



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

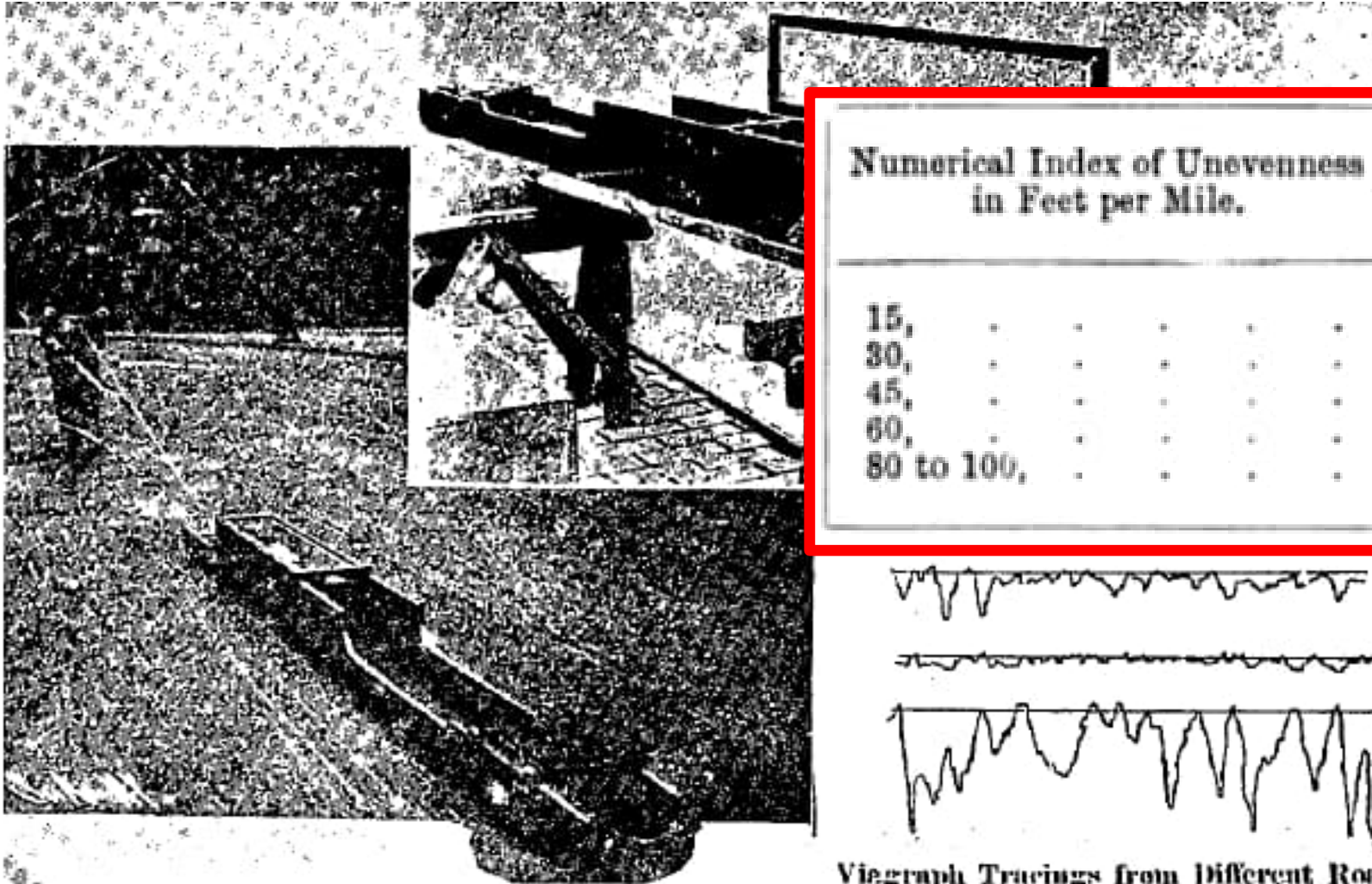


History of Measurement Equipment

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	

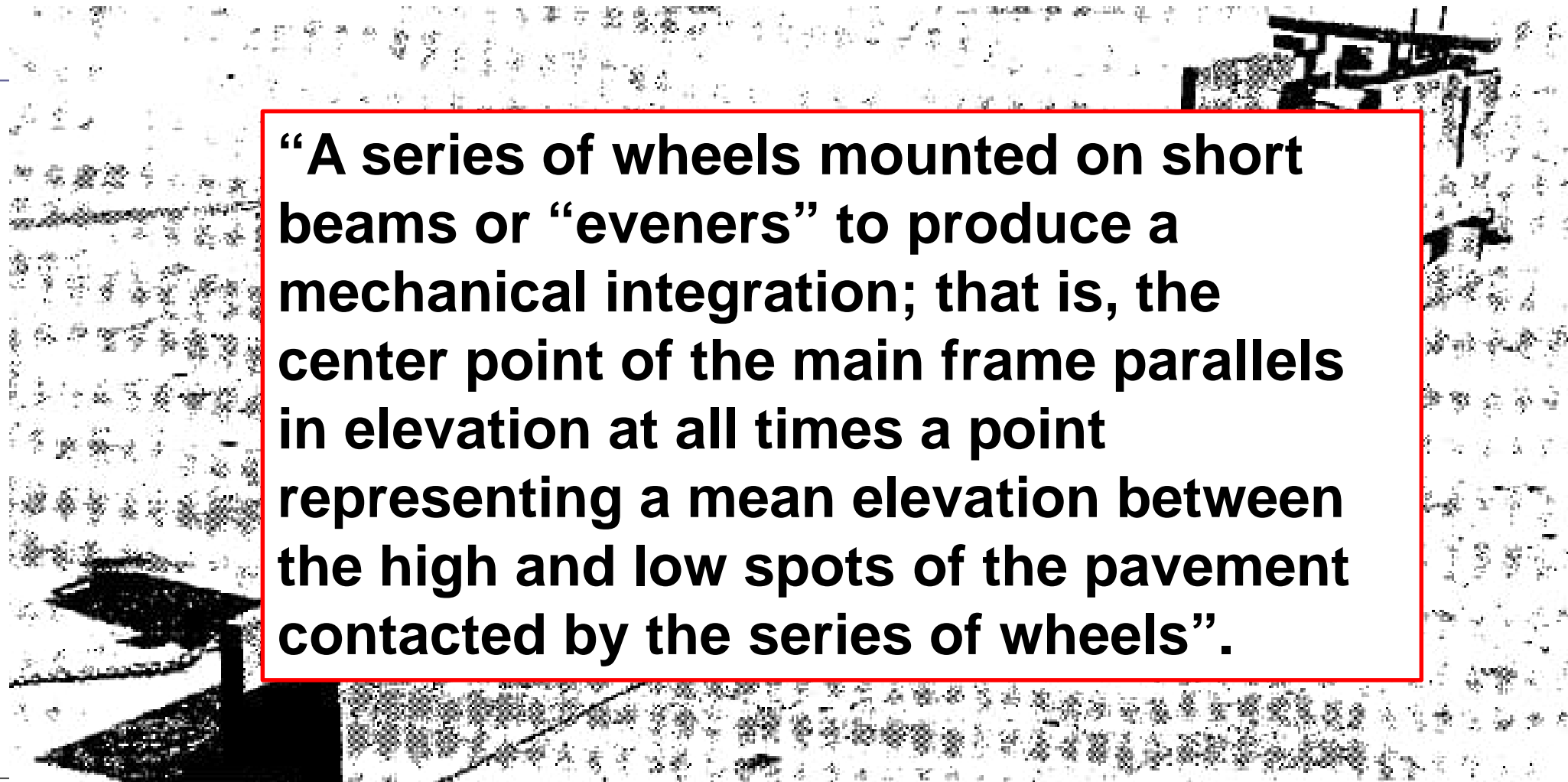
Earliest Roughness Measurement Devices Were Straightedge Based—Brown's Viagraph pre 1900



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

Viagraph 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”.

California Profilograph Equipment Development

1940s



10 ft

1957-60

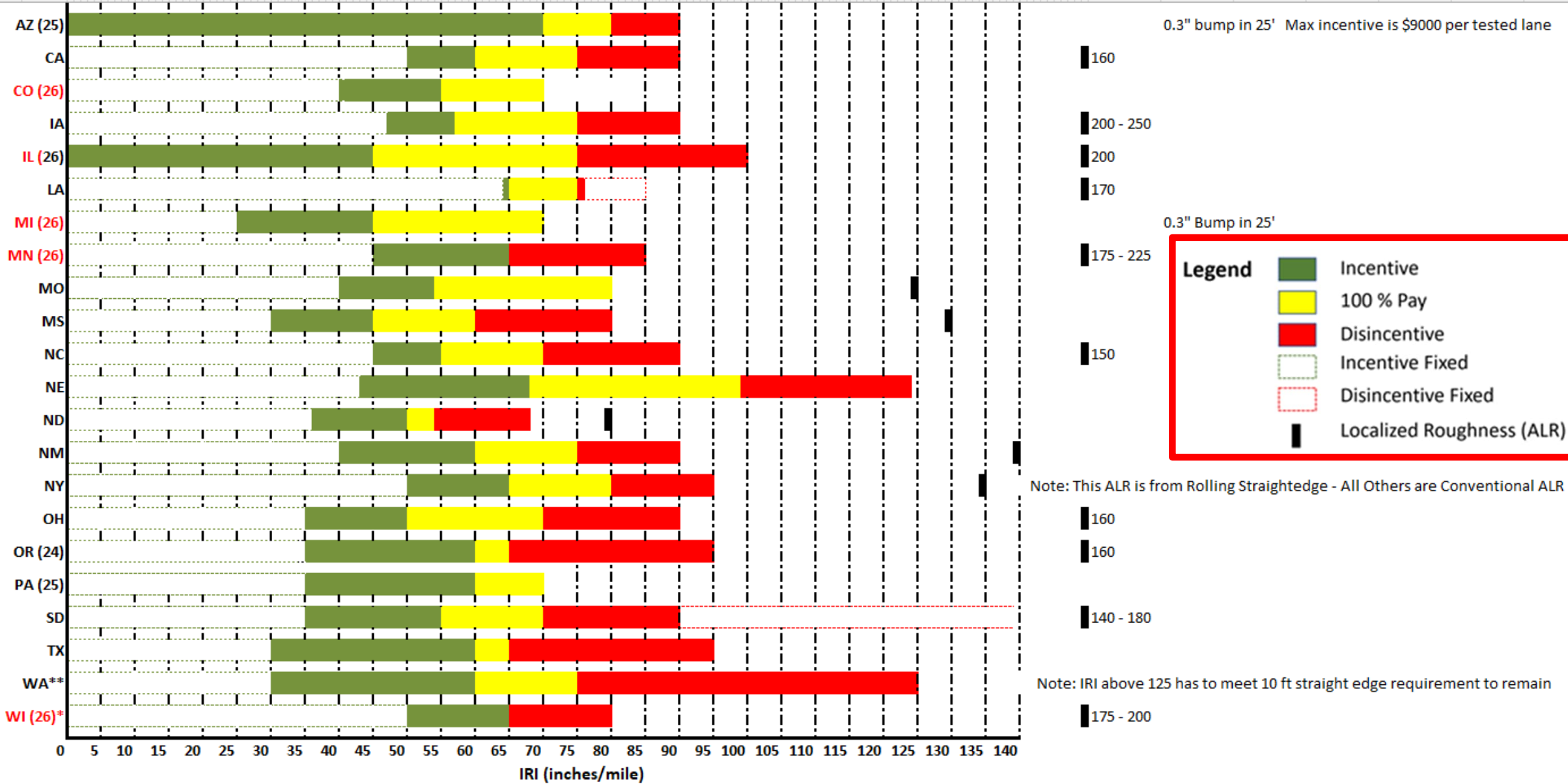


25 ft

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



2026 State Smoothness Specifications



*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

Washington DOT Study 2002

Consumer
Ride Quality
Scale of 1 -5

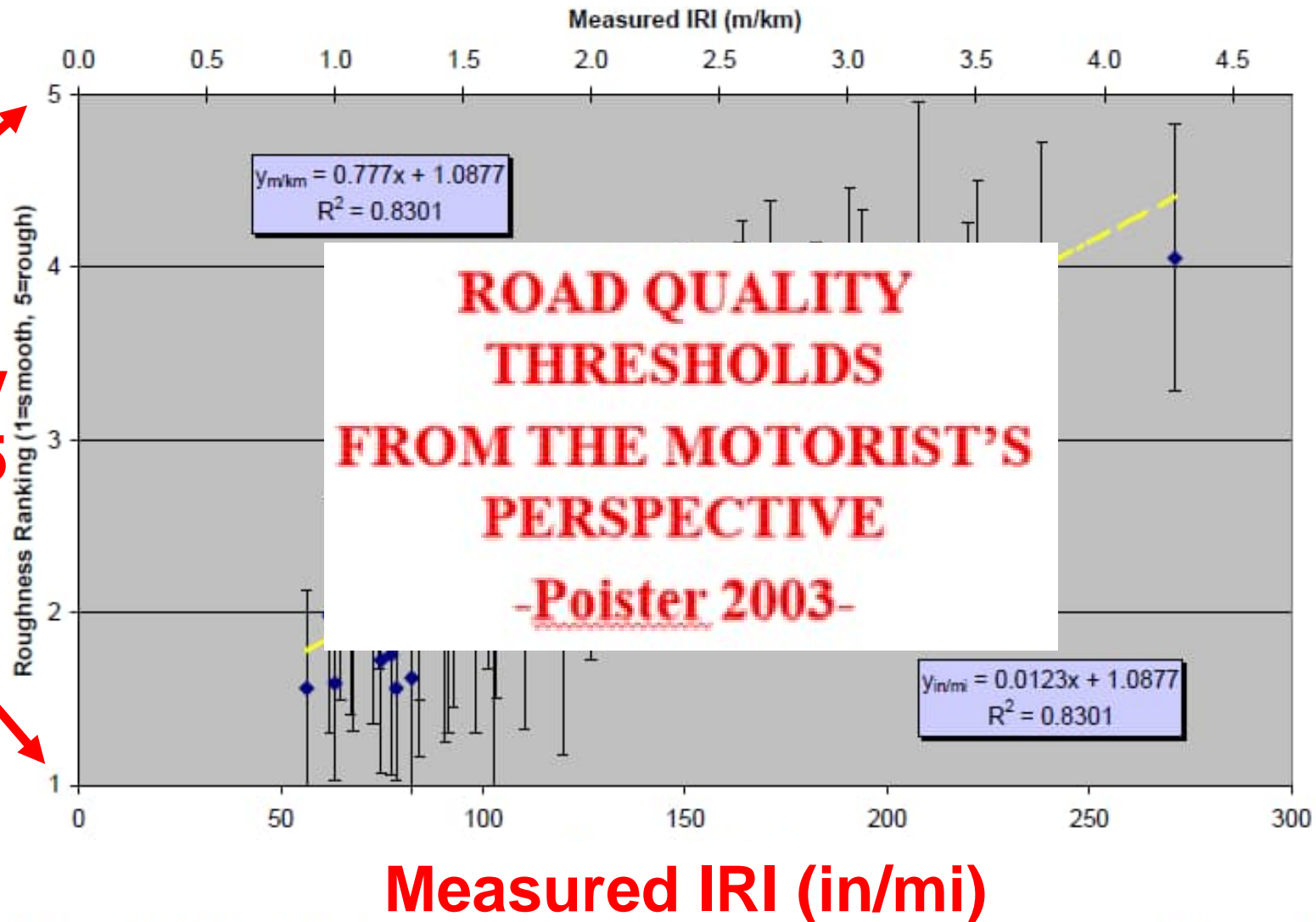
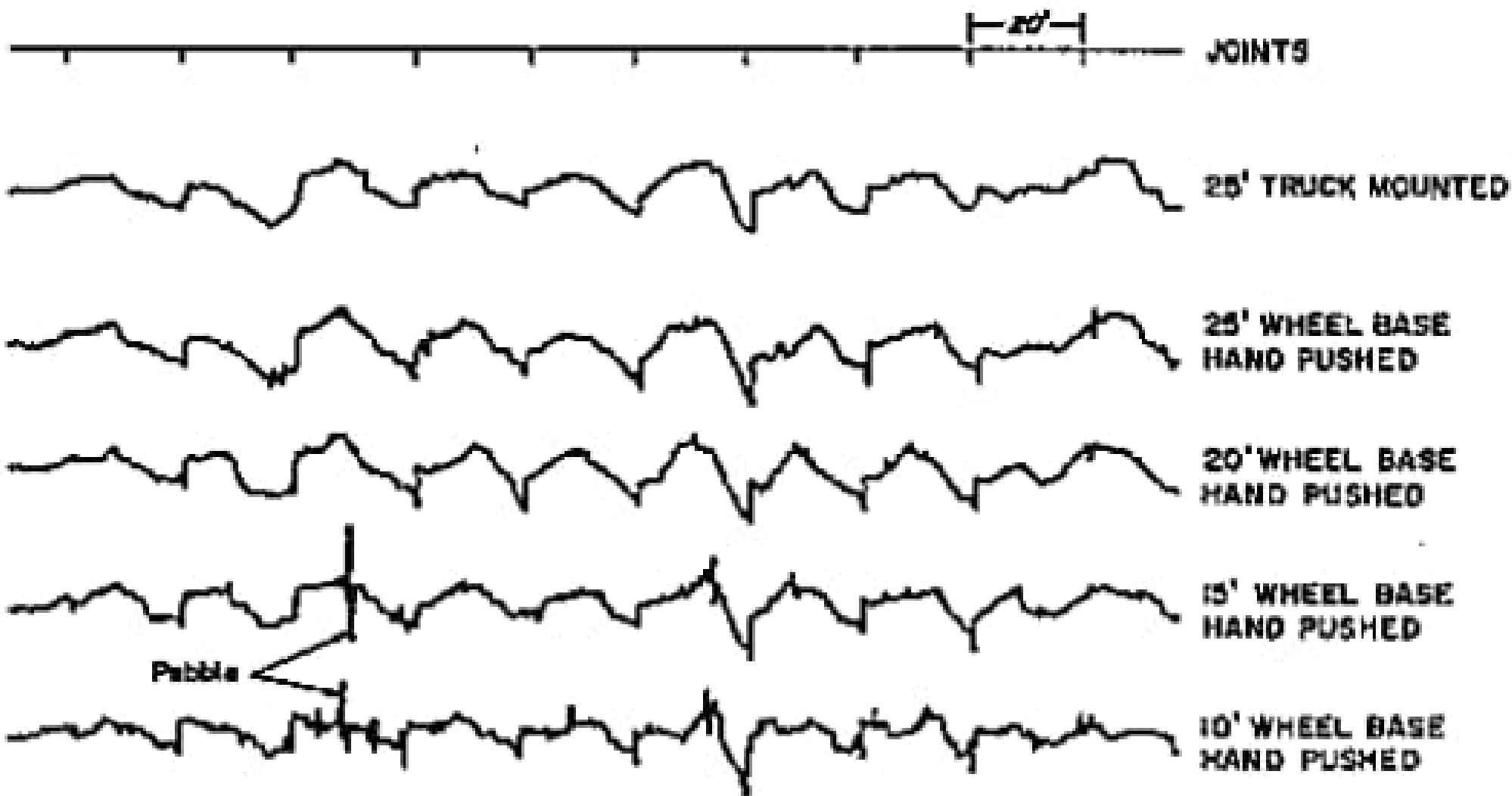


Figure 13. Mean Roughness Ranking with One Standard Deviation vs. Measured IRI

I



Vertical Scale



Horizontal Scale



HONORING THE PAST. PAVING THE FUTURE.

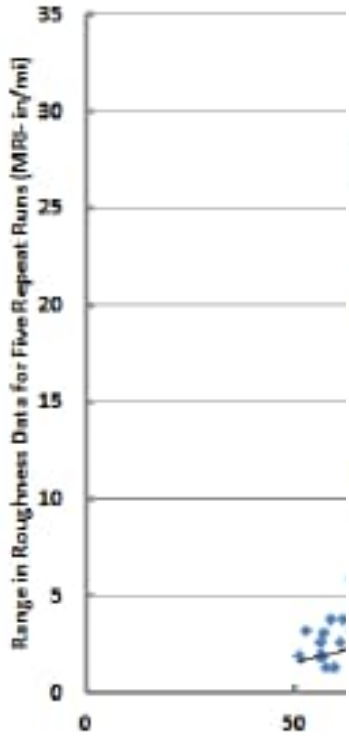
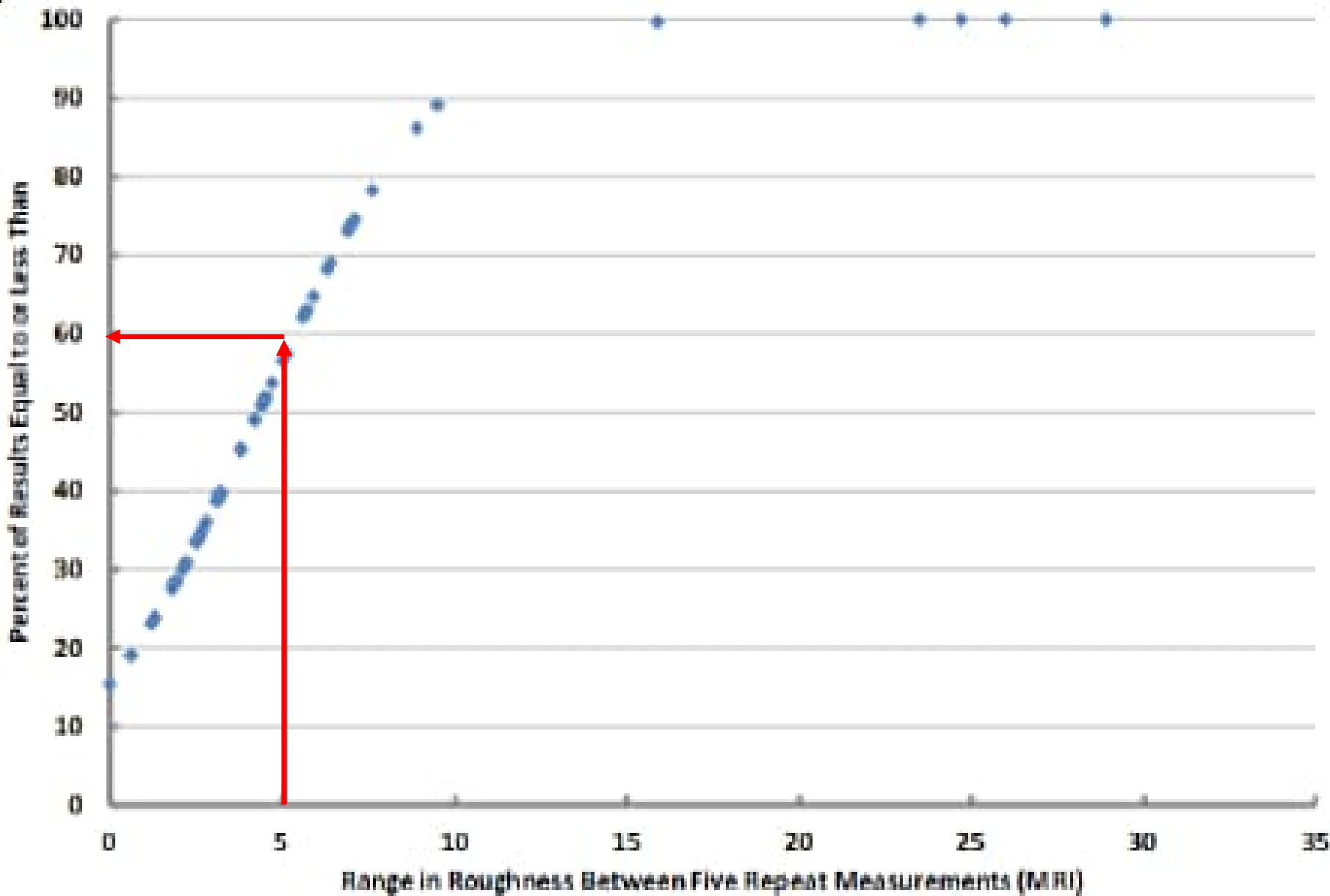
SINGLE WHEEL PATH MEASUREMENT

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

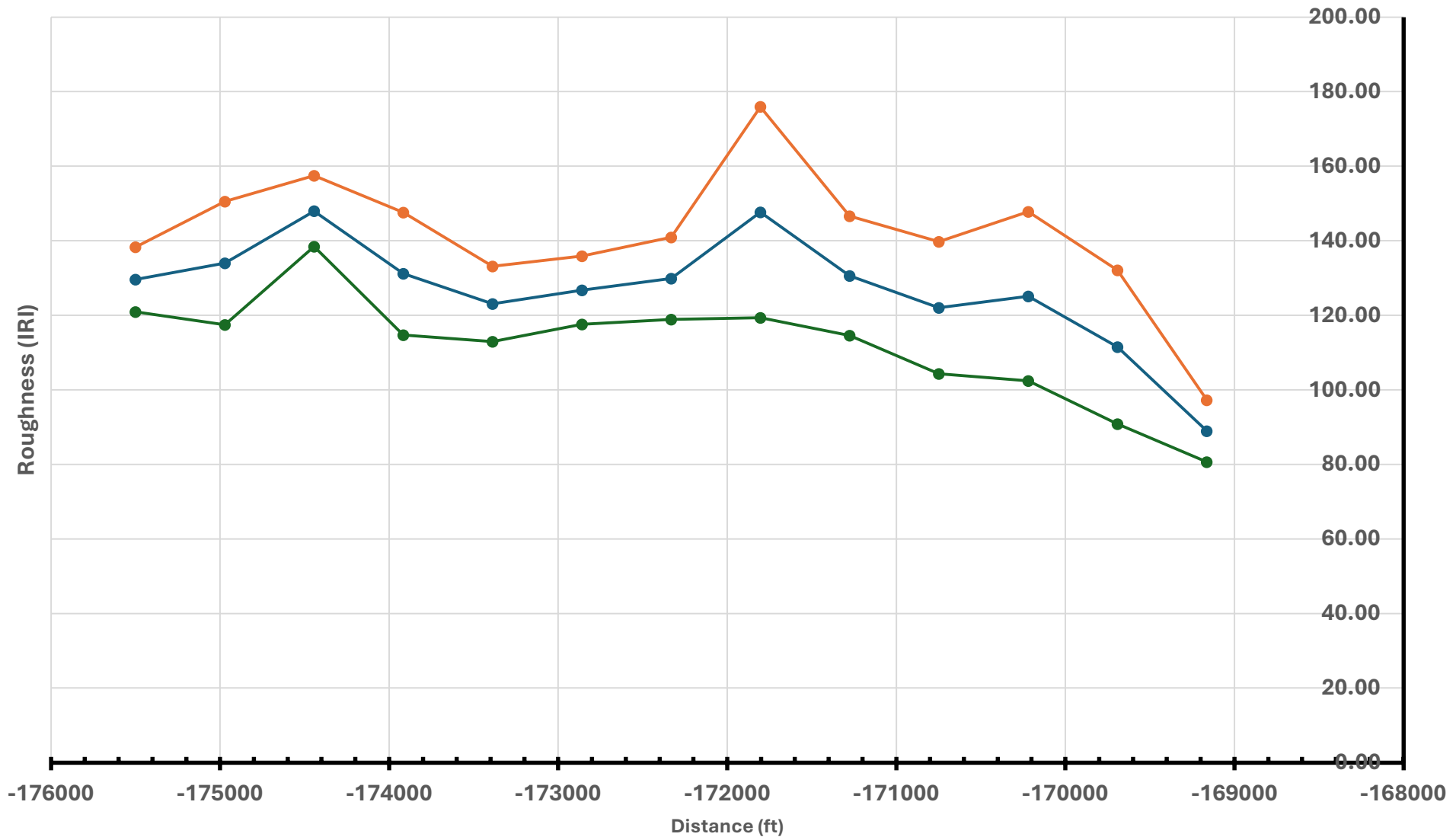


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Variability Between Profiles

MRI vs Profile 1 and Profile 2

—●— MRI —●— Profile 1 —●— Profile 2



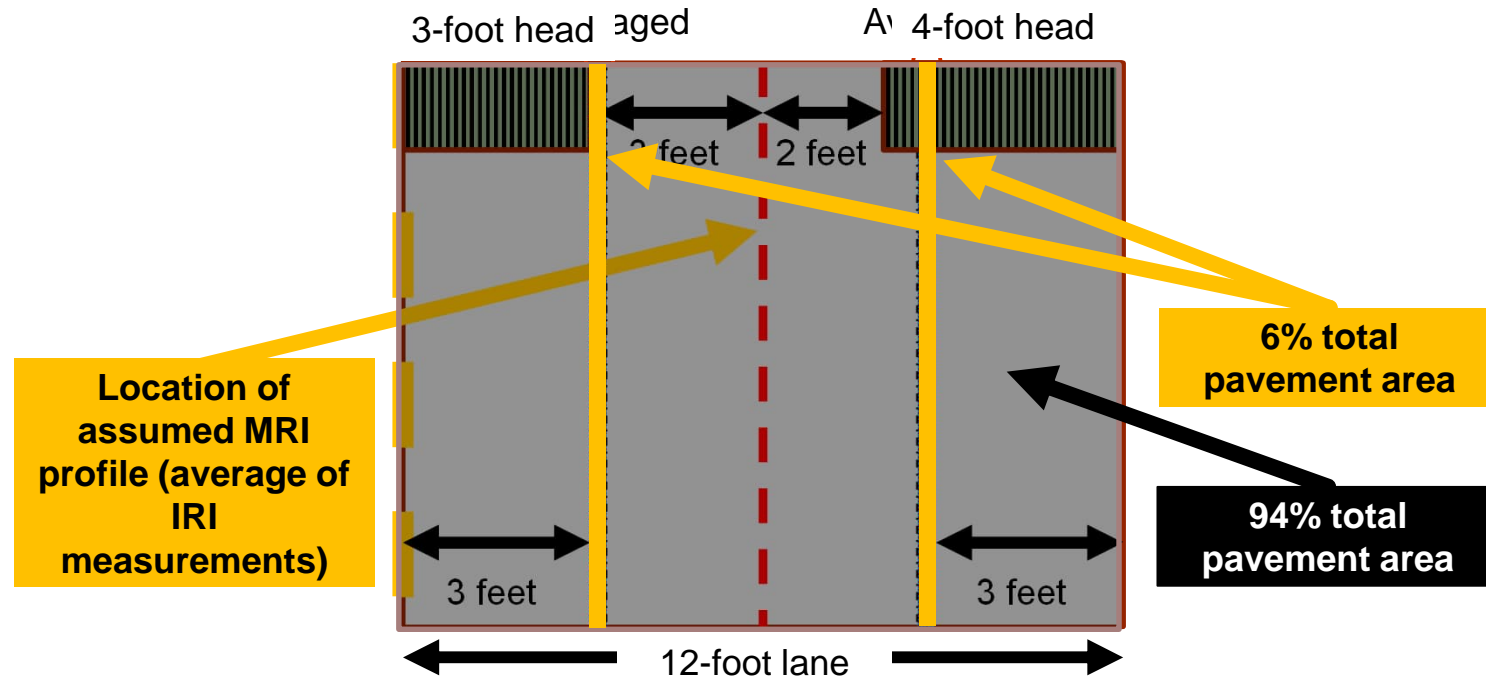


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CORRECTING ROUGHNESS

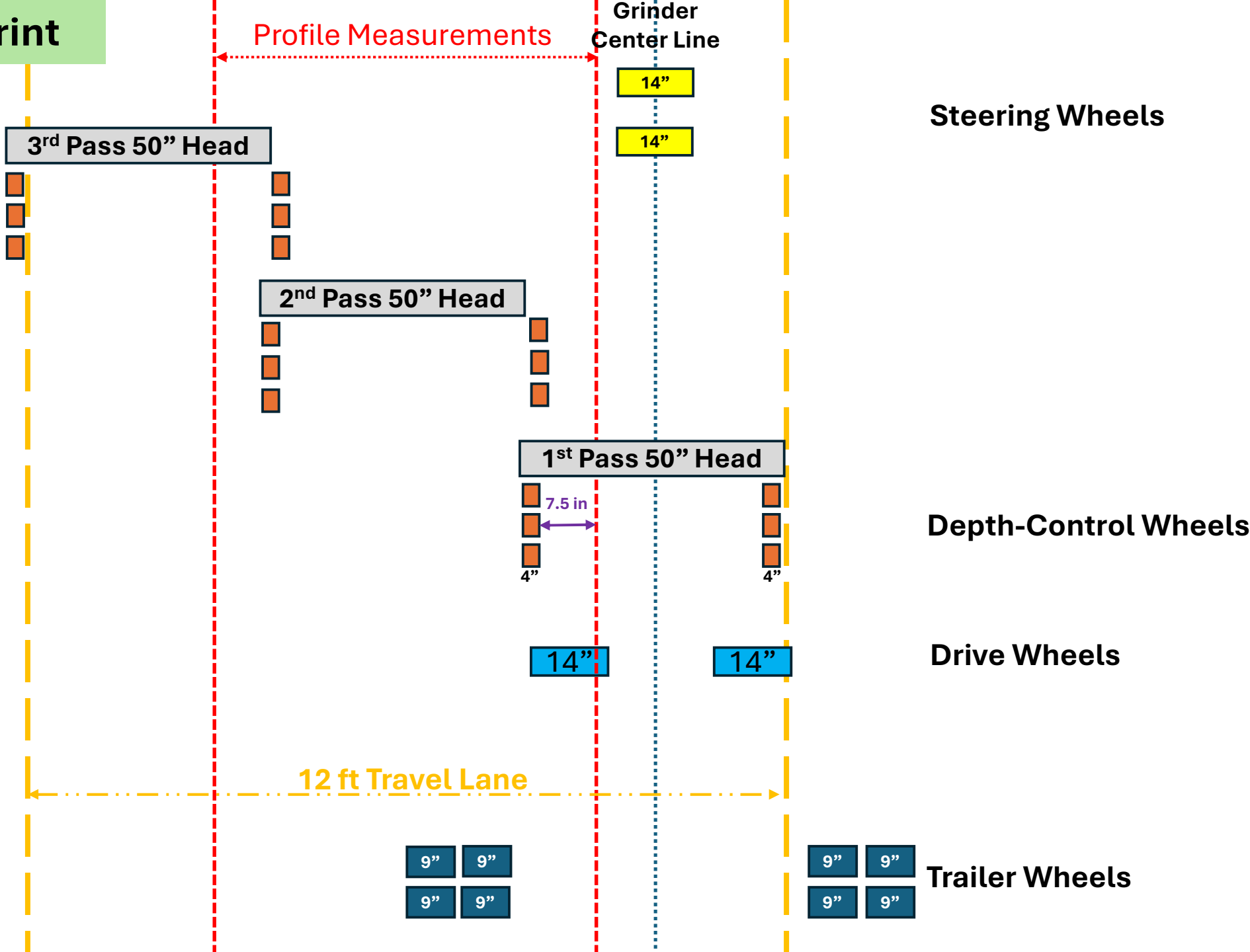
How We Measure Smoothness

Transverse Profile Variability Is Real

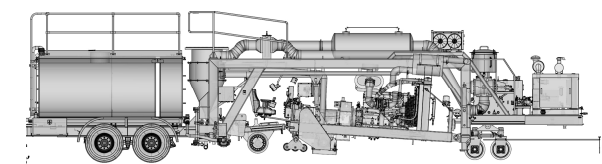


**Percent
Within
Limits?**

PC6000 Grinder Footprint



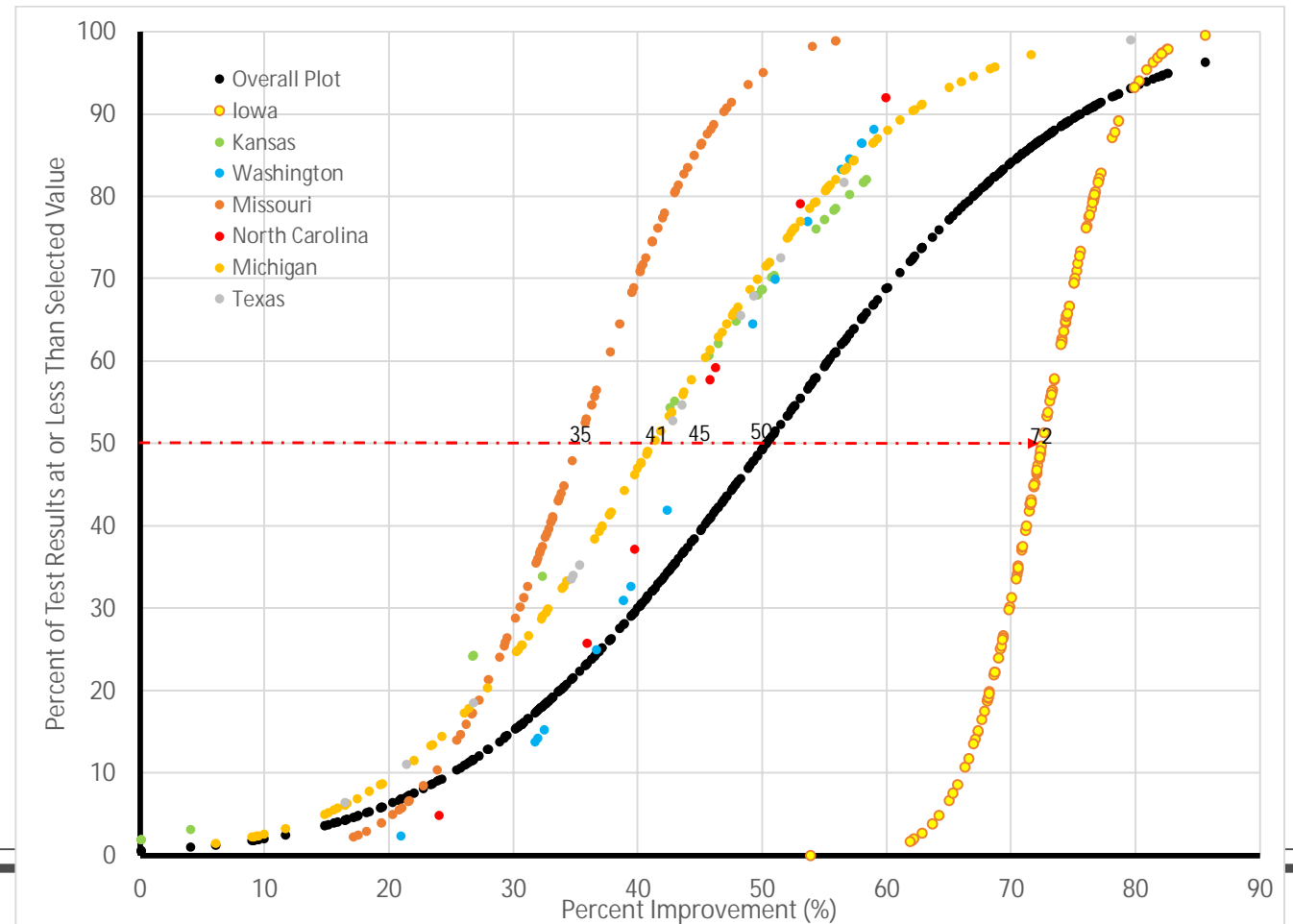
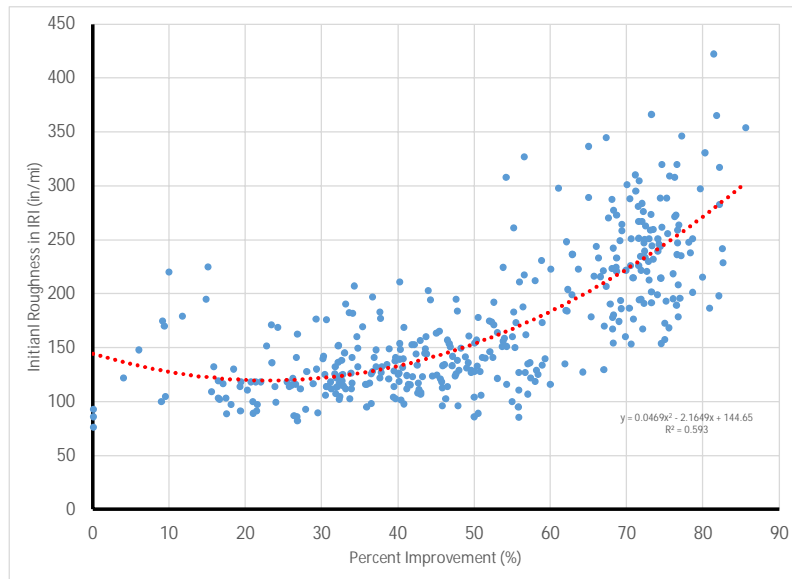
Note: Only Horizontal Dimensions are to Scale, Vertical are not



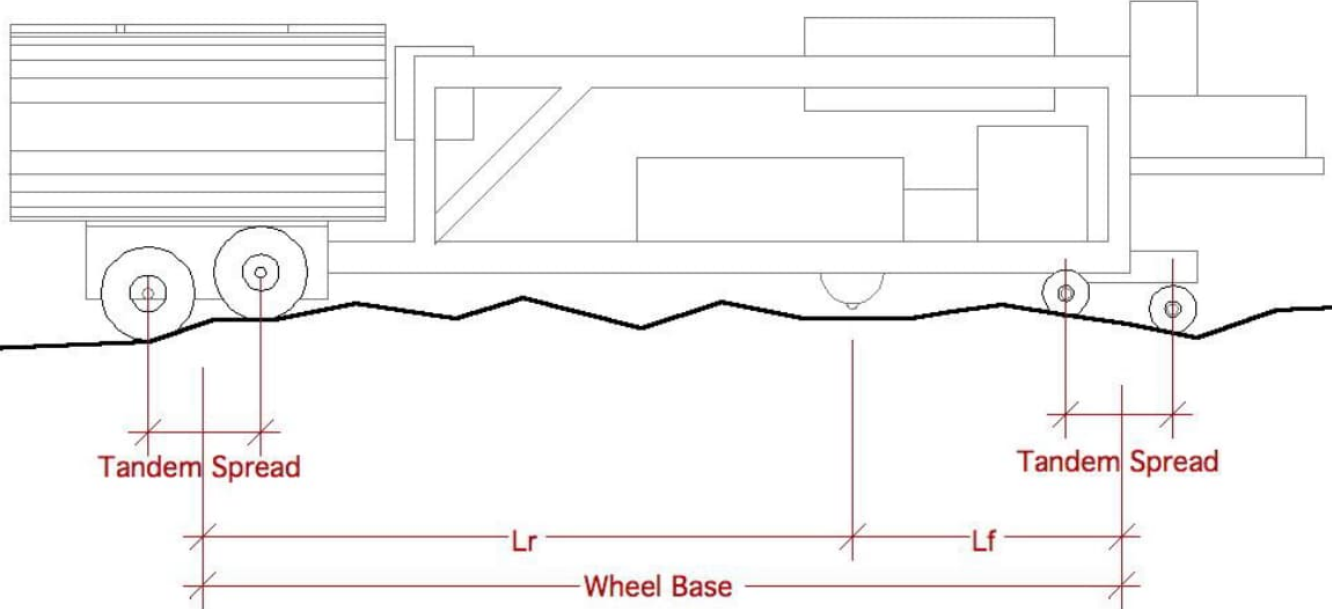
Dimensions Courtesy of Diamond Products

What About Correction of Smoothness on Existing Pavements

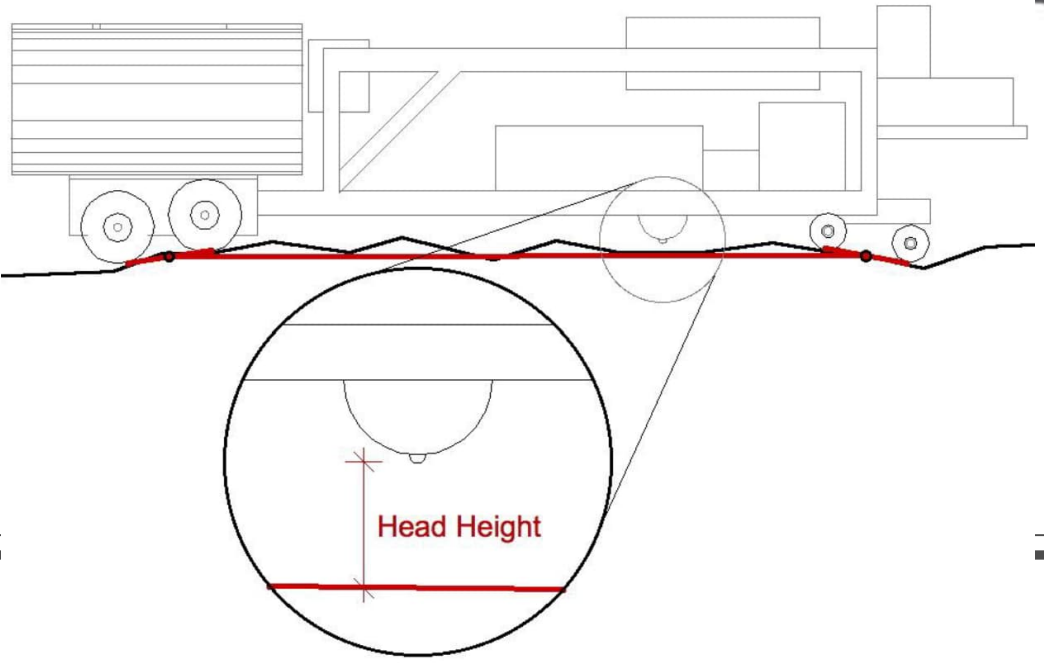
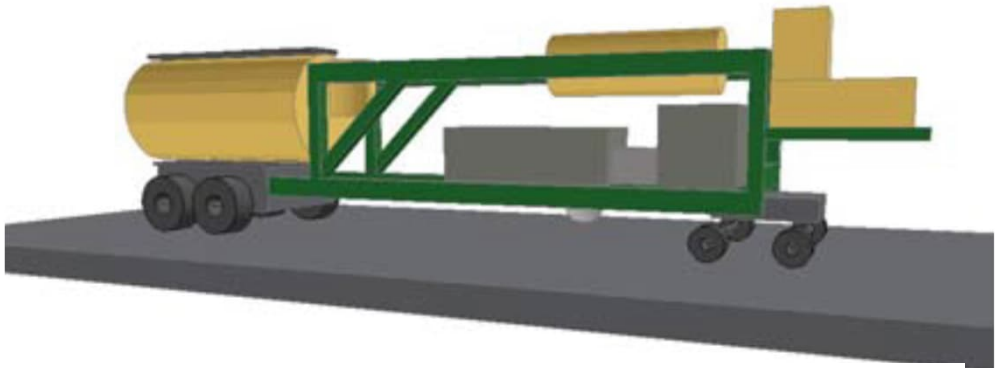
Should be a Two Tier Per Cent Improvement Specification



ProVal Grinder Representations

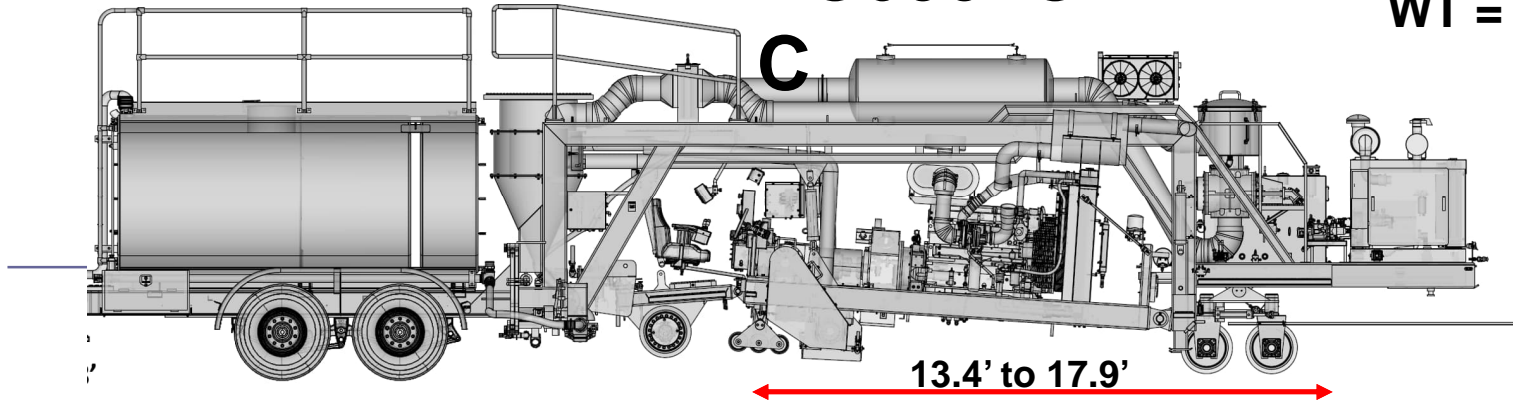


Head Position = $L_f / \text{Wheel Base}$



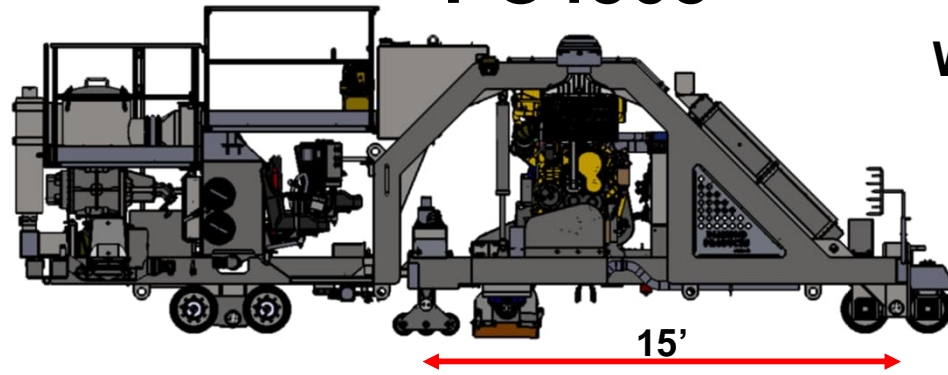
PC6004CE

WT = 57,000 to 80,000 lbs.



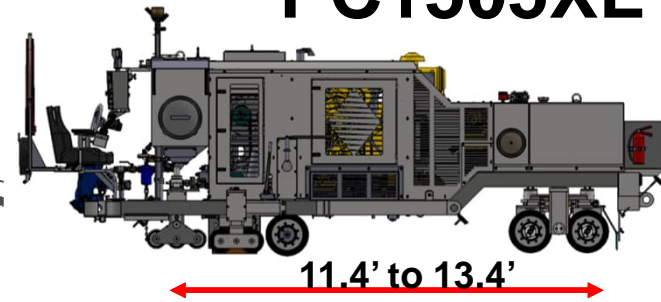
PC4505

WT = 46,500 lbs.



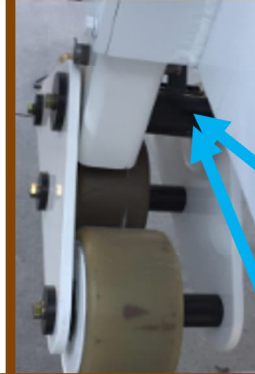
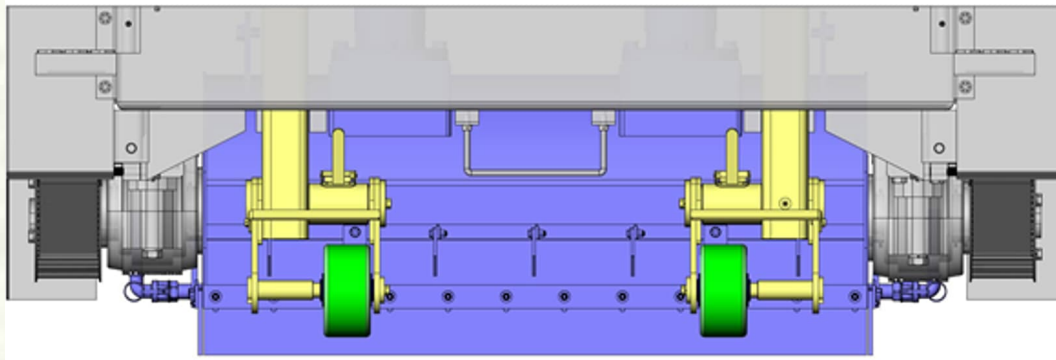
PC1505XL

WT = 24,500 lbs.



Depth Control Wheel Assemblies and Positions

Inboard Position



Depth Control Wheel Clamp

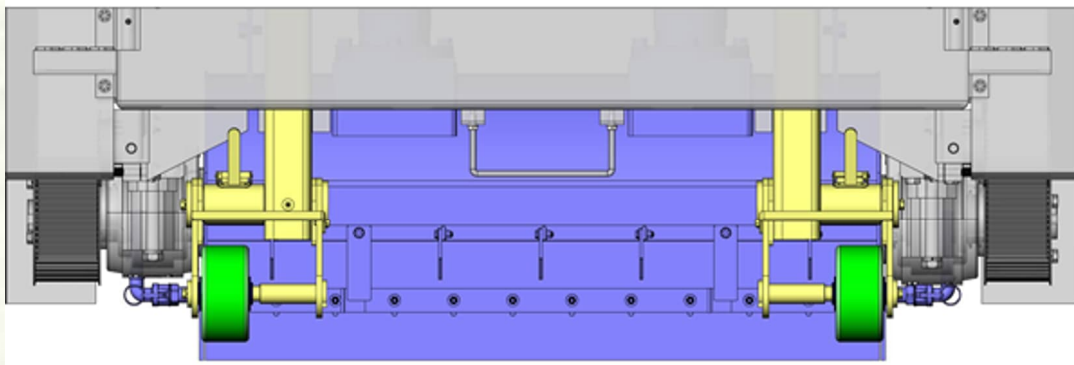


Closed



Open

Outboard Position



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



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AS-BUILT ROUGHNESS INCLUDED IN PAVEMENT MANAGEMENT DATA

Concrete Pavement Preservation Original PMS Concept



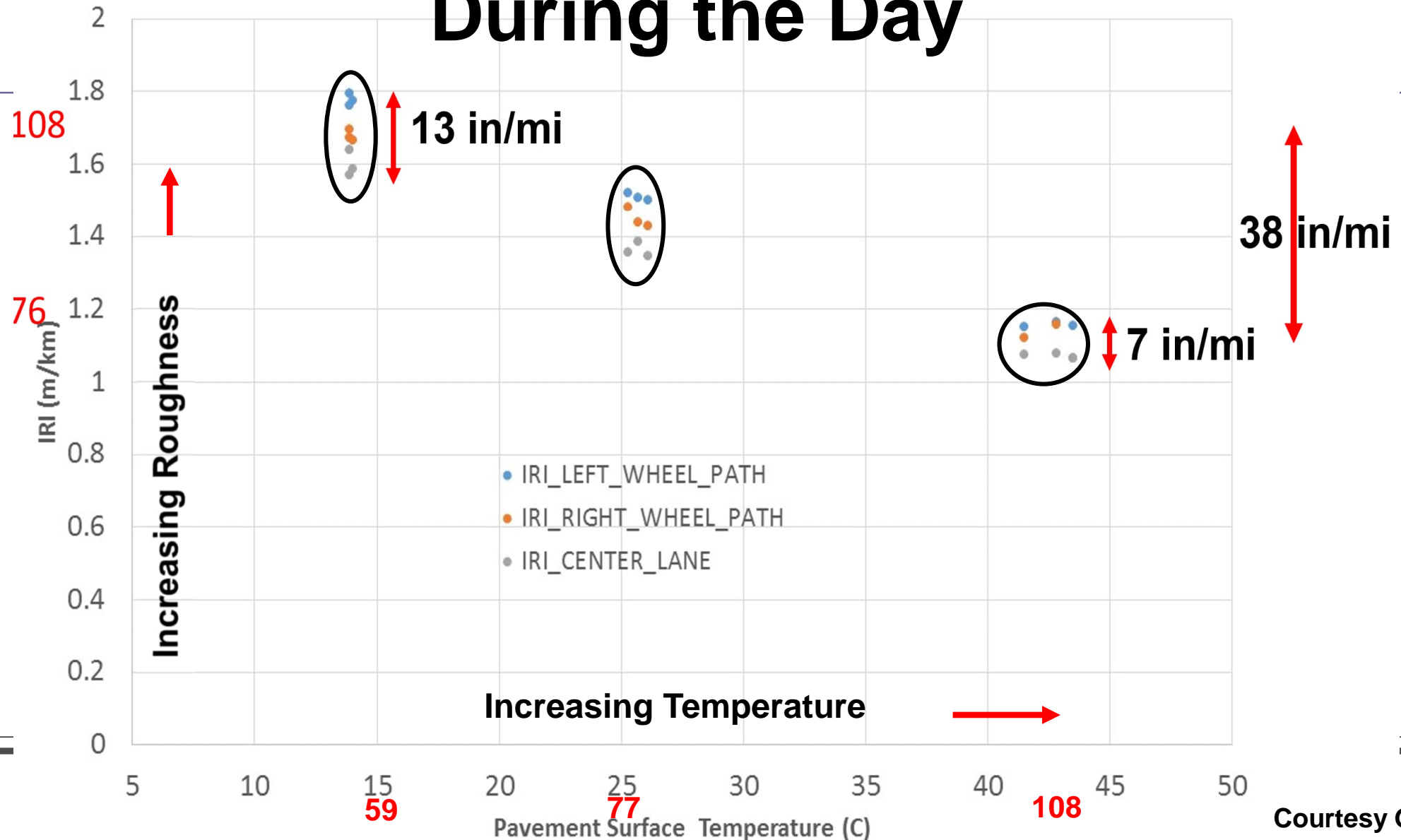
Circle of Life

OTHER ISSUES

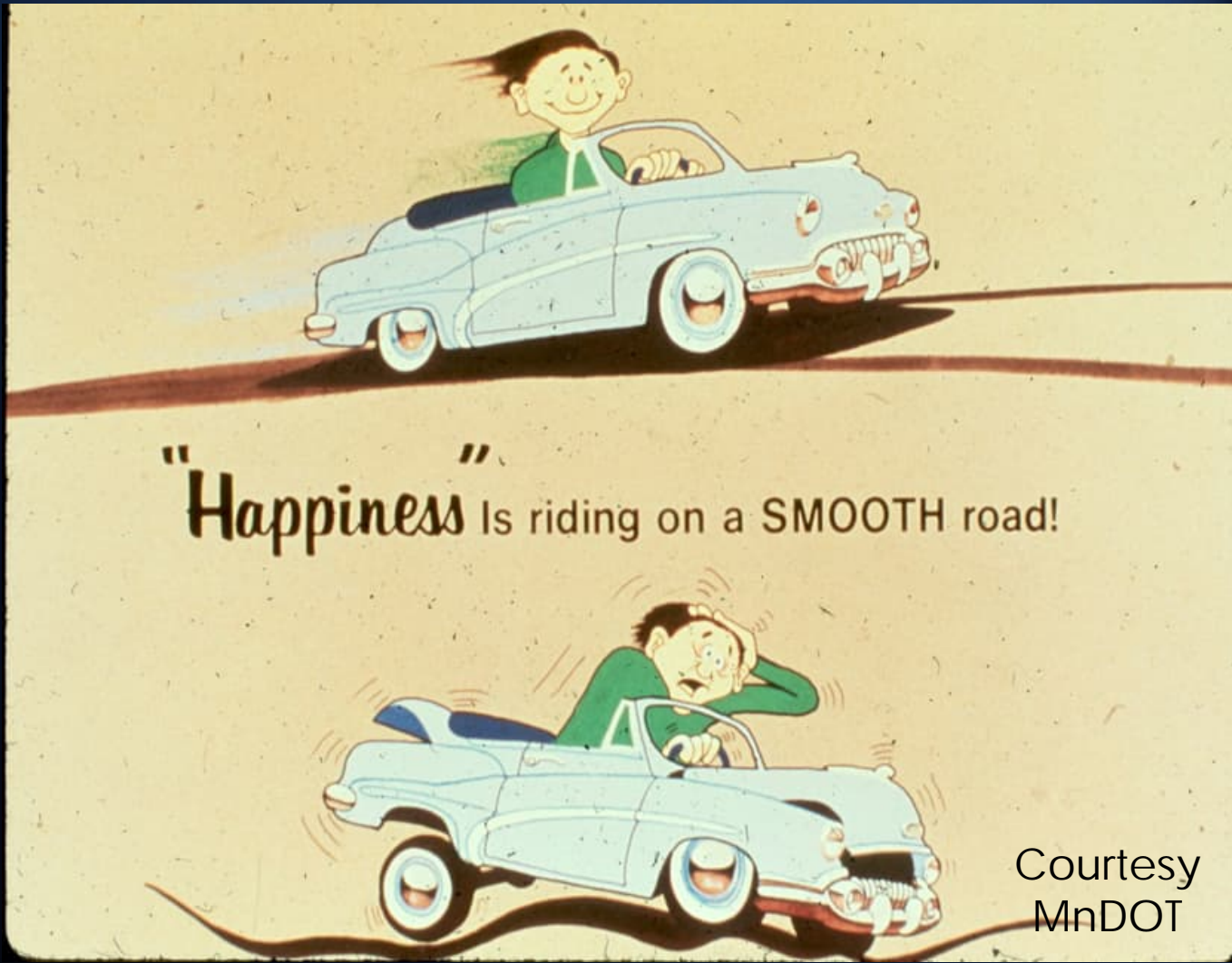


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Variability in SPS-2 Roughness Measurement During the Day



THE END



Courtesy
MnDOT