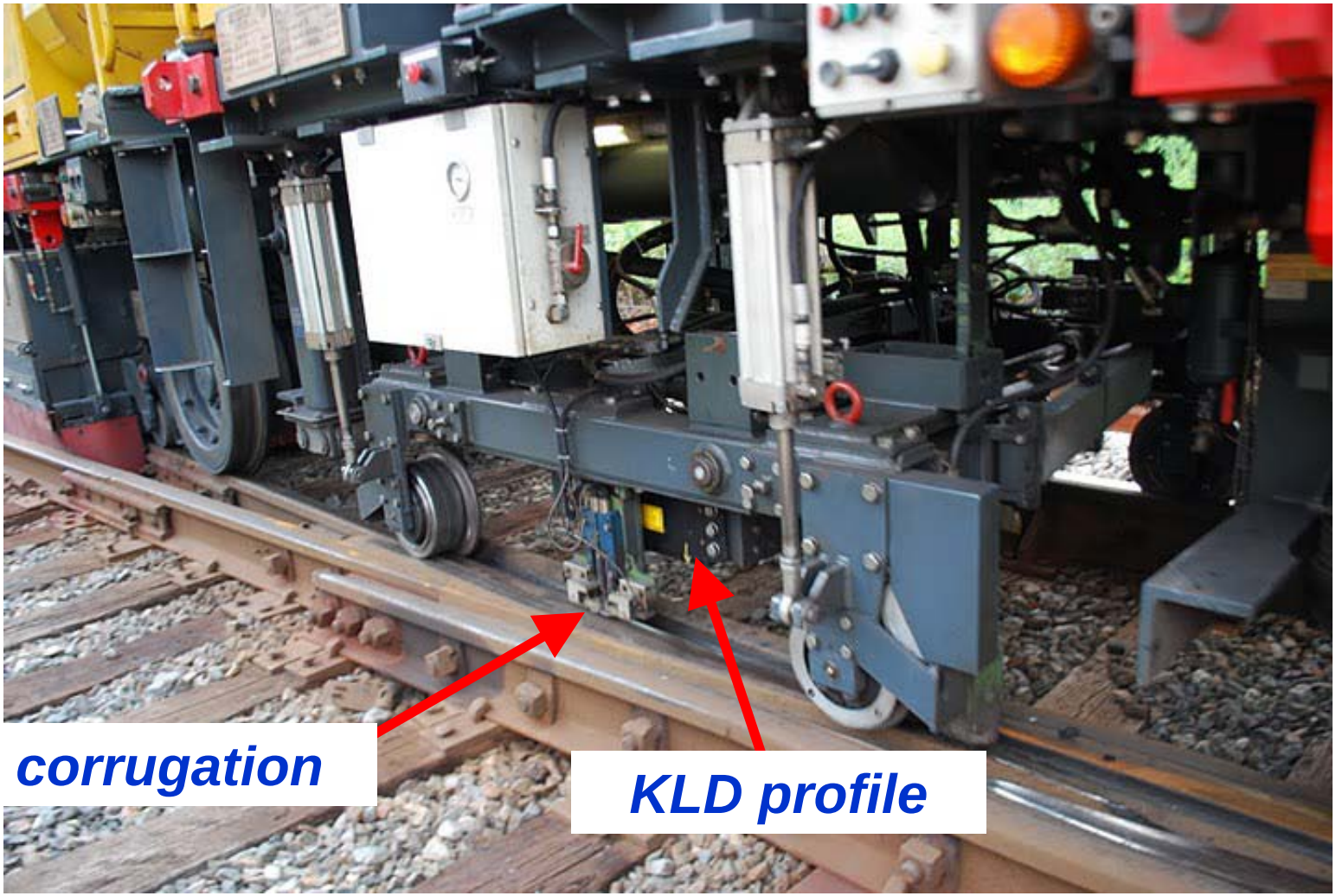
16-stone machine

- *capable of grinding embedded rail (uses small stones) in tangent and curves down to 25 m rad.*
- *very smooth surface finish (< 10 µm)*
- *equipped with automated, real-time measuring systems for monitoring and recording:*
  - ► *corrugation*
  - ► *cross section profile*

Speno SRR16-M4

measuring trolley

measuring trolley



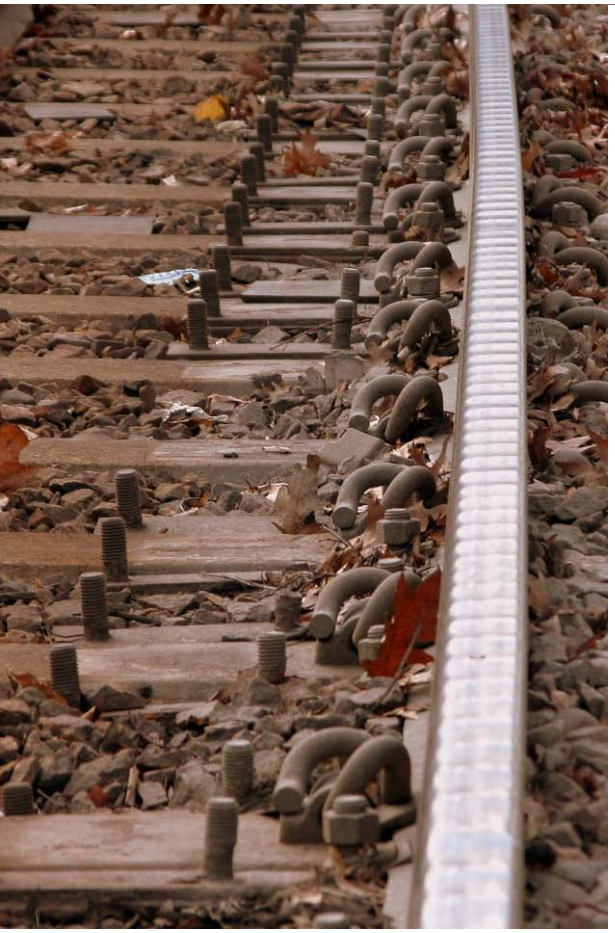
Pre-grind rail condition with corrugation

Grinding embedded roadway section

Post-grind rail condition – corrugation removed

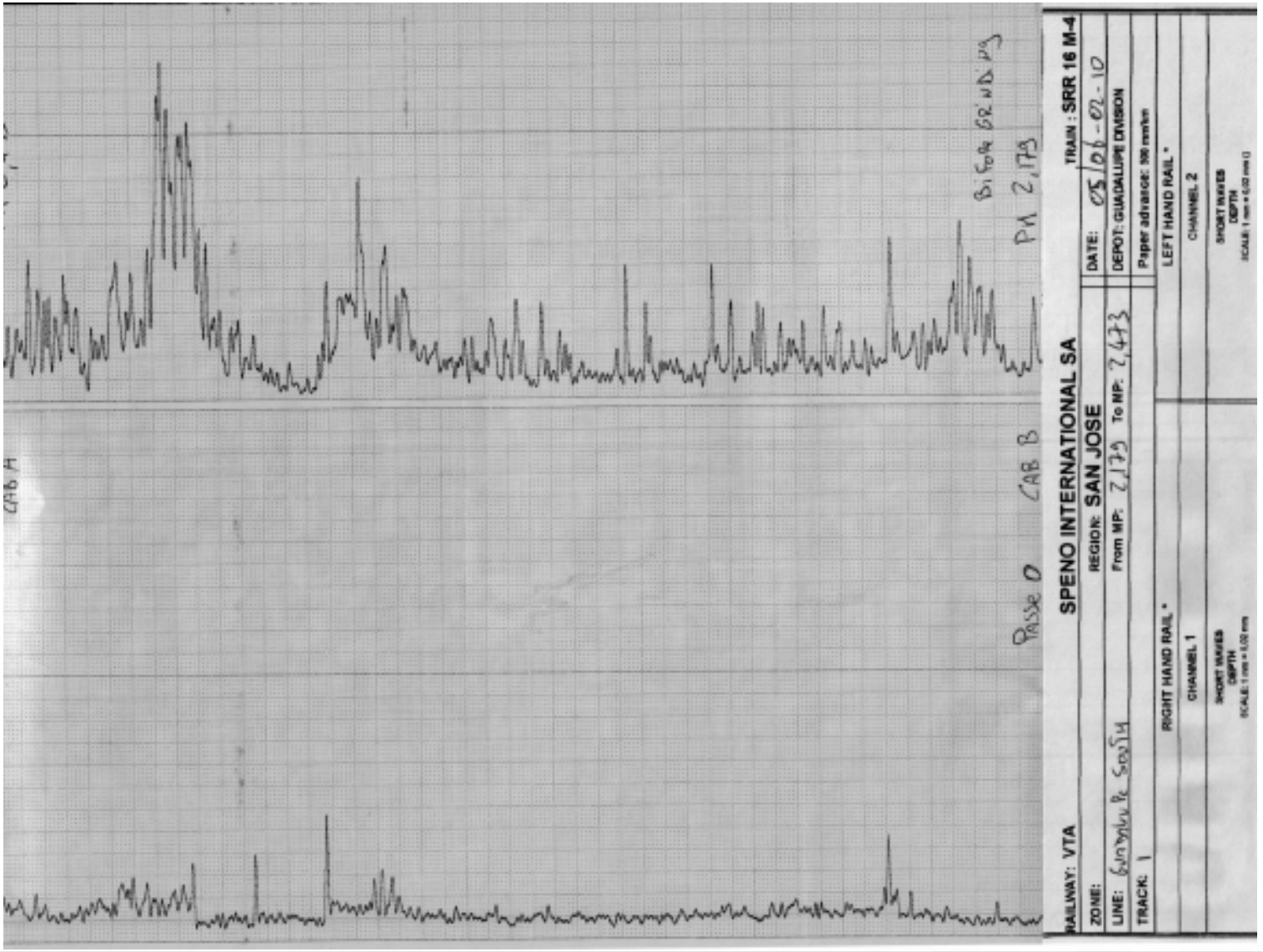
Pre-grind rail condition with corrugation

Pre-grind rail condition with corrugation

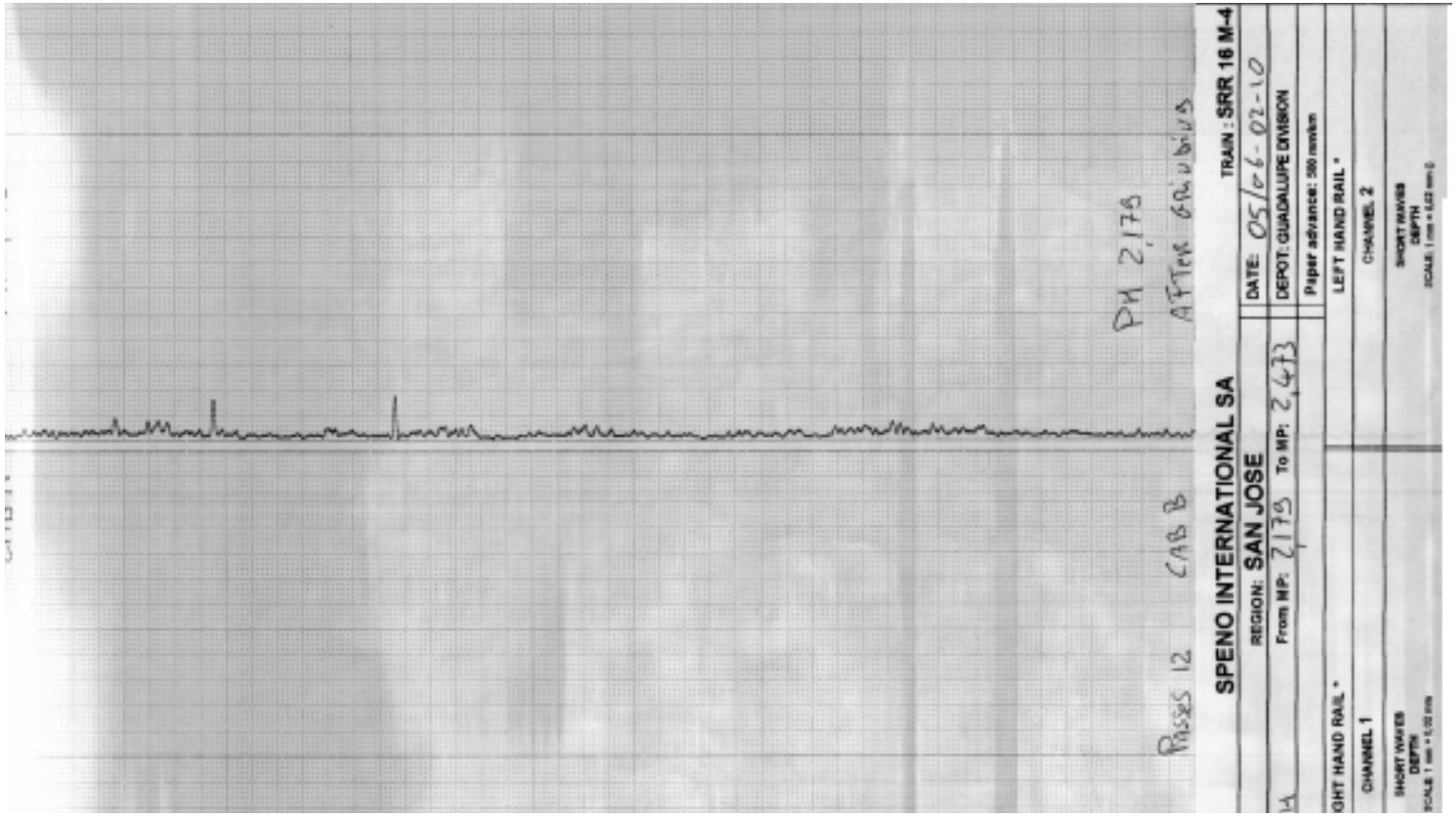


Grinding embedded roadway section

CORRUGATION BEFORE GRINDING



CORRUGATION CHART AFTER GRINDING



Spec. is to reduce corrugation to 0.02 mm over 200 mm.

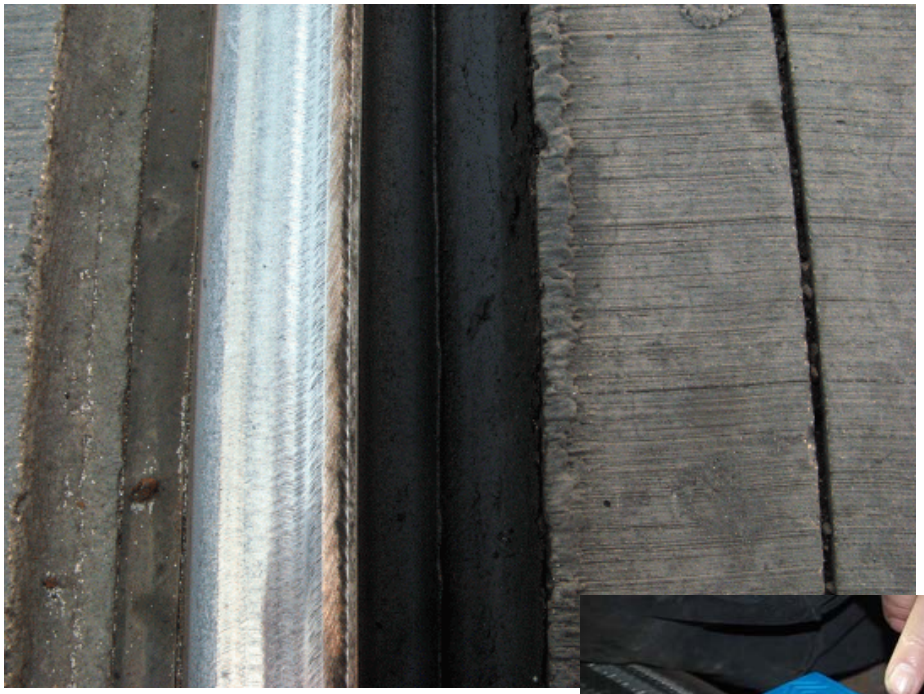
Post-grind rail condition – corrugation removed

Rail Grinding Embedded Rails

In addition to removing corrugations, this machine produced a very smooth rail surface finish not achieved in the past.

Very smooth surface finish

(5-10 µm)

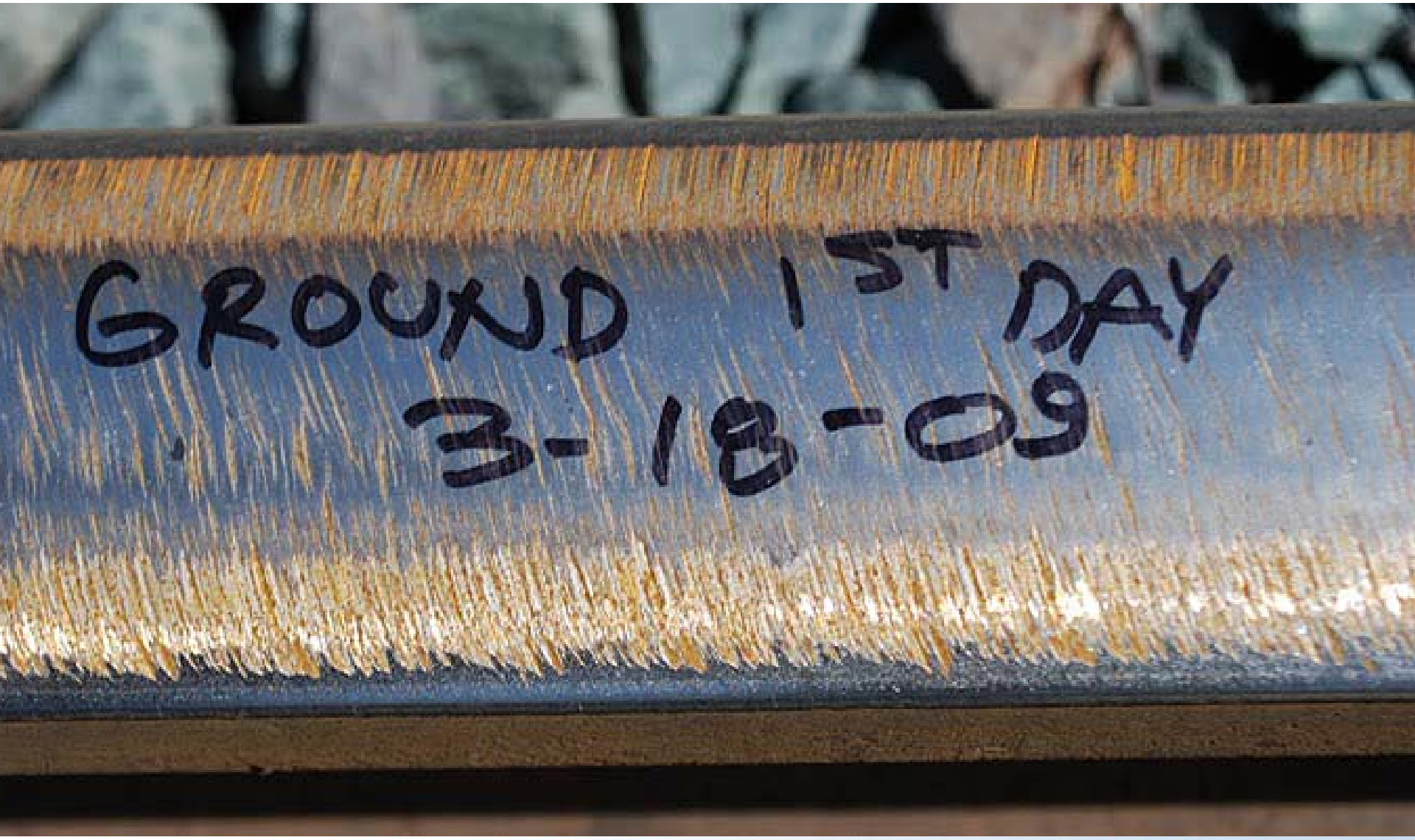


Hommel tester

Very smooth surface finish

Previous typical post-grind "rough" surface finish

(> 15 µm)



Previous typical post-grind "rough" surface finish

(> 15 µm)

Precise Rail Profile Implementation

Another important enhancement to the work in San Diego was the use of a laser-based profile measuring system to measure before and after rail profile conditions.

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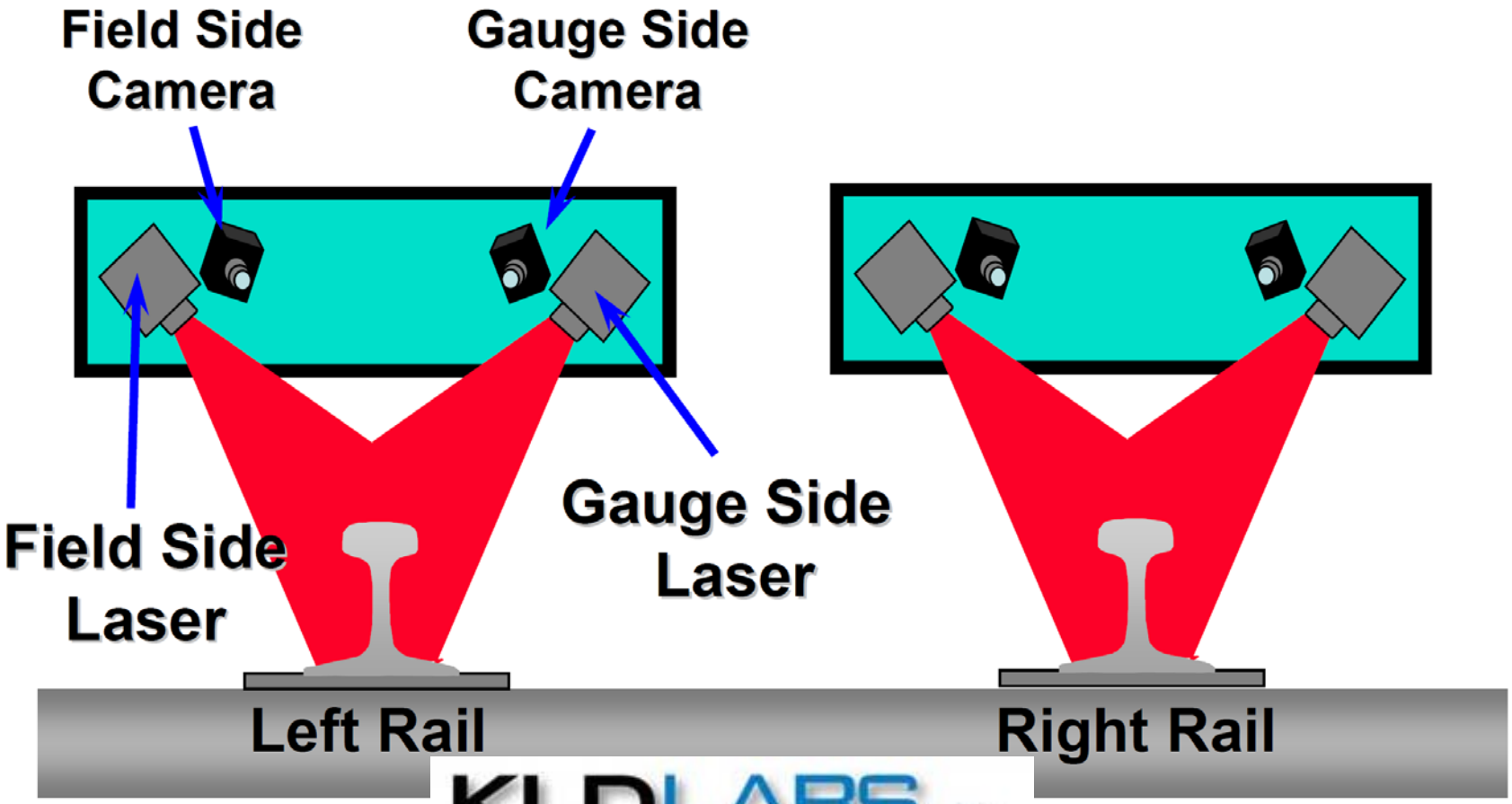
MEASUREMENT TECHNOLOGIES

ORIAN
Rail Measurement Sensor Heads



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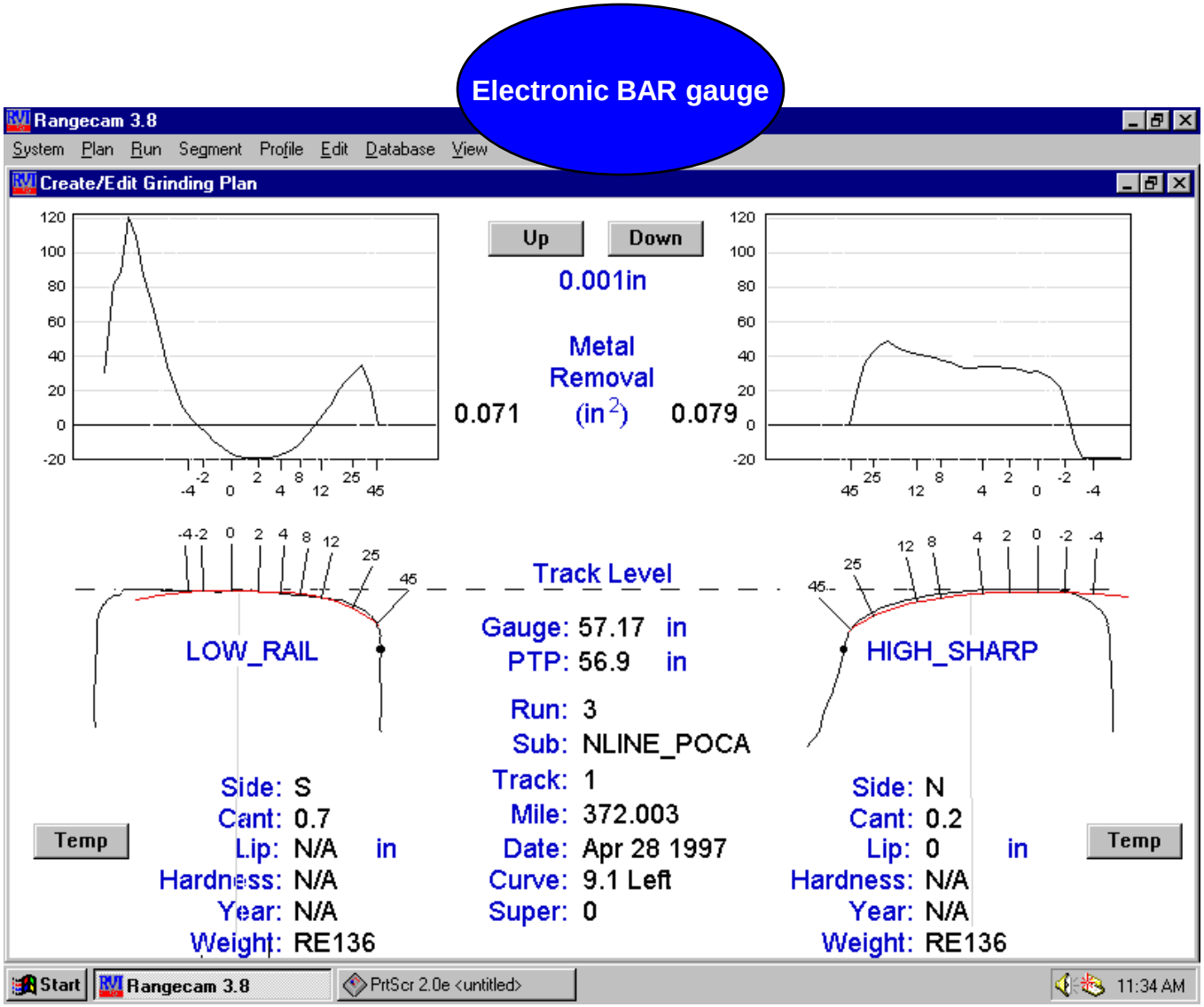
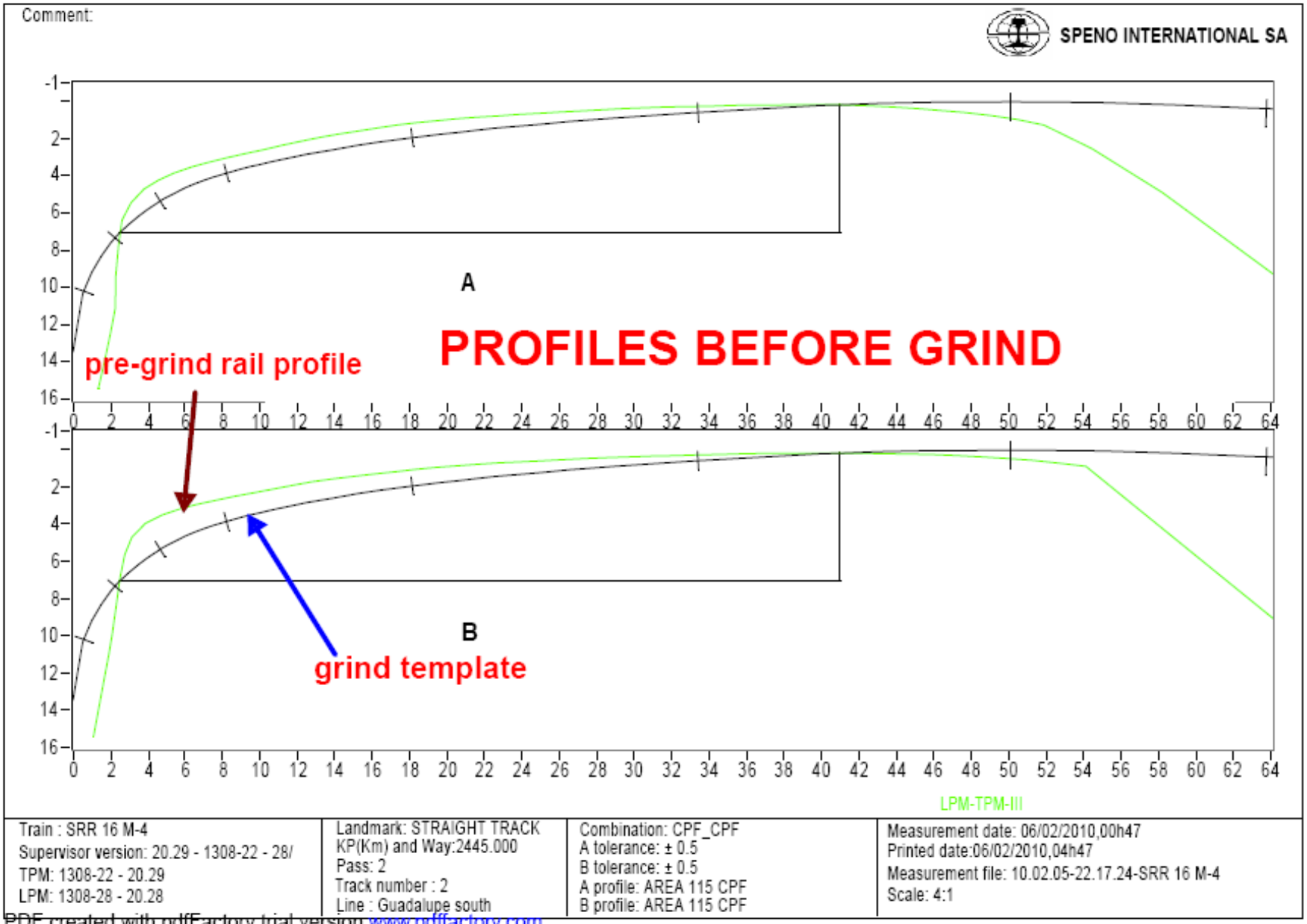
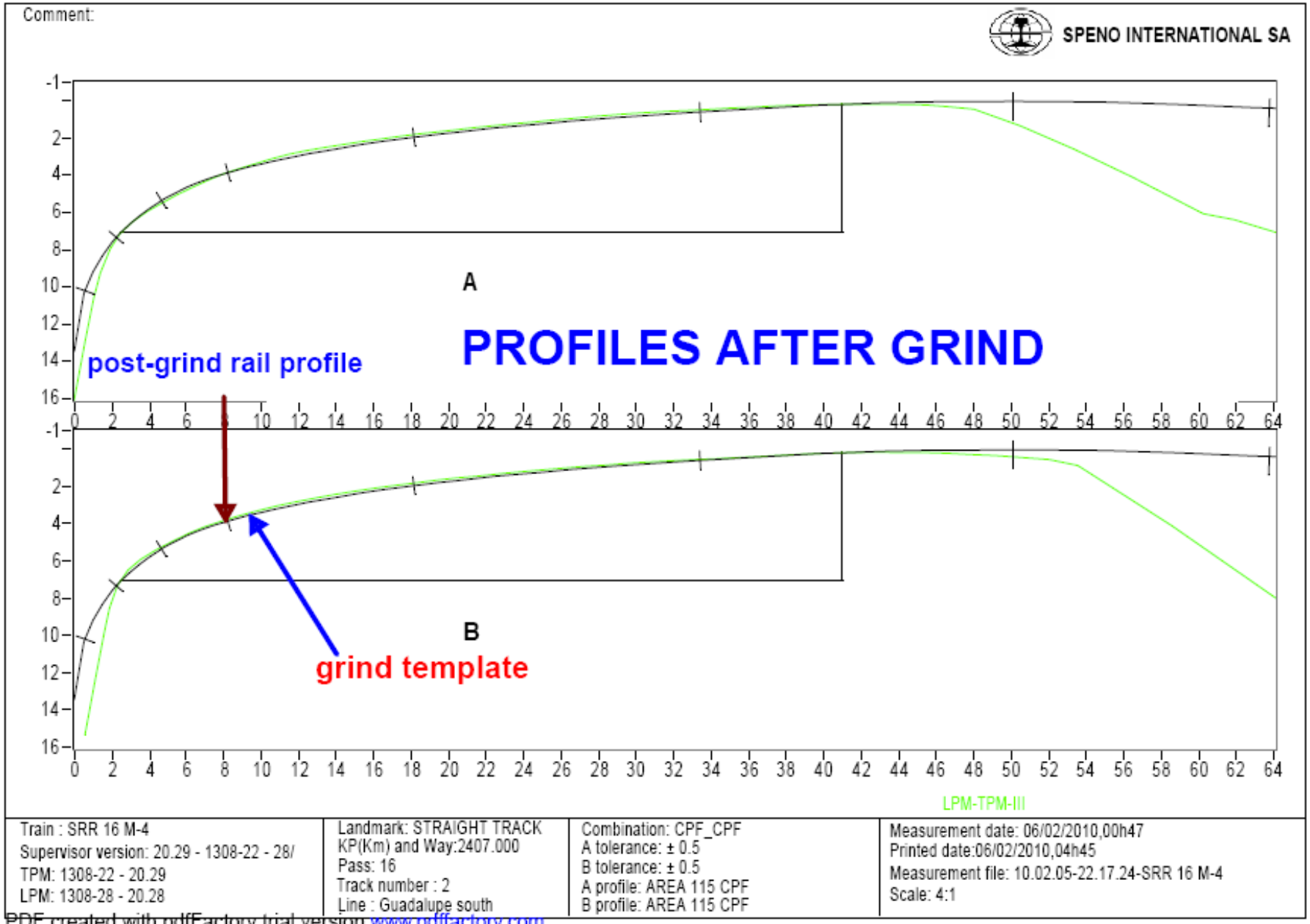
MEASUREMENT TECHNOLOGIES

Metal Removal



Onboard Display of KLD data





Rail Grinding Embedded Rails

It is believed the work completed on San San Diego Trolley is one of the first implementations of full profile grinding on embedded track in North America.

In addition to full profile implementation, corrugation was essentially eliminated, and a very smooth surface finish was left on the rail.

Enhanced Rail Grinding Specification

- ***To achieve the benefits of reduced noise and vibration levels, as well as improved ride quality and extended rail and wheel life cycles, a new type of enhanced rail grinding specification is required.***
- ***An important detail of this new specification is the tighter tolerances, but even more important is the accurate measurements to document and confirm that the specified resulted are being achieved on a daily basis.***

Grinding embedded roadway section

PROPOSED DRAFT

TRANSIT SYSTEM

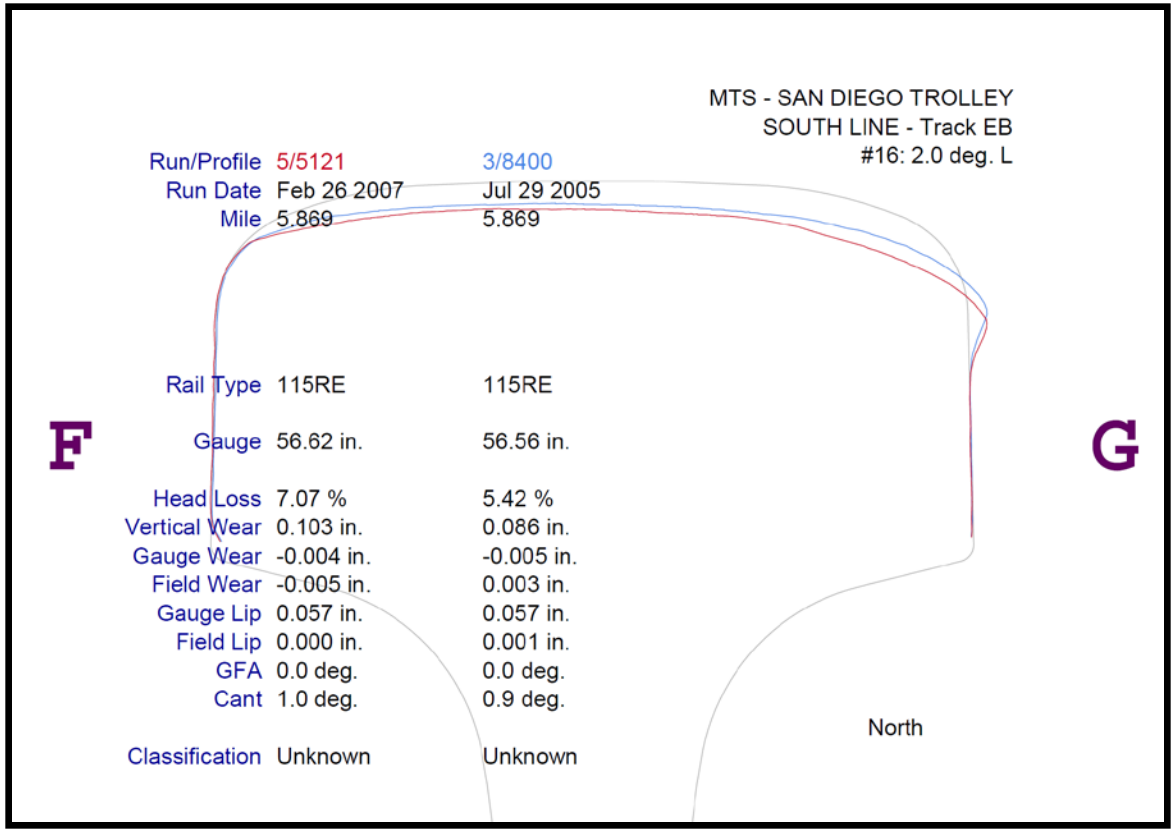
RAIL GRINDING SPECIFICATION

(includes embedded track)

2010

APTA Rail Conference
Vancouver, BC, Canada

Optical Rail Measurement



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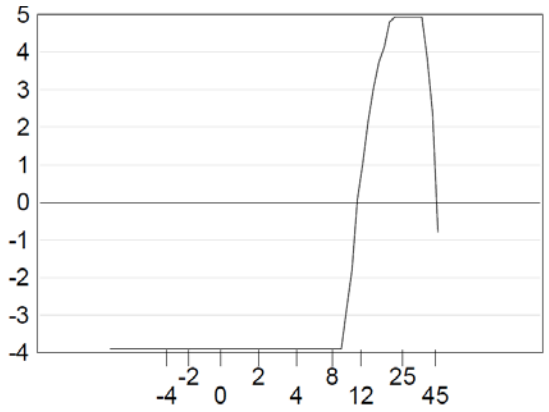
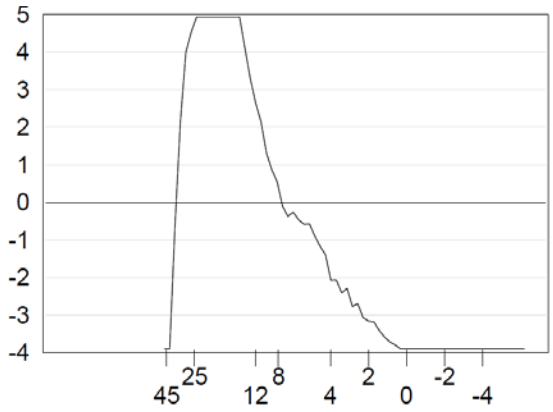
DIVISION OF HOLLAND LP

Rail Measurement

- ***Generate rail wear database***
  - ***wear charts***
  - ***comparisons, queries, automated classification, identification of section (115, 136, etc)***
  - ***trend analysis / forecasting capability***
- ***Support rail grinding operations***
  - ***actual vs. desired profile comparison***
  - ***pre-grind survey plan generation***
  - ***real time quality control (following grinder)***

Optical Rail Measurement





0.1mm

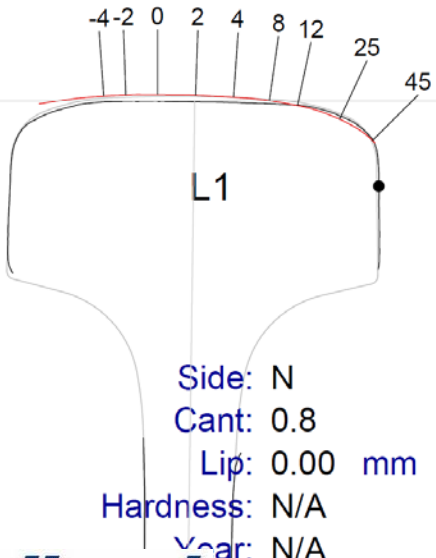
Metal Removal

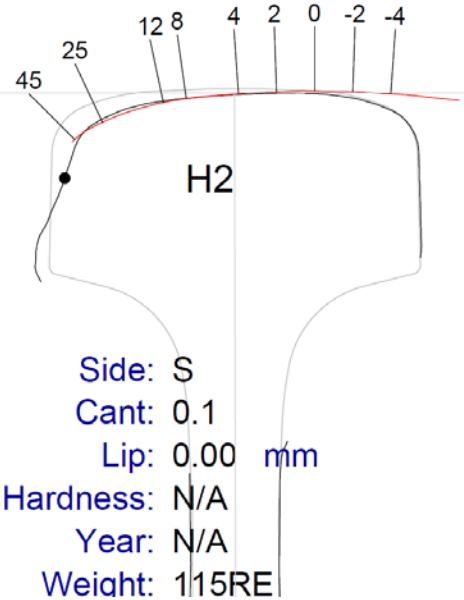
6.796 (mm²) 8.411

Curve: 4.00 Left

Gauge: 56.88 in

PTP: 56.6 in





Run: 3
Sub: SOUTH LINE
Track: EB
Mile: 0.539
Date: Jul 29 2005

S/E: 0.00

Side: N
Cant: 0.8
Lip: 0.00 mm
Hardness: N/A
Year: N/A
Weight: 115RE

Side: S
Cant: 0.1
Lip: 0.00 mm
Hardness: N/A
Year: N/A
Weight: 115RE

Holland

INDUSTRIAL METRICS DIVISION OF HOLLAND LP

San Diego Trolley – System Map

Track Segment Report

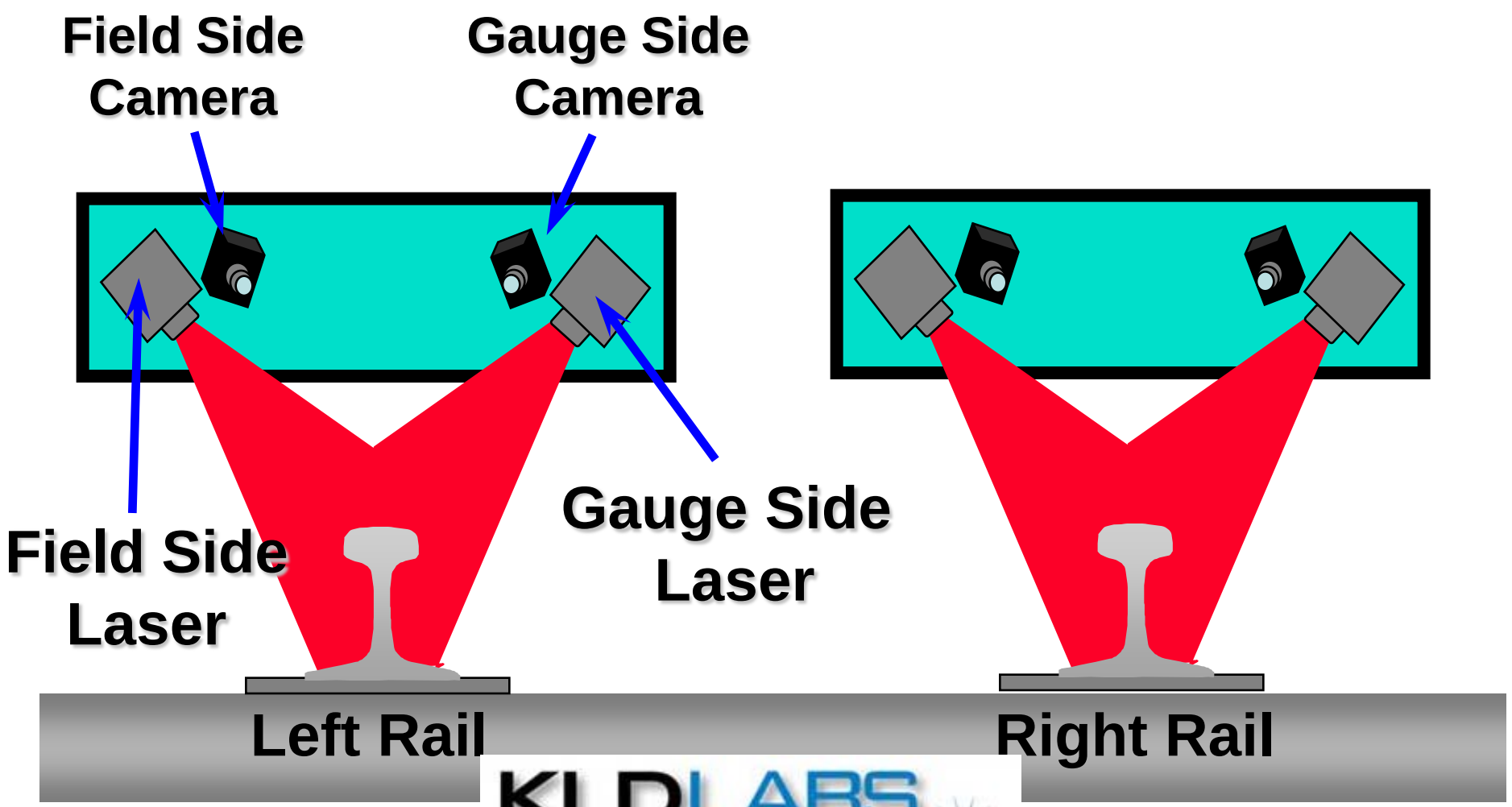
MTS San Diego Trolley
Track Segment Reports

Sub: 3 - MTSCCLOOP
Track: EAST
Printed Date: February 10, 2012

ADVANCED RAIL MANAGEMENT (CANADA) INC.

Segment:	Location (Mile)		Degrees Dir:	Length: (ft)	Description:	Page 1 of 6
TANGENT	1.390	1.441		271		
	1.397	DIAMOND			IMP JU	
	1.404	DIAMOND				
	1.429	FROG			CC13	
	1.437	SWITCH				
	1.440	SWITCH			IN	
	1.440	SWITCH				
C#1	1.441	1.473	0.3 R	171		
	1.450	FROG			INT-A	
	1.454	STATION END			12th & Imperial Transit Centre	
TANGENT	1.473	1.492		98		
C#2	1.492	1.537	2.9 R	235		
	1.507	STATION END			12th & Imperial Transit Centre	
	1.509	SWITCH				
	1.523	FROG			CC5	

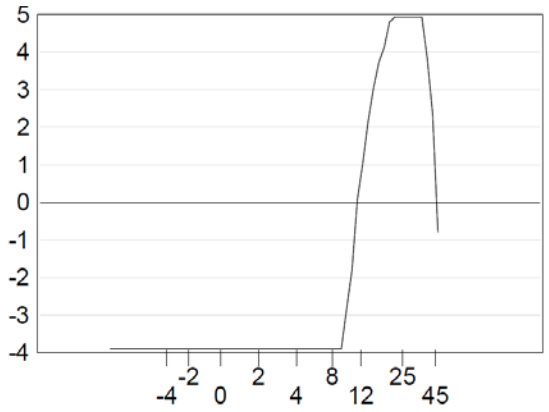
ORIAN
Rail Measurement Sensor Heads

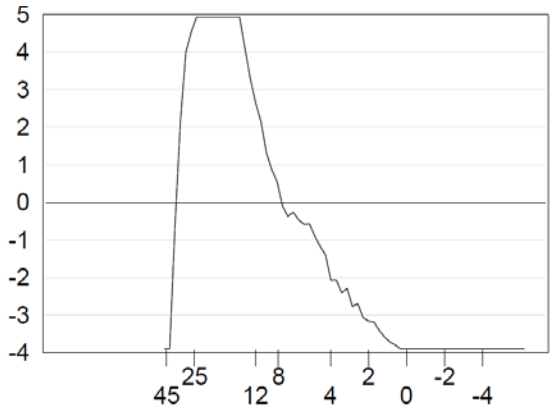


KLDLABS
MEASUREMENT TECHNOLOGIES

Optical Rail Measurement Test Vehicle

Optical Rail Measurement





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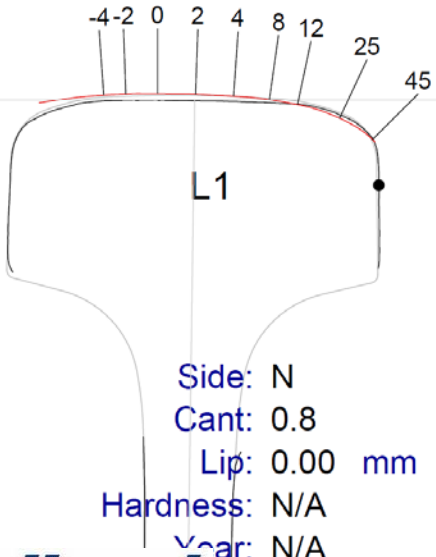

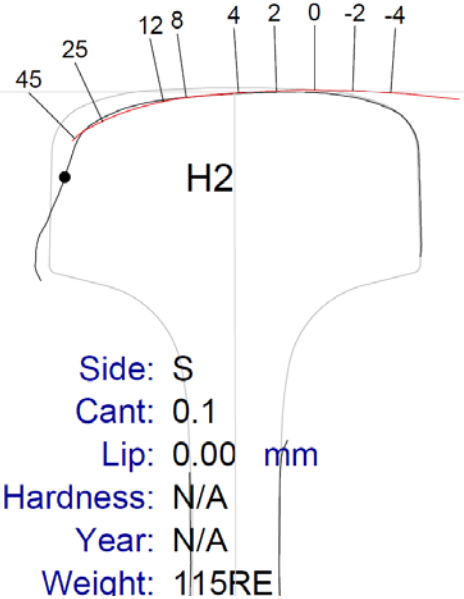

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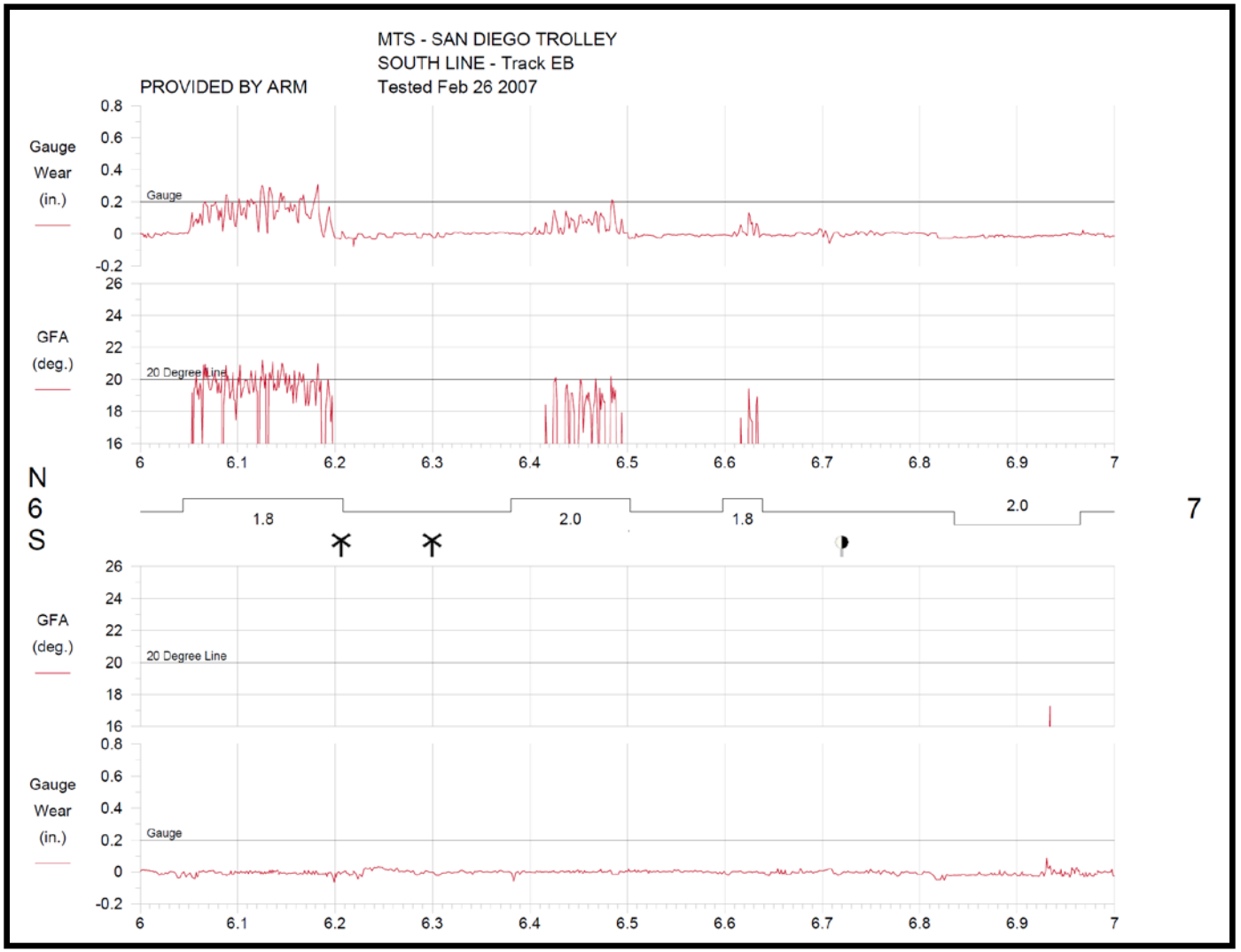
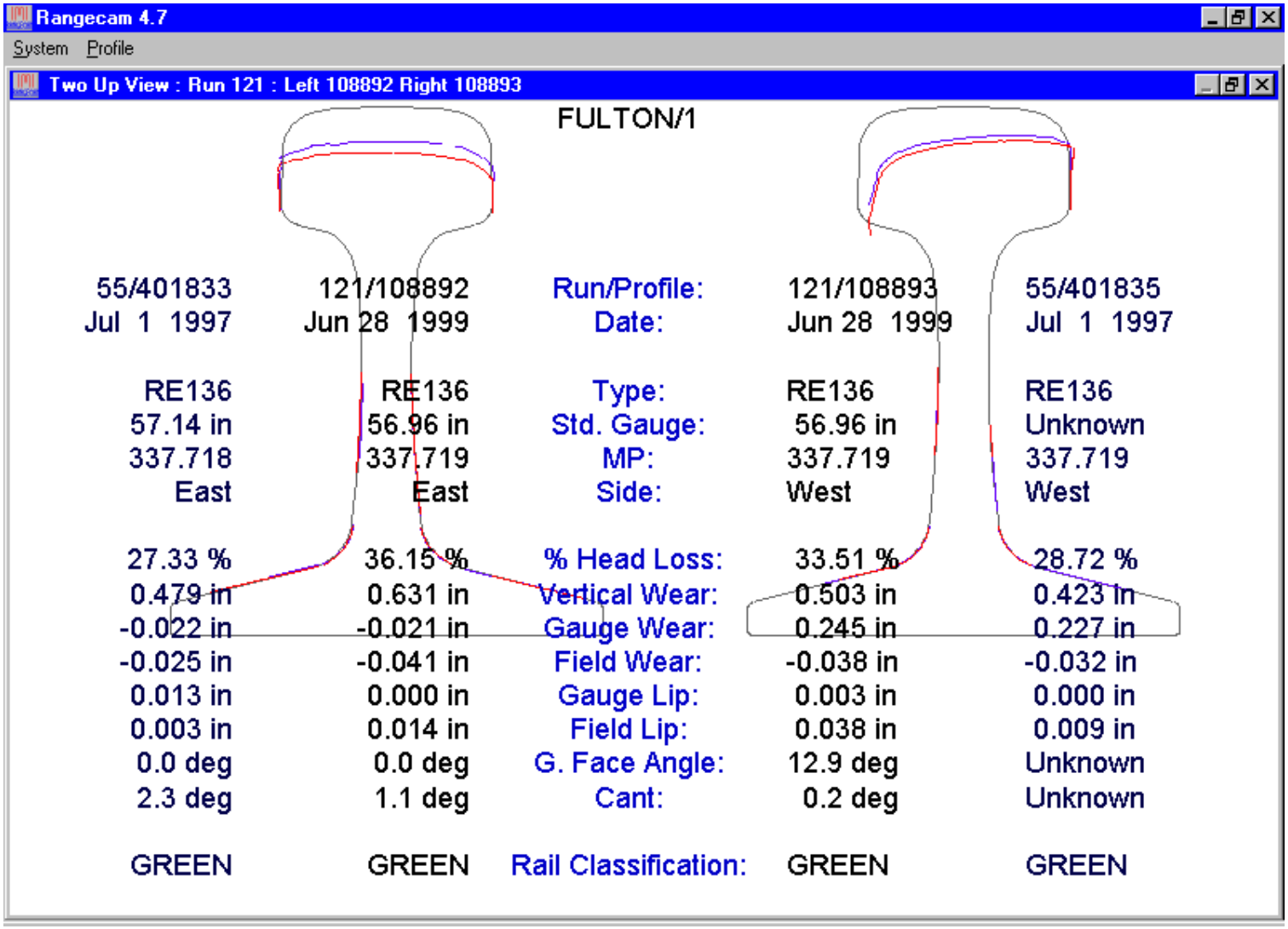
Holland

INDUSTRIAL METRICS DIVISION OF HOLLAND LP

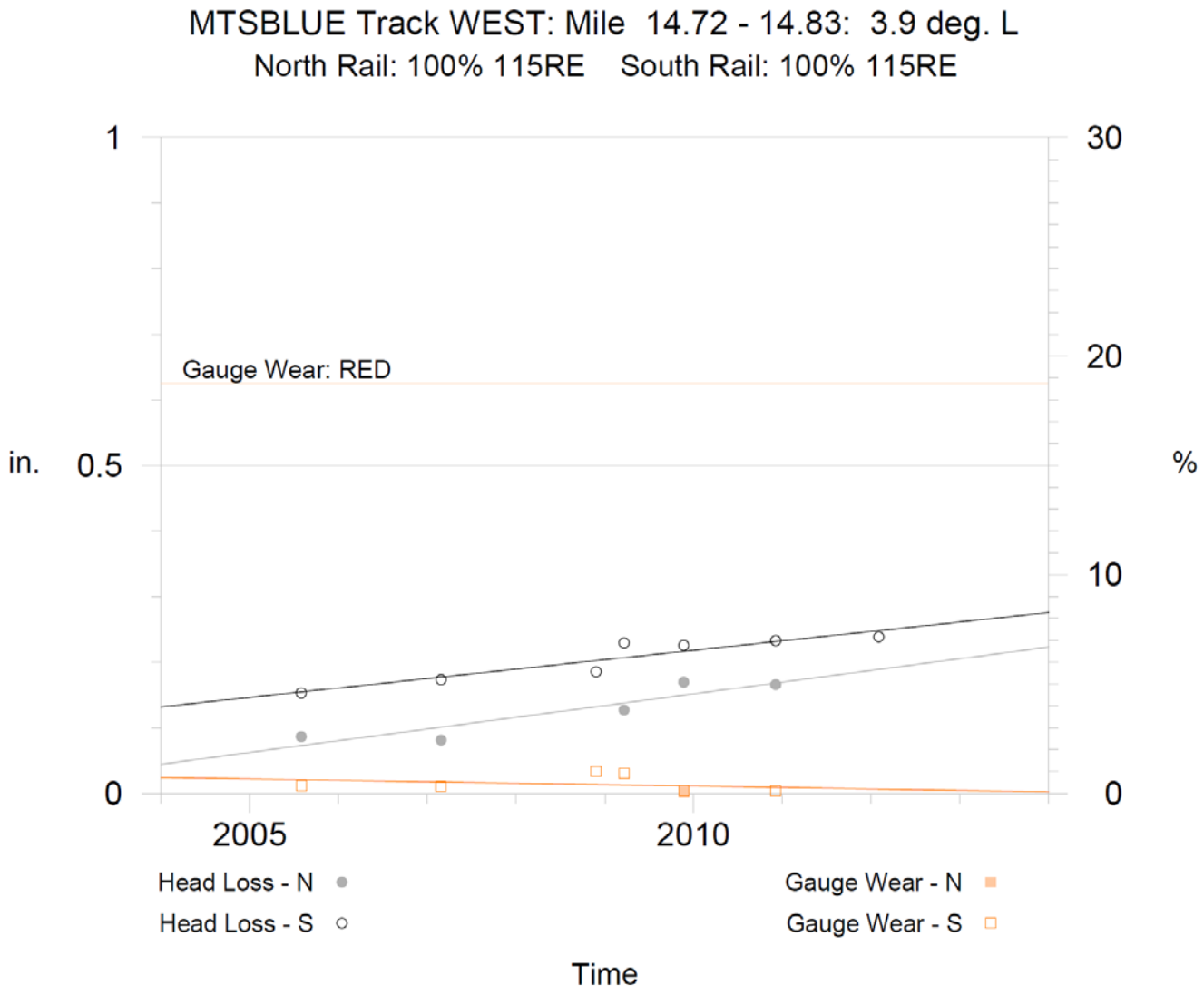
sample gauge wear & GFA chart



“Two-up” Comparison View



Trend Chart


MTSBLUE Track WEST: Mile 14.72 - 14.83: 3.9 deg. L
North Rail: 100% 115RE South Rail: 100% 115RE
1
0.5
0
in.
30
20
10
0
%
Gauge Wear: RED
2005
2010
Head Loss - N
Head Loss - S
Gauge Wear - N
Gauge Wear - S
Time

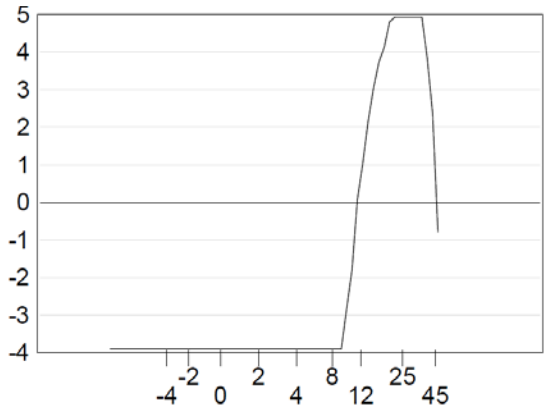
Profile Rail Grinding

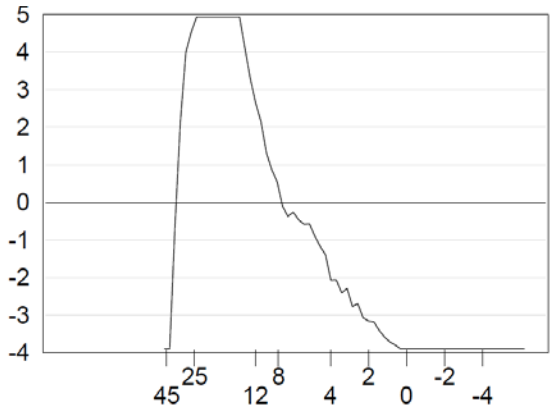
SPENO INTERNATIONAL SA

LORAM
SPEED PERFORMANCE RELIABILITY

Grinding Template

Optical Rail Measurement





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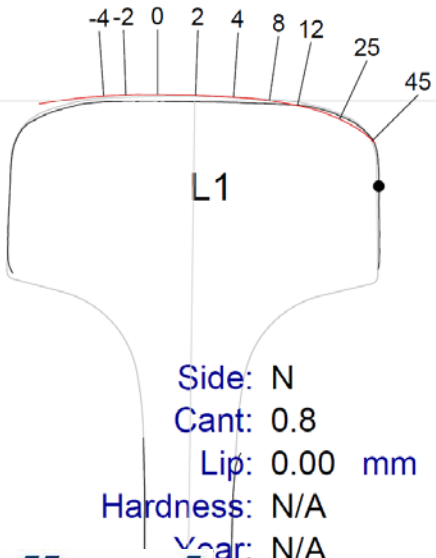

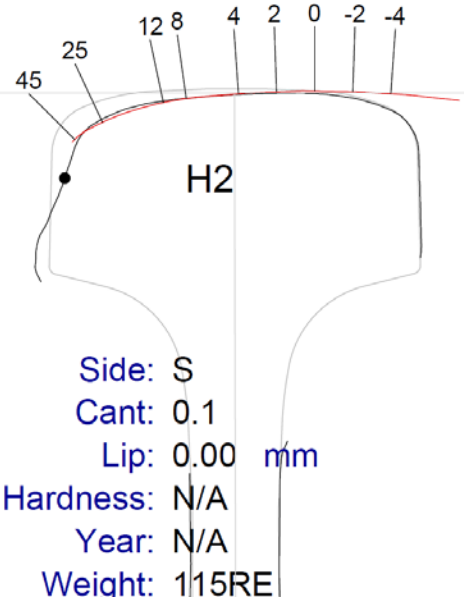

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Holland

INDUSTRIAL METRICS DIVISION OF HOLLAND LP

Grind Quality Report

MTS San Diego Trolley
Grind Quality Report

ADVANCED RAIL MANAGEMENT (CANADA) INC.

Sub: MTSORANGE
Track: WEST
Run: 18
Run Date: November 27, 2008
From Mile 1.423 **To Mile** 20.36

Report Date: March 02, 2012

Tangent

Segment From : Mile 1.451 **Segment To : Mile** 2.113

Side	Template	Extreme Gauge	Gauge	Centre	Crown Radius	Max/Min Diff. Index
N	EDM_CPF	0.062	0.053	0.021	15.350	41
S	EDM_CPF	0.028	0.013	-0.013	9.430	41

Curve 3 2.4 deg. R

Segment From : Mile 2.158 **Segment To : Mile** 2.211

Side	Template	Extreme Gauge	Gauge	Centre	Crown Radius	Max/Min Diff. Index
N	EDM_CPG	-0.013	-0.016	0.003	18.700	19
S	EDM_CPF	0.047	0.030	0.004	16.750	43

Query Report

MTS San Diego Trolley

Wide Gauge (57.5" or more) Summary

Sub: 1 - SOUTH LINE
Track: WB
Run: 6 - 4
Side: Both
Query Items: Gauge >= 57.5 in.

Query Date: 10-Apr-07
Run Date: 26-Feb-07
Range: 1.429 : 15.069

ARM ADVANCED RAIL MANAGEMENT (CANADA) INC.

Curve #:	Degree:	Direction:	Side:	From: (Mile)	To: (Mile)	Length: (ft)
Curve # 1	5	L	N(L)	1.462	1.462	1
	5	L	S(H)	1.462	1.462	1
	5	L	N(L)	1.456	1.456	1
	5	L	S(H)	1.456	1.456	1
	5	L	N(L)	1.448	1.448	1
	5	L	S(H)	1.448	1.448	1
					Total:	**6ft**

Profile Rail Grinding & Optical Rail Measurement

MTS San Diego Trolley