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Road Profile Users' Group

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HONORING THE PAST. PAVING THE FUTURE.

2026 RPUG CONFERENCE ★ PITTSBURGH, PA ★ APRIL 28 - MAY 1

MEASURING AND CORRECTING CONCRETE PAVEMENT RIDE QUALITY

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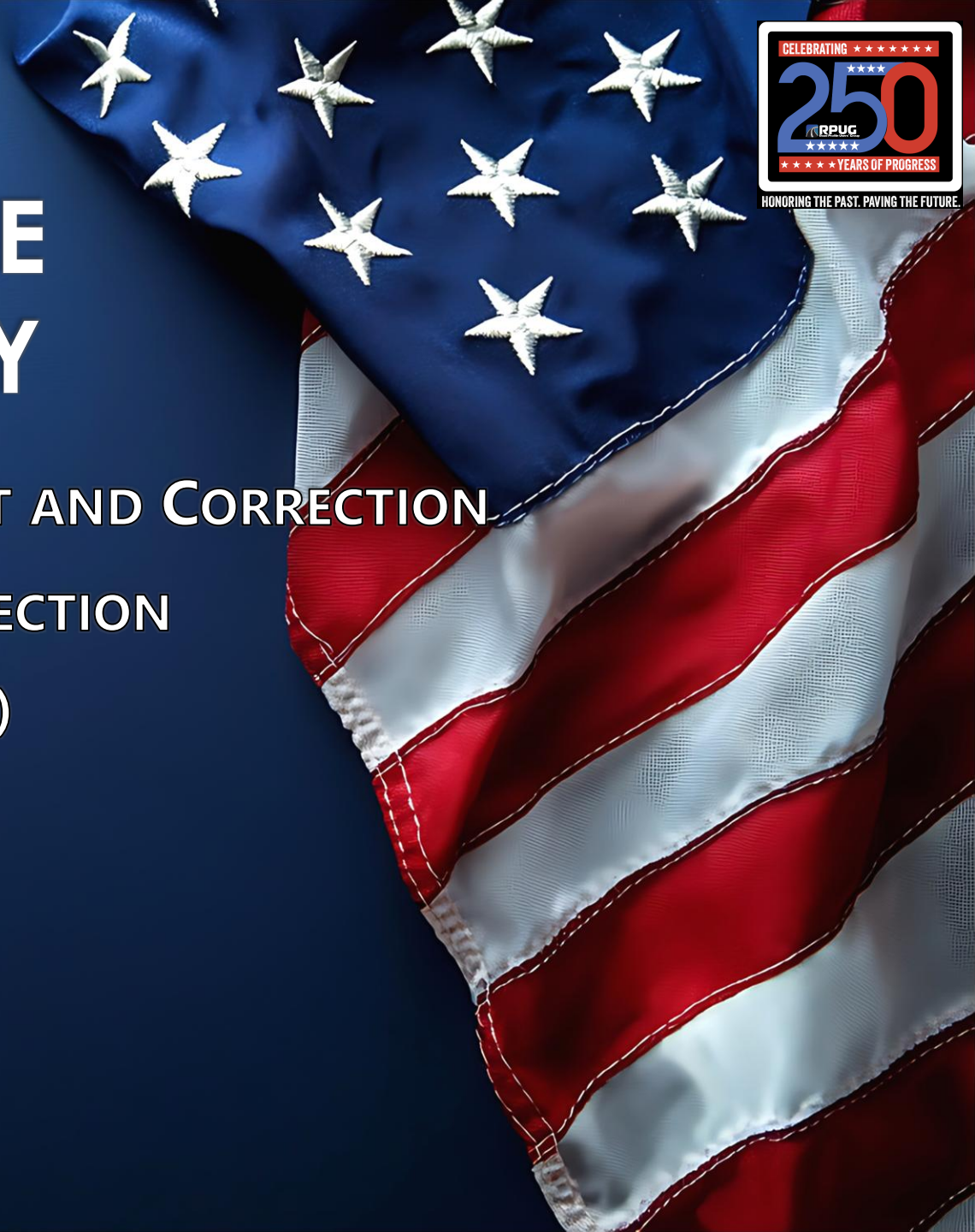
MEASURING AND CORRECTING CONCRETE PAVEMENT RIDE QUALITY



- History of Ride Quality Measurement and Correction
- Relevance of Measurement and Correction
  - 25 FT BASELINE (Localized Roughness)
  - Single wheel path measurement
  - MRI vs IRI
  - Correcting Roughness
  - As-built roughness in pms

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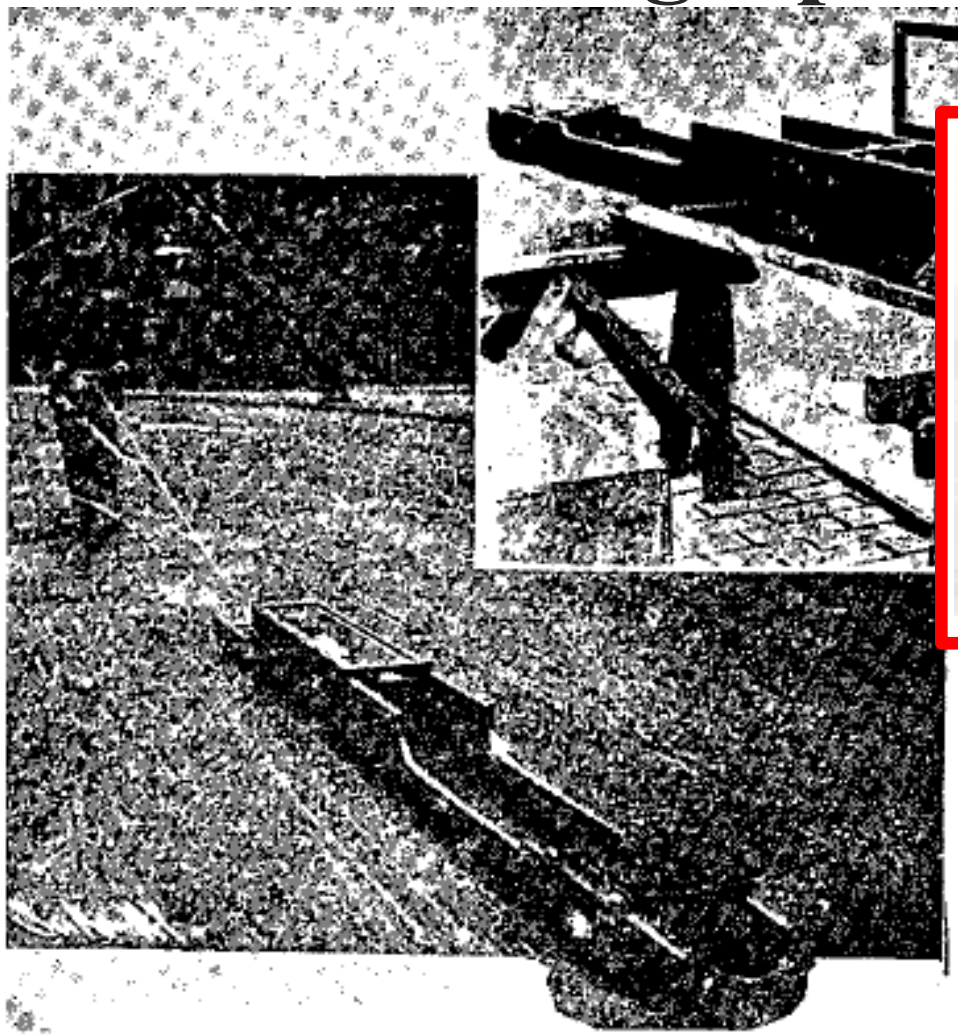
History of Measurement Equipment

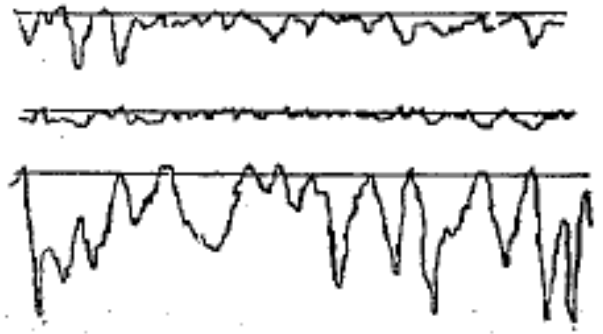
1900 **Development of Measurement Devices** Today

Straight Edge	Surface Measurement (Profilograph)	Response Type	Profiler
Brown Viagraph Pre 1900	Bates Rd Test 1922	Via Log 1926	GM Profilometer 1964
Rolling Straight Edge	California Profilograph 1940	BPR Roughometer 1920s	Inertial Profilometer Today
	CHLOE 1958-60	PCA Ridemeter 1950s	LIDAR
		Mays Meter	

Earliest Roughness Measurement Devices Were Straightedge Based—Brown's Viagraph pre 1900

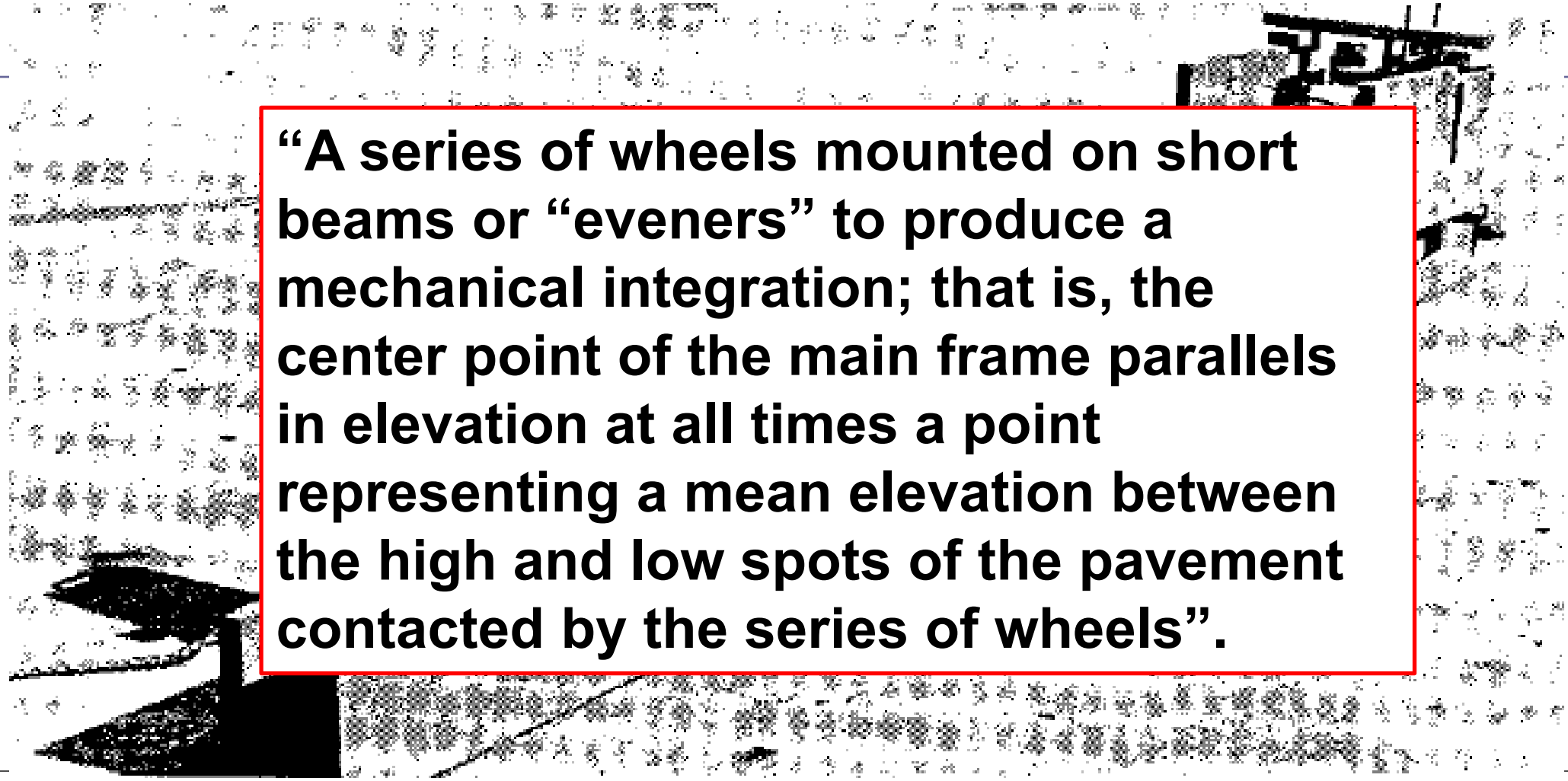


Numerical Index of Unevenness in Feet per Mile.	Condition of Road Surface.
15,	Excellent.
30,	Good.
45,	Fair.
60,	Passable.
80 to 100,	Bad.



Viegraph Tracings from Different Roads.

Hveem's "Poor Mans" Profilograph- 1929



"A series of wheels mounted on short beams or "eveners" to produce a mechanical integration; that is, the center point of the main frame parallels in elevation at all times a point representing a mean elevation between the high and low spots of the pavement contacted by the series of wheels".

Devices for Recording and Evaluating Pavement Roughness, F.N. Hveem 1960

California Profilograph Equipment Development

1940s

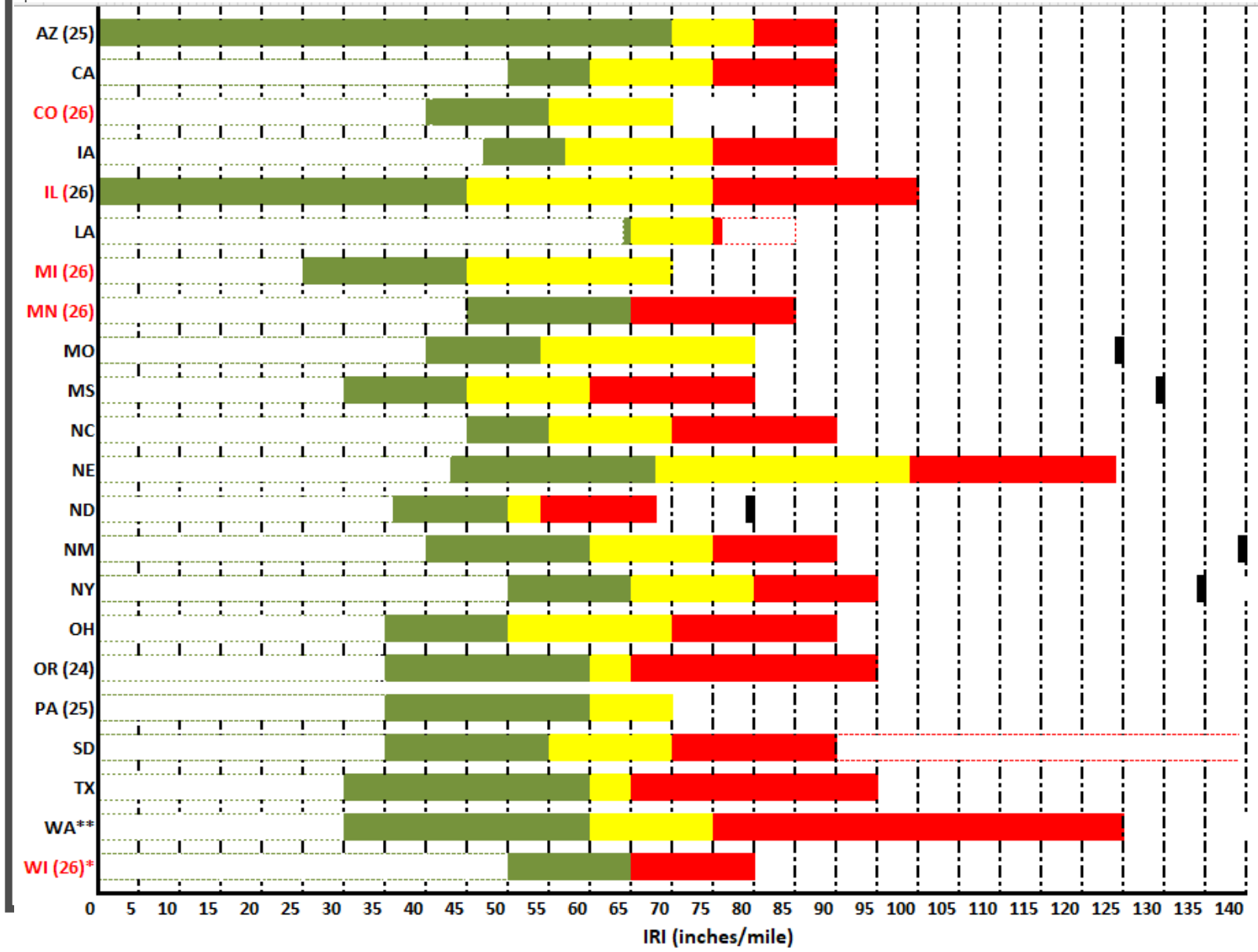
1957-60

10 ft

25 ft

"With the general increase in the speed of traffic and the trend toward vehicles with a longer wheel base, it was concluded that and improved profilograph should have a longer frame and a **25-ft length as selected more or less arbitrarily**."

2026 State Smoothness Specifications



0.3" bump in 25' Max incentive is $9000 per tested lane

160

200 - 250

200

170

0.3" Bump in 25'

175 - 225

150

Legend

- Incentive
- 100 % Pay
- Disincentive
- Incentive Fixed
- Disincentive Fixed
- Localized Roughness (ALR)

Note: This ALR is from Rolling Straightedge - All Others are Conventional ALR

160

160

140 - 180

Note: IRI above 125 has to meet 10 ft straight edge requirement to remain

175 - 200

*Note: Wisconsin long interval roughness is based on 500 ft baseline length

**Note WSDOT's baseline is 52.8 ft and then averaged to 528 ft

25 FT BASELINE FOR LOCALIZED ROUGHNESS

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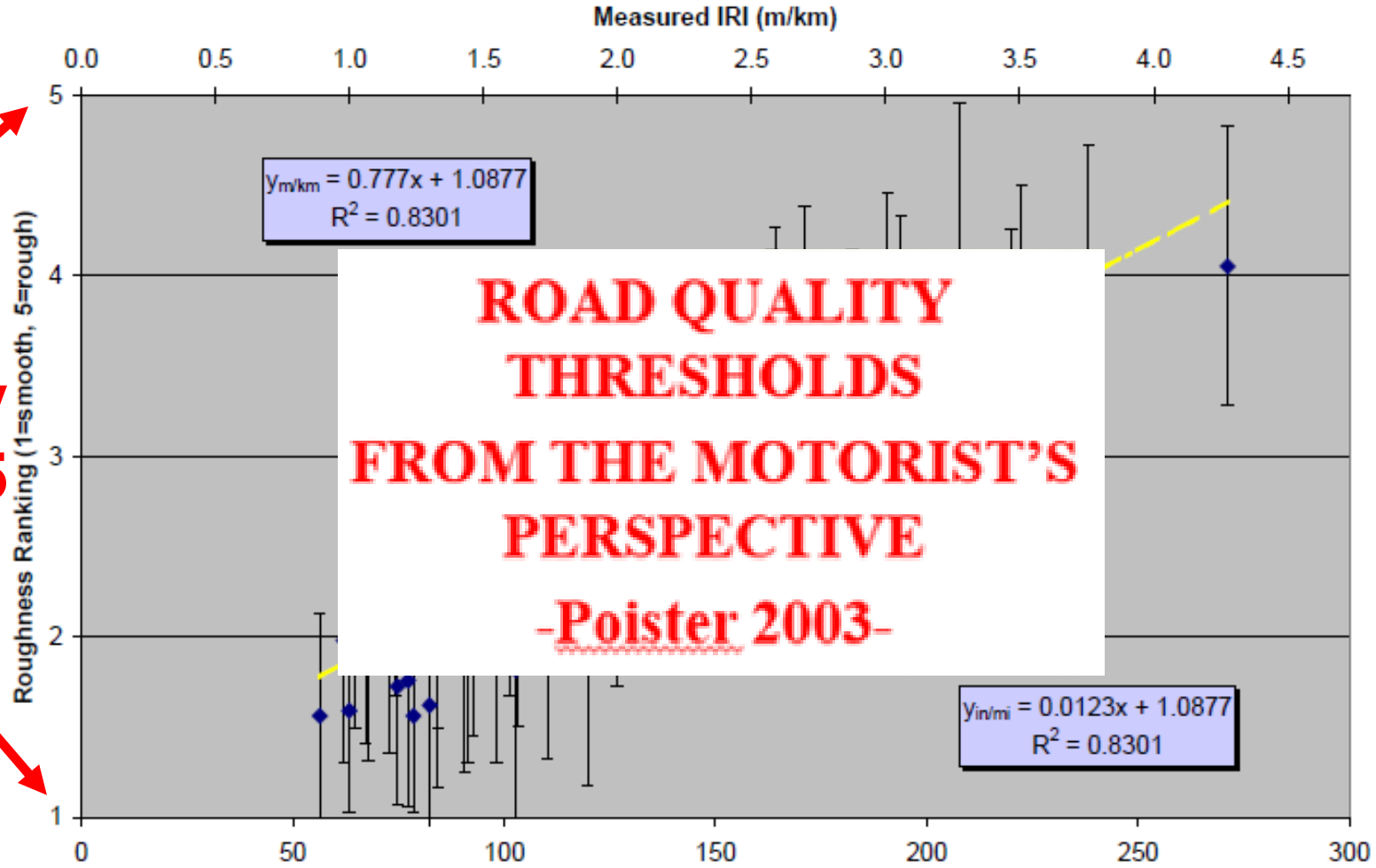
Washington DOT Study 2002



ROAD QUALITY THRESHOLDS FROM THE MOTORIST'S PERSPECTIVE

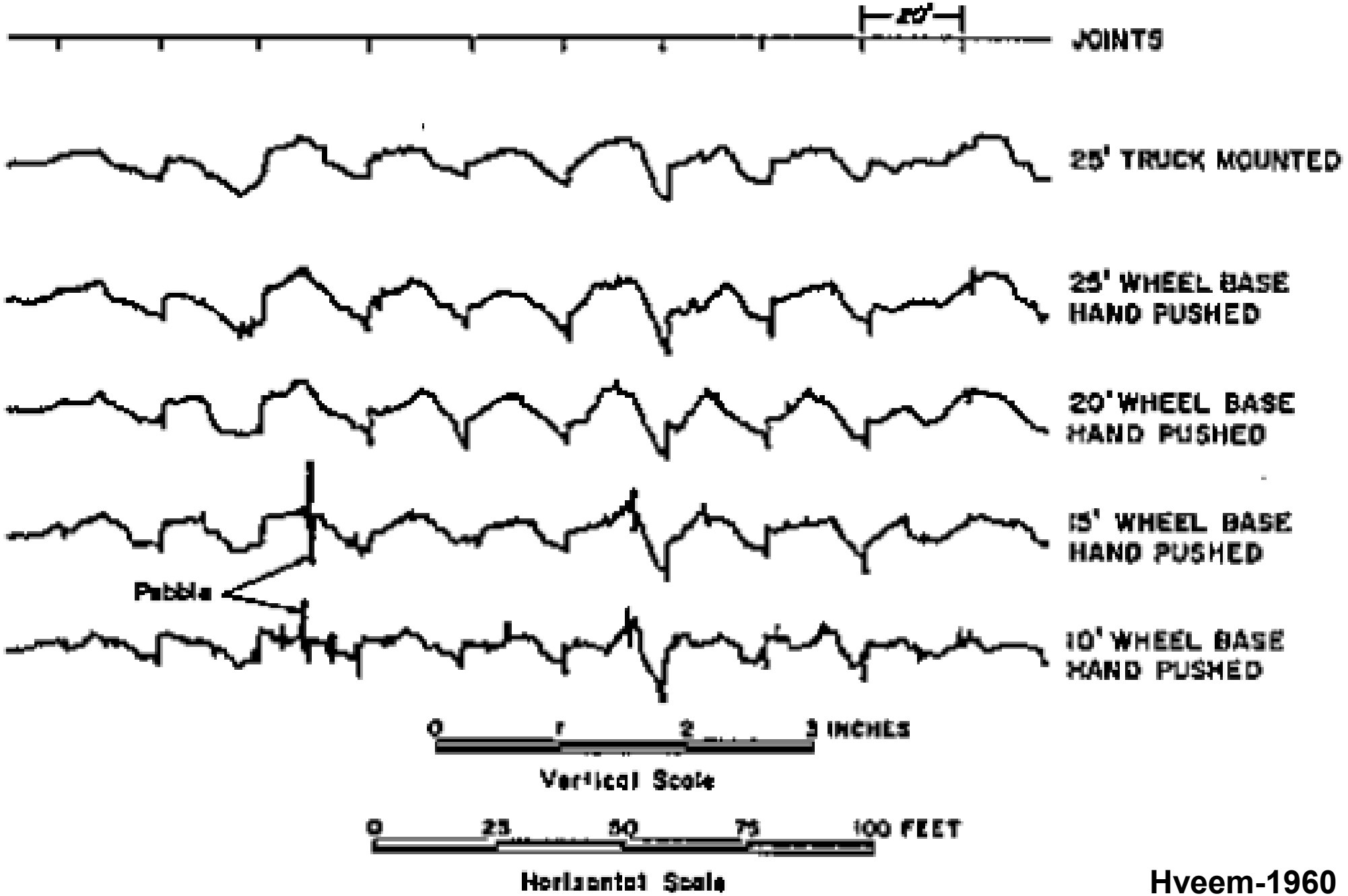
-Poister 2003-

Consumer Ride Quality Scale of 1 -5

Measured IRI (in/mi)

Figure 13. Mean Roughness Ranking with One Standard Deviation vs. Measured IRI

200 in



Hveem-1960

SINGLE WHEEL PATH MEASUREMENT

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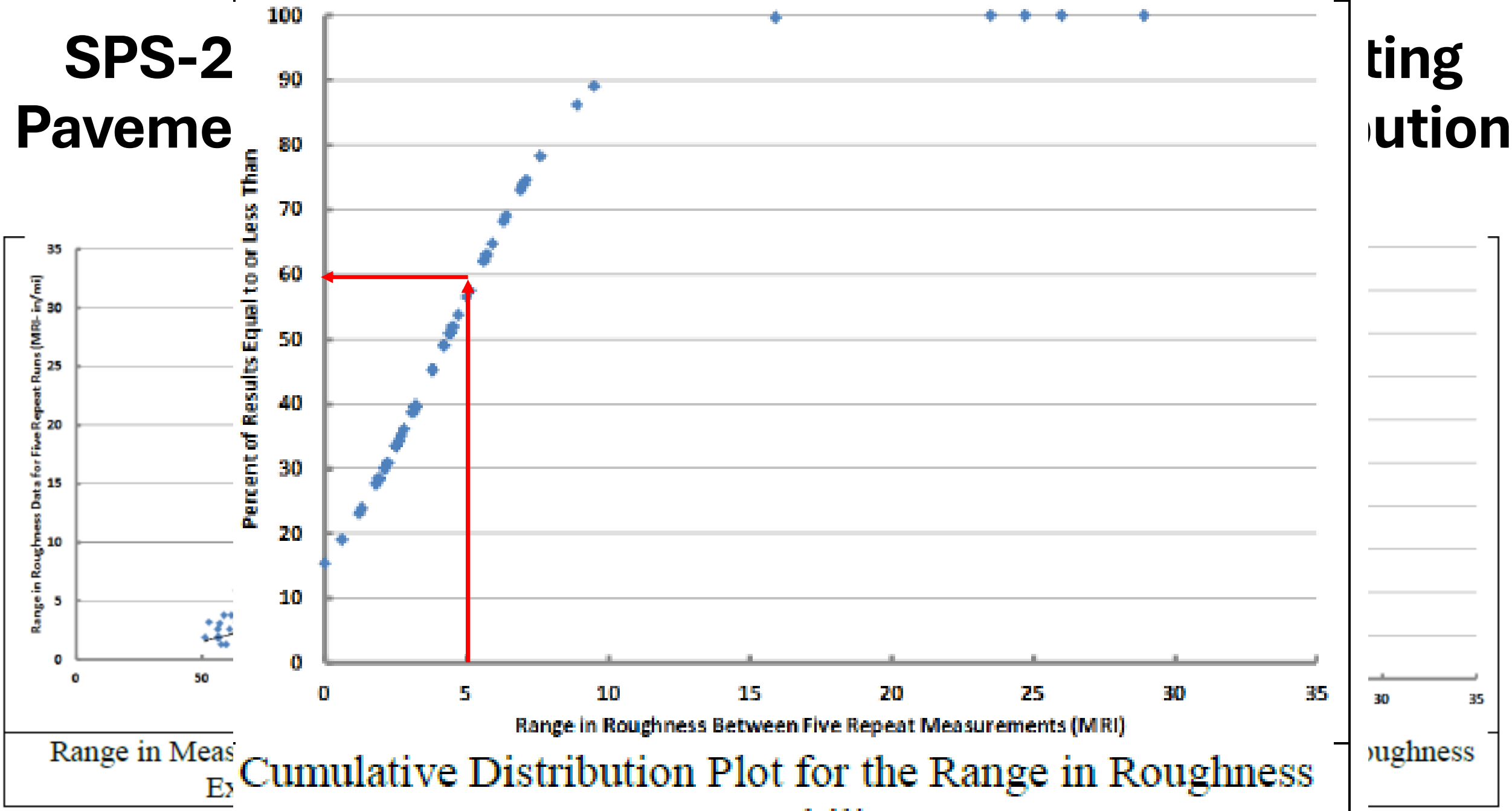
Why Do We Think One Test Per Wheel Path is OK

We are No Longer Dragging Sleds or Pushing Profilographs

SPS-2 Paveme ting ution



Cumulative Distribution Plot for the Range in Roughness Repeatability

MRI VS IRI

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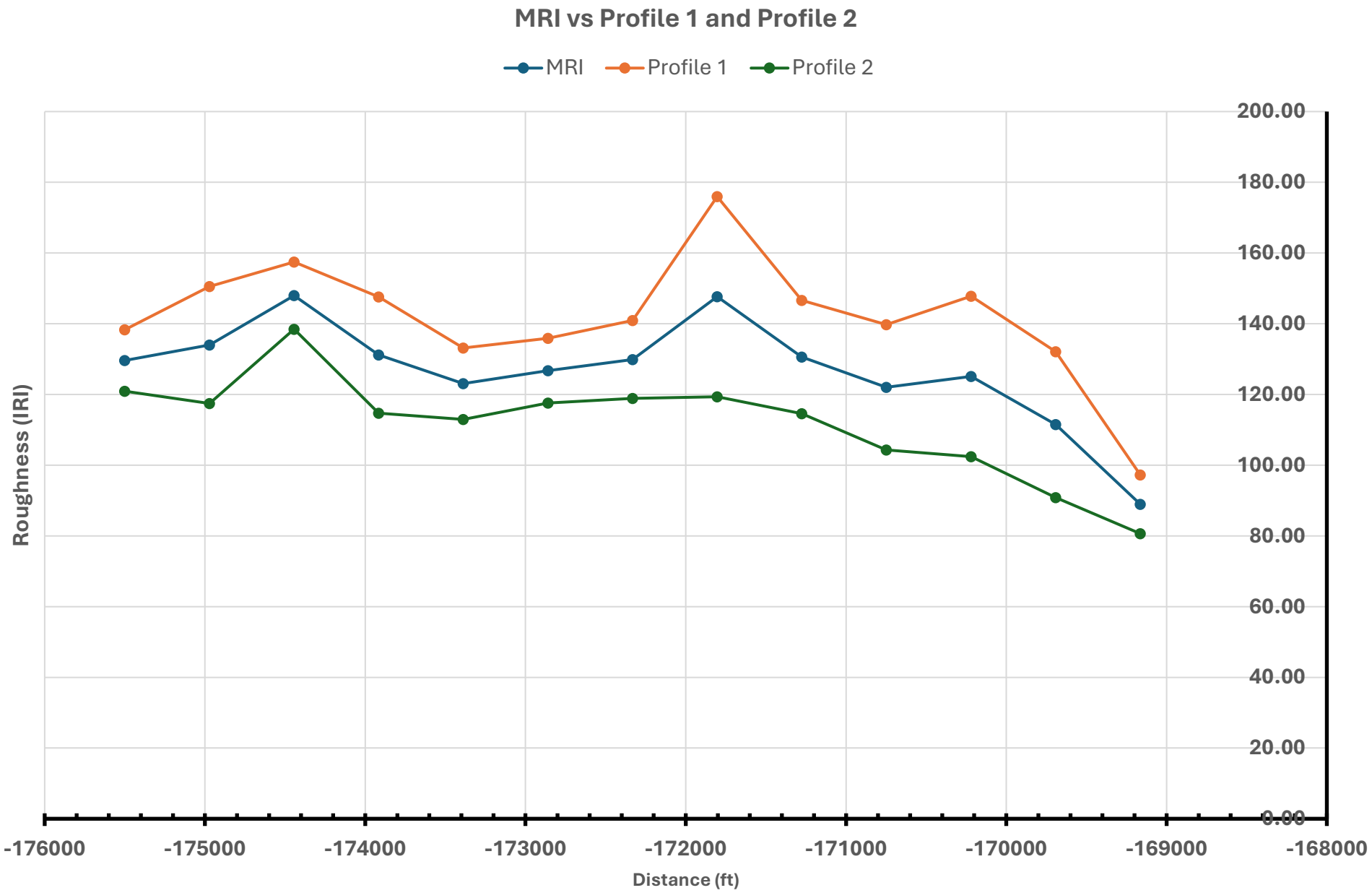
Variability Between Profiles



CORRECTING ROUGHNESS

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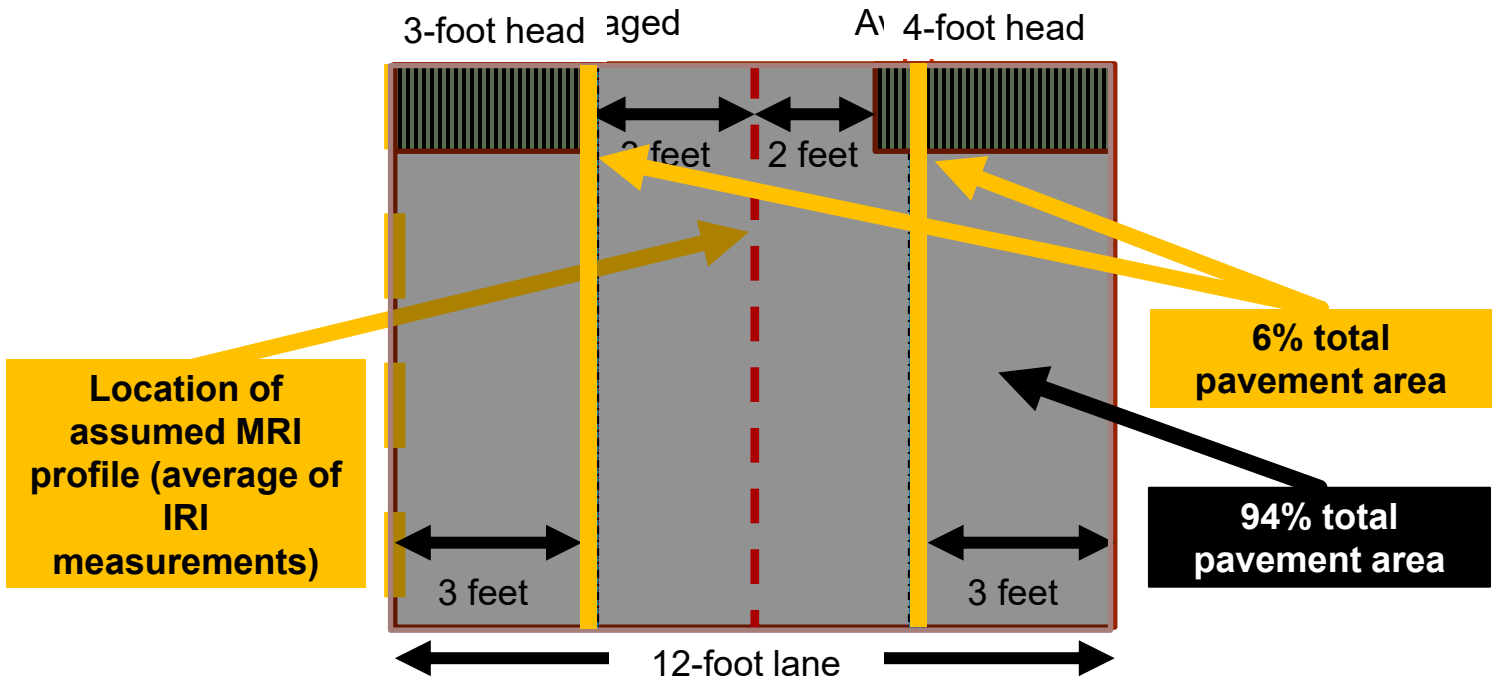
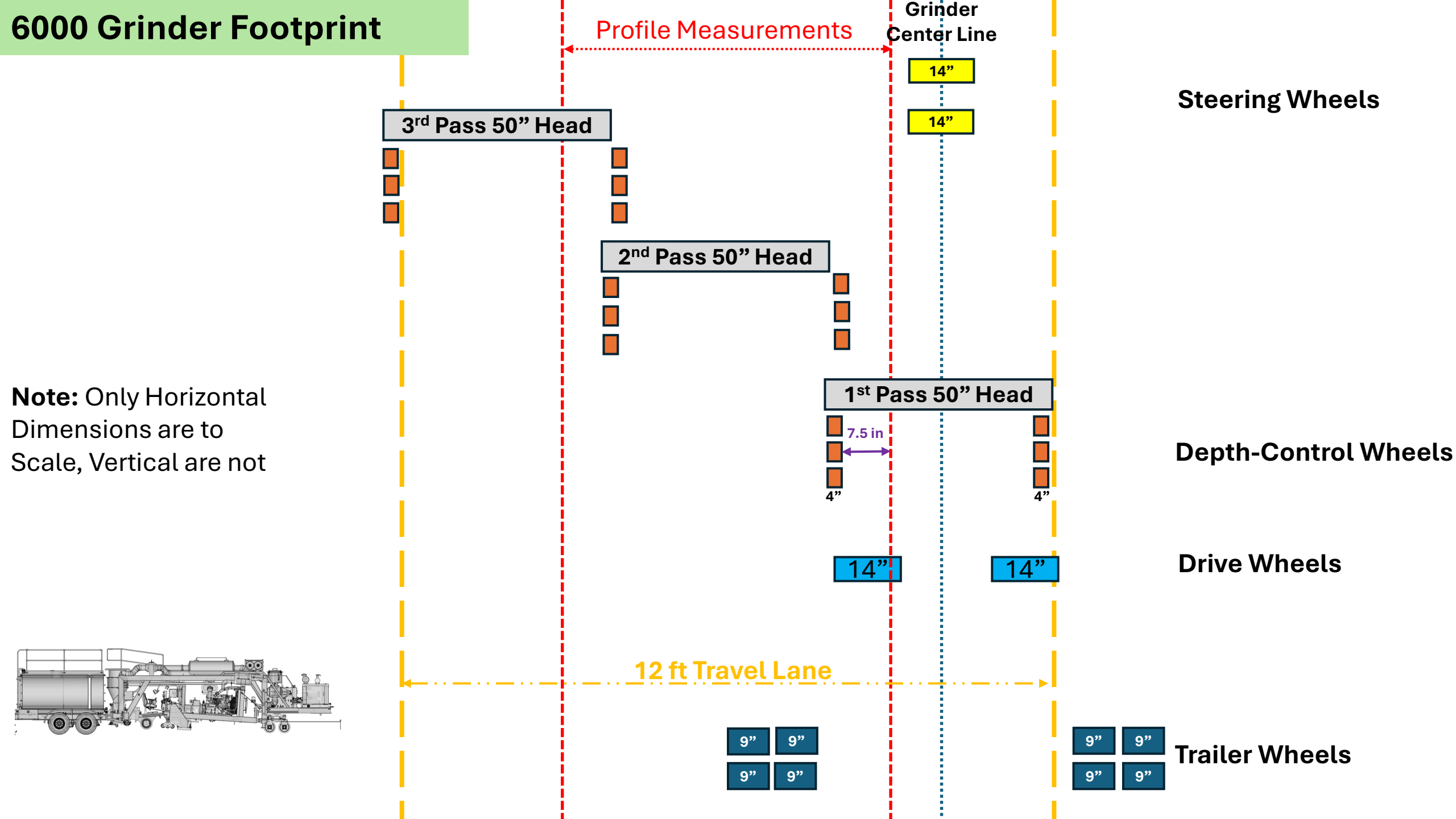
How We Measure Smoothness

Transverse Profile Variability Is Real



Percent Within Limits?

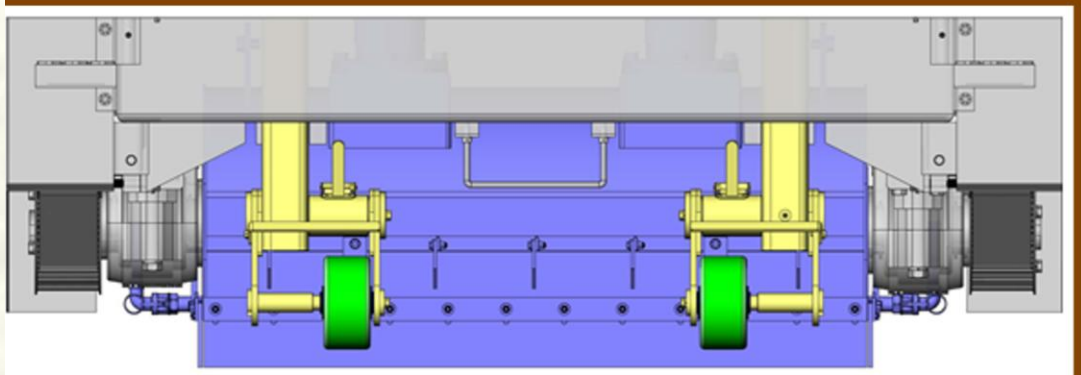
6000 Grinder Footprint



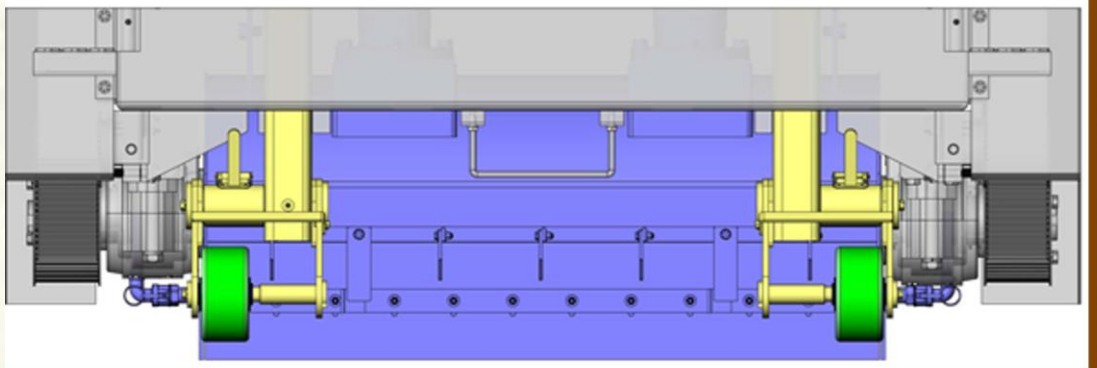
Note: Only Horizontal Dimensions are to Scale, Vertical are not

Depth Control Wheel Assemblies and Positions

Inboard Position



Outboard Position



Depth Control Wheel Clamp

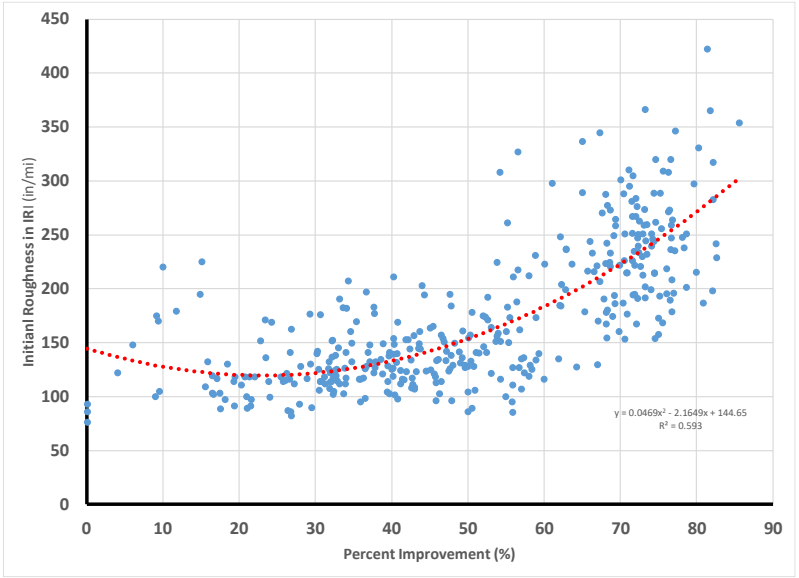
Closed

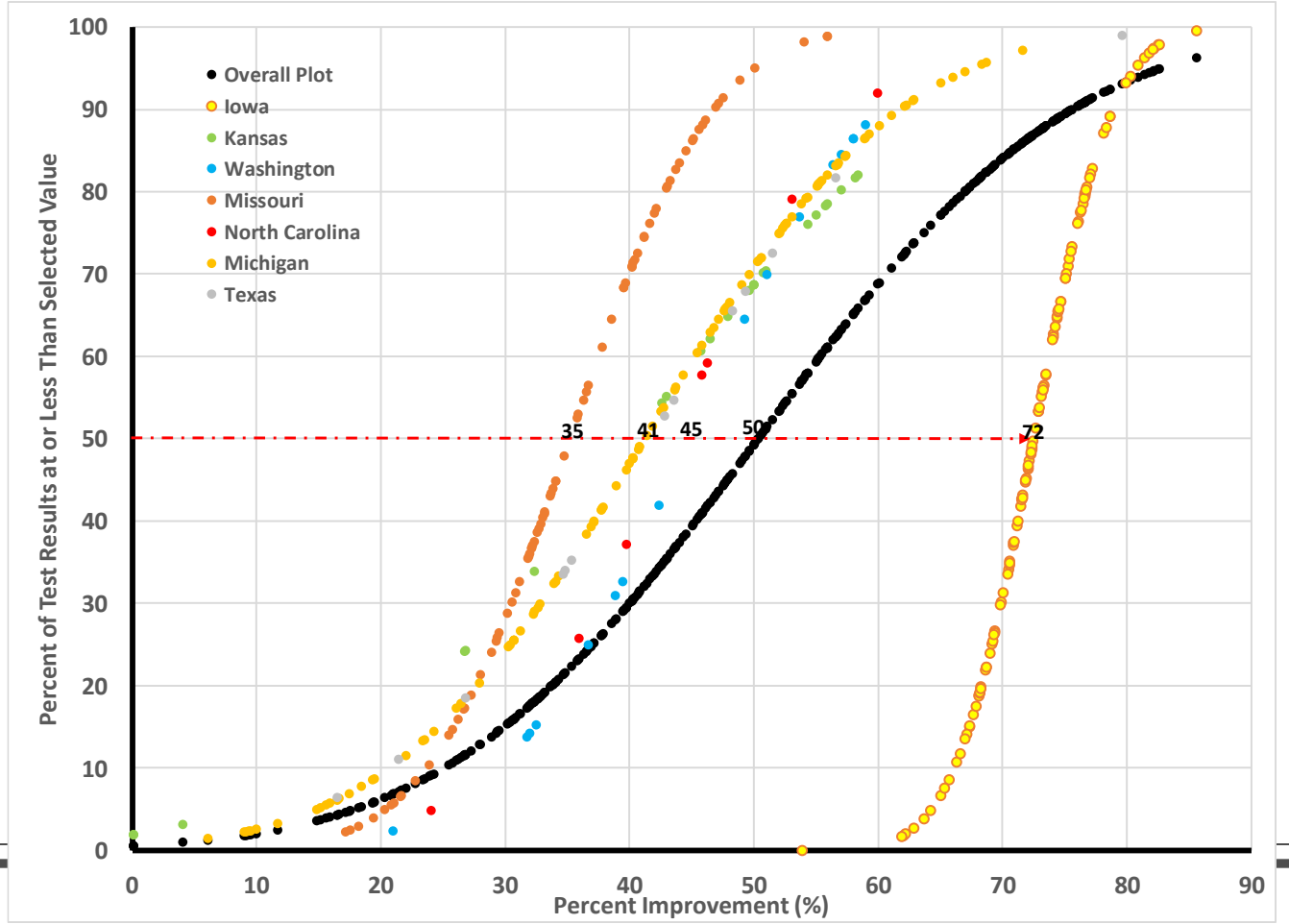
Open

Clamp on inboard view above was removed, assembly shifted to outboard position, and is ready for clamp to be re-installed on opposite side of leg brace

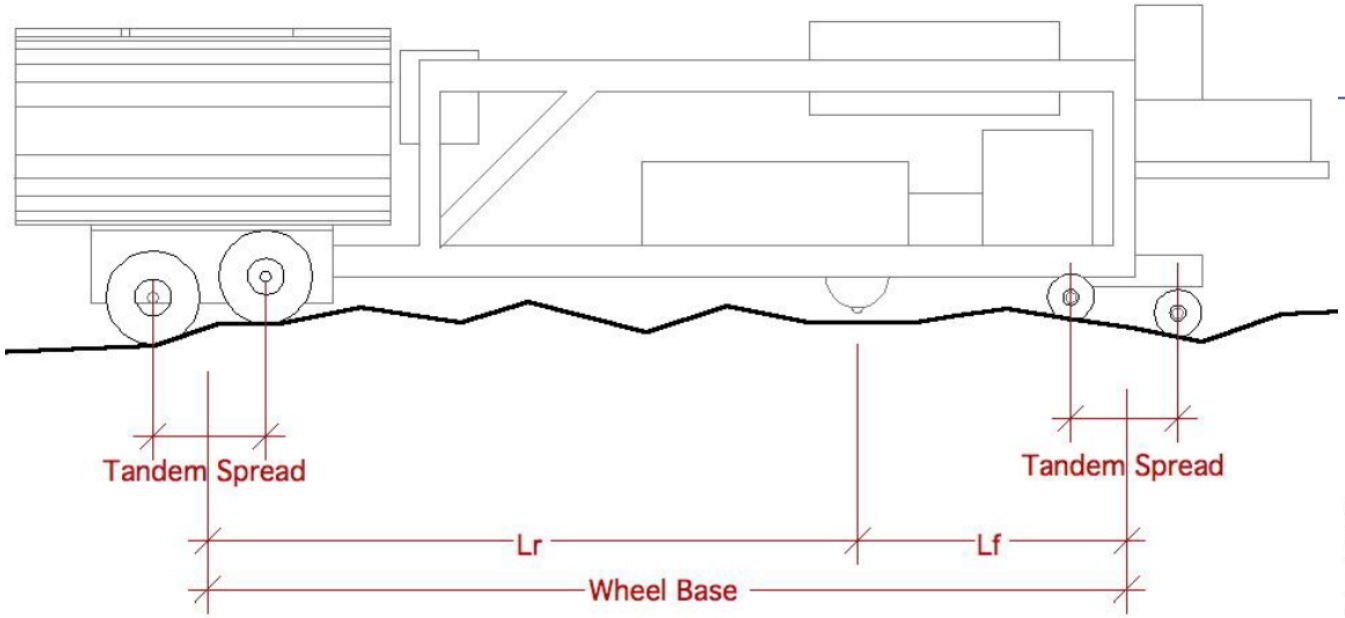
What About Correction of Smoothness on Existing Pavements

Should be a Two Tier Per Cent Improvement Specification

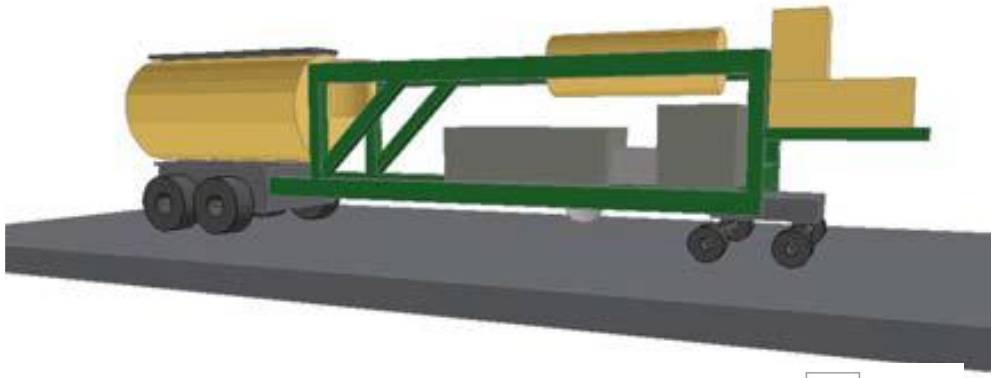


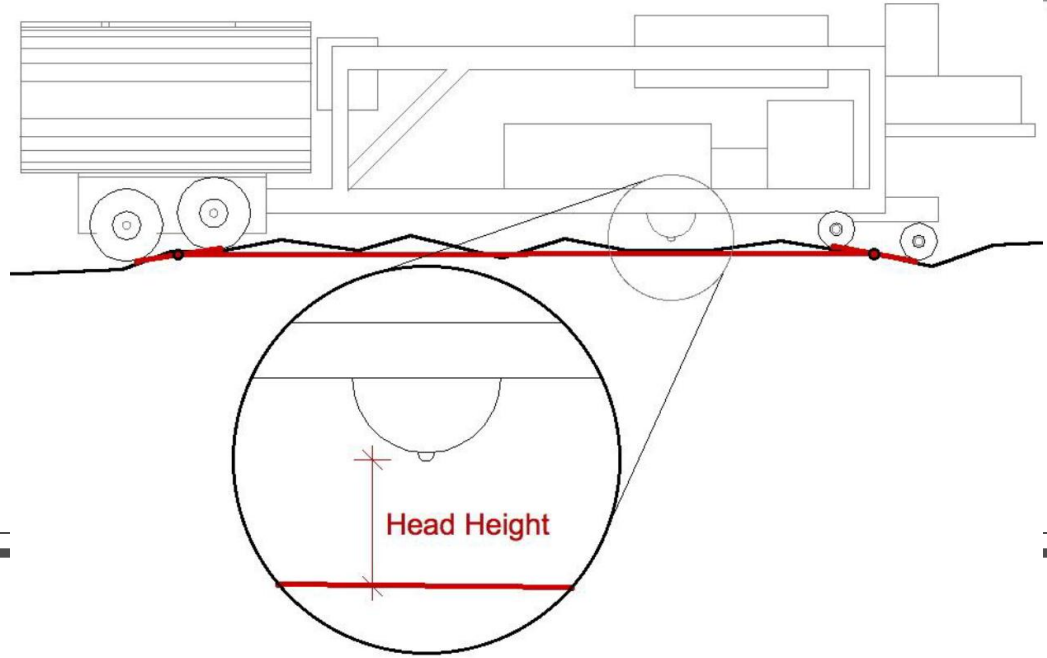


ProVal Grinder Representations

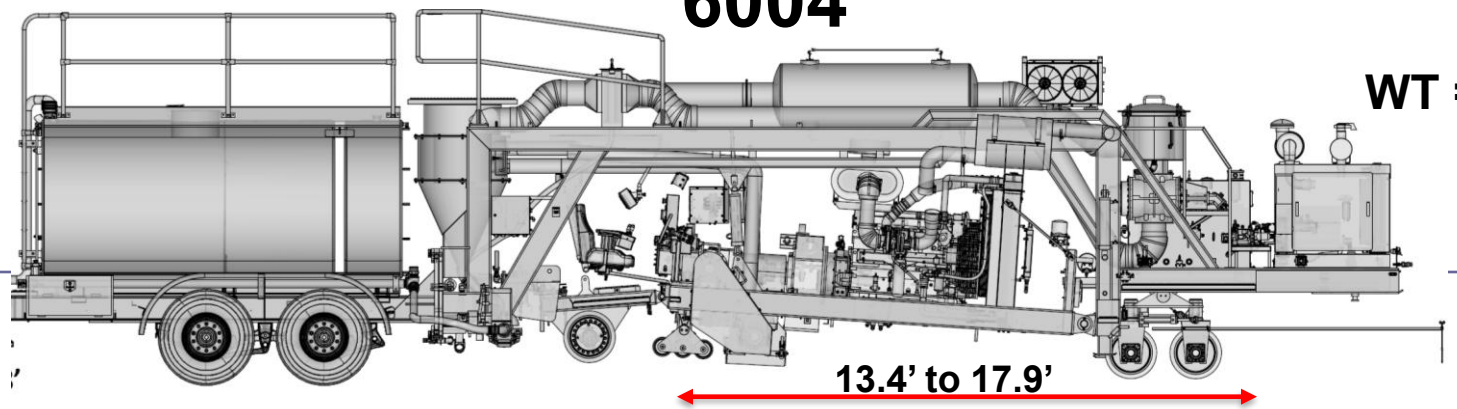


Head Position = Lf / Wheel Base



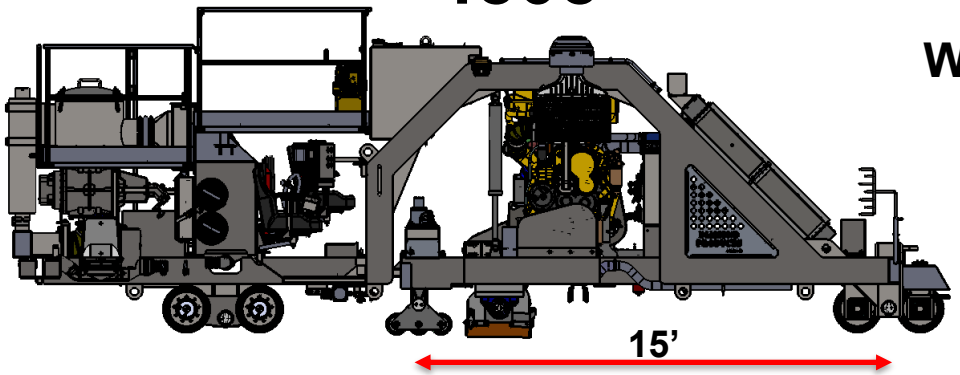


6004



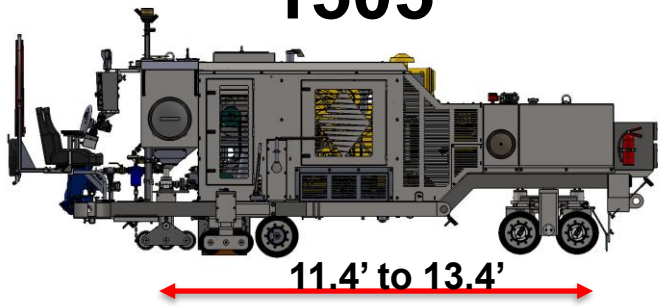
WT = 57,000 to 80,000 lbs.

4505



WT = 46,500 lbs.

1505



WT = 24,500 lbs.

AS-BUILT ROUGHNESS INCLUDED IN PAVEMENT MANAGEMENT DATA

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Concrete Pavement Preservation Original PMS Concept

Circle of Life

OTHER ISSUES

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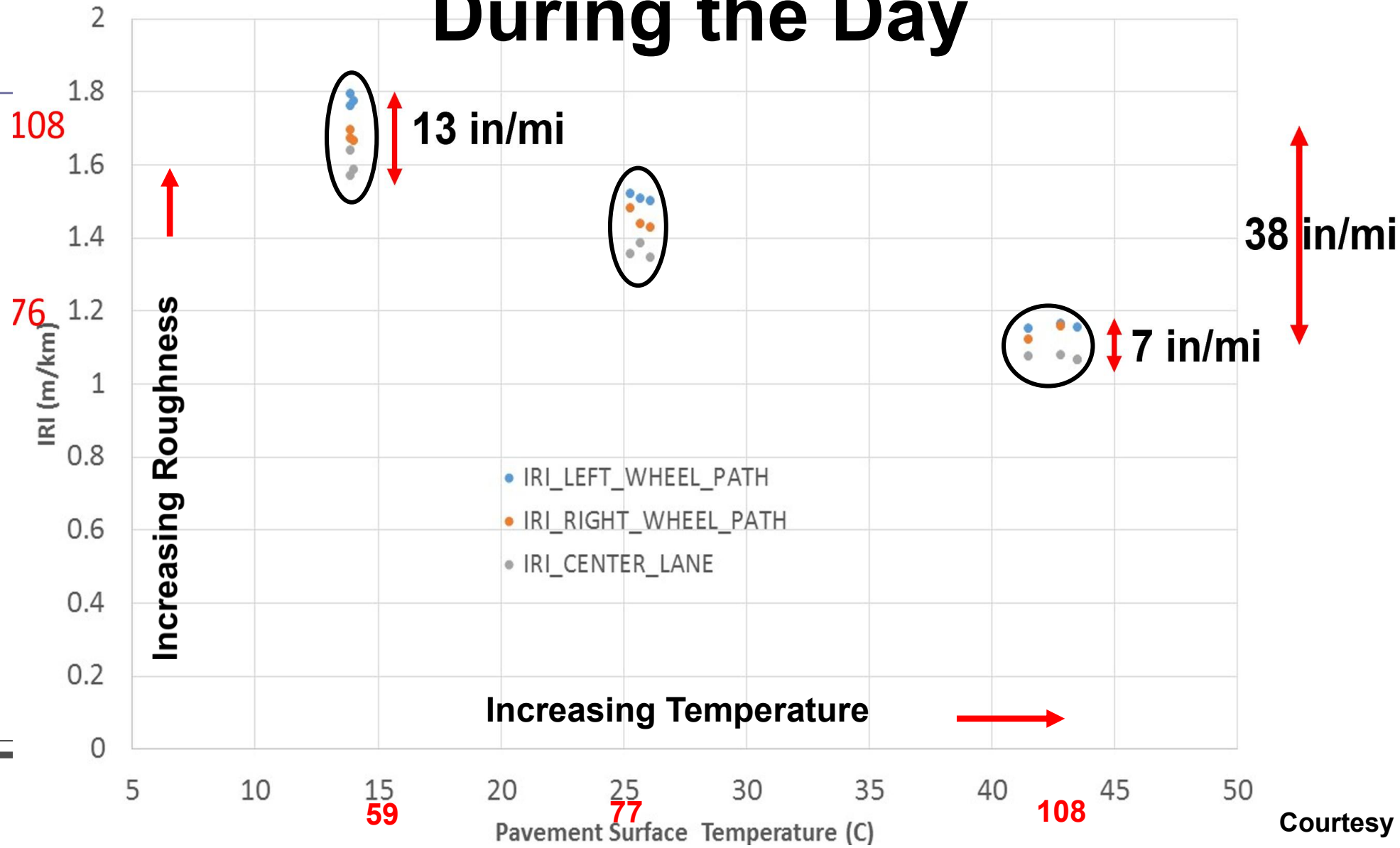
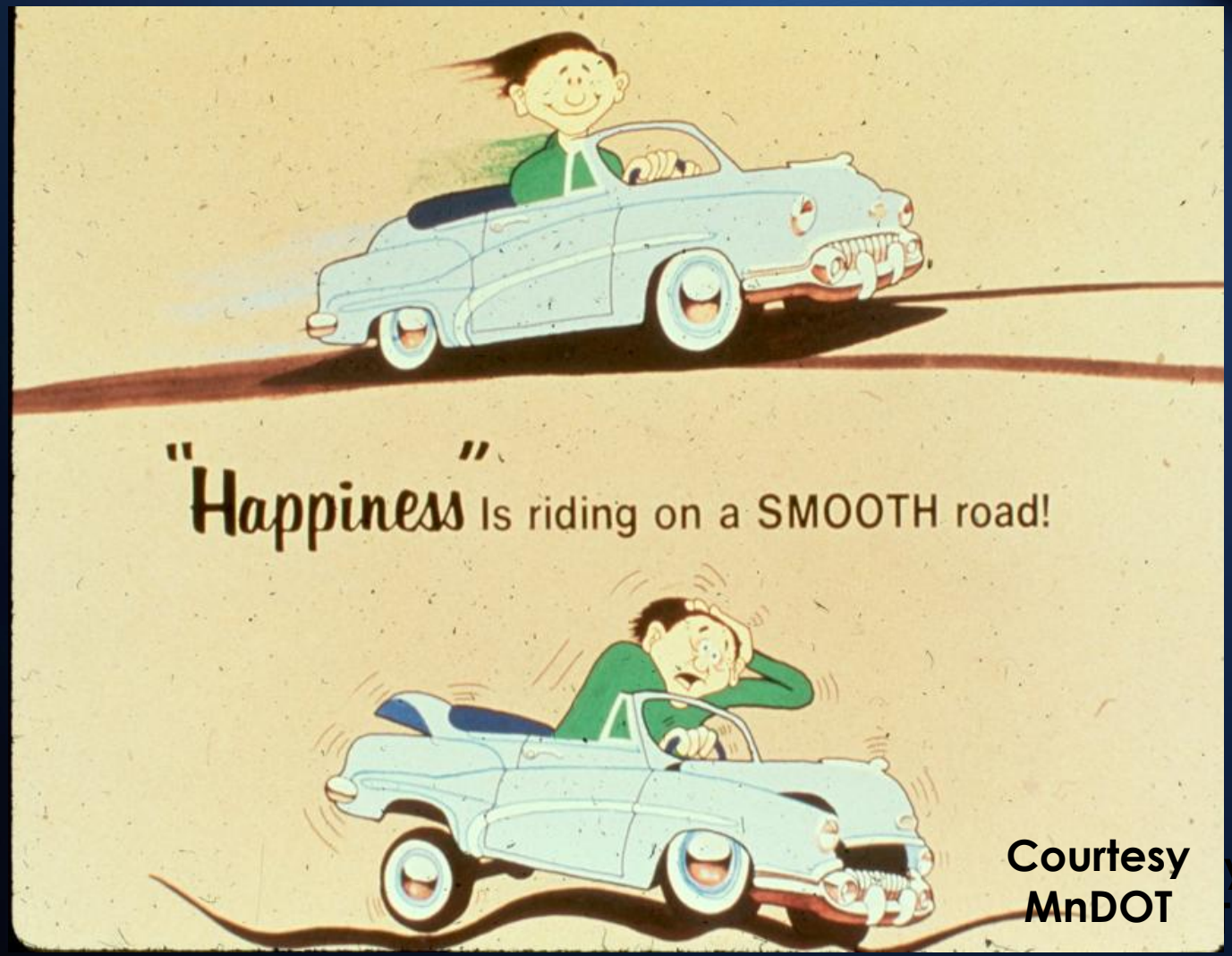
Variability in SPS-2 Roughness Measurement During the Day



Courtesy Gary Elkins

THE END



Courtesy MnDOT

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