

**The Value of Smooth Pavements**

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## What do the Highway Users Want?

- 1 Uncongested Highways
- 2 Safety
- 3 Smoothness

(Based on 1995 NQI Survey and 2000 FHWA Infrastructure Survey)

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## What do the Studies Show?

- Smoother highways last longer
  - NCHRP 1-31, FHWA, and NAPA
- Smoother roads stay smoother longer
- Smoother roads are safer
- Smoother roads save money

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## Types of Smoothness Specs

- Measured Smoothness
  - Straightedges and profilographs
  - Roughness profile of pavement surface
- Ride Quality
  - Inertial profilers and “response-type” devices
  - Produce profile traces or measure

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## Smoothness Specifications—Basics

### Smoothness Index System

- International Roughness Index (IRI)
  - Any profiler (inertial, Inclinator, rod-and-level) that generates a profile trace showing pavement shape
  - IRI is calculated from the pavement profile
- Profilograph Index (Pri)
  - Measured with a California Profilograph (or Rainhart)
  - Apply a blanking band (0.2 inch typical)

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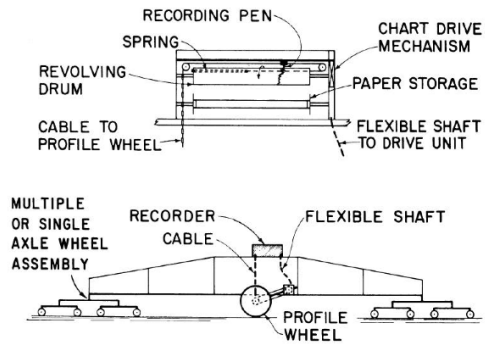
## Inertial Profilers



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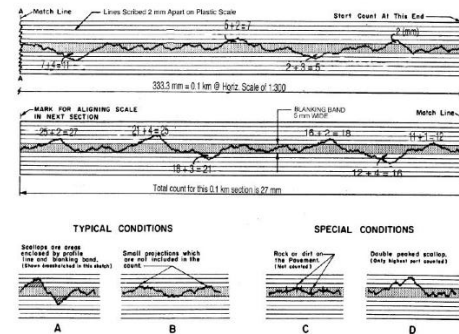
Photos Courtesy SSI

## California Profilograph



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## California Profilograph



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## Incentives / Disincentives for Pavement Smoothness

### ■ “Pay for Smoothness” Philosophy

- Incentive Limits
- Full Pay Limits
- Disincentive Limits
- Threshold for Corrective Action (Reject)

■ In a perfect world, limits are based on initial smoothness, long-term smoothness, and pavement performance in a life-cycle cost analysis.

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## FHWA Smoothness Specification

### ■ IRI

- 0.1 mile randomly selected segment
- Single trace—middle of lane
- IRI every 25 foot segment

### ■ Type III Conditions (New / Reconstructed Roads)

### ■ Type IV Conditions (Overlay, Recycle/Mill w/ OL)

### ■ Type V Conditions (Straightedge)

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## FHWA Smoothness Specification Type III New / Reconstructed Roads

IRI (in/mi)	Pay Factor	IRI (in/mi)	Pay Factor
>95	Reject	50-60	1.03
90-95	0.80	40-50	1.06
80-90	0.90	30-40	1.08
70-80	0.96	<30	1.10
60-70	1.00		

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## FHWA Smoothness Specification Type IV OL, Recycle or Mill / OL

Single Lift % Improvement	Pay Factor	Multi-Lift % Improvement	Pay Factor
>48.4%	12.50	>61.1%	12.50
24.8-48.5%	.5274(%) - 13.027	43.3-61.1%	0.6983(%) - 30.168
12.4-24.7%	0	34.0-43.2%	0
0.9-12.3%	3.2609(%) - 40.435	<25.4-33.9%	4.3605(%) - 148.260
<0.9	Reject	<25.4%	Reject

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## What is the Value of Smoothness?

- “Pay for Smoothness” – is this valid?
- What does the cost/benefit analysis show?
  - How do you measure that benefit (initial/life cycle)
  - What is the cost to implement a Smoothness Specification?
    - Direct costs to agency
    - Indirect costs (higher bid price)
- Smoothness Incentive vs. Mat/Mix Incentives?