

# Road Smoothing Specification

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## Glossary

Road Smoothing area	Rough area to be smoothed with taper-in and taper-out parts
DD100	Decay Detector 100. High speed Inertial Profiler, Product of Diamond Road
Class 1 Inertial Profiler	Inertial profiler with longitudinal sampling less than or equal to 25mm (1 inch)
IRI	International Roughness Index
MRI	Mean Roughness Index. A number calculated by averaging the IRI values from the two wheel path profiles.
RSI	Road Smoothness Index, calculated for one wheel path
MRSI	Mean Road Smoothness Index. Average calculated from the RSI of two wheel paths.
Pavement Section	<ol style="list-style-type: none"><li>1. Each travel lane or median, 0.1 mile long. Sections include:<ol style="list-style-type: none"><li>a. All traffic lanes</li><li>b. Ramps</li><li>c. Medians and shoulders 8 ft and wider</li><li>d. Turn lanes</li><li>e. Approach slabs with final riding surfaces placed as part of the contract</li></ol></li><li>2. Each pavement section is laid out consecutively from the Cardinal start of the project.</li></ol>
Wheel Path	A continuous parallel line 2.5 ft inside the lane or median lines.

## Road Smoothing Procedure

1. Profile road prior to any work.
2. Identify areas for road smoothing.

3. Perform road smoothing.
4. Profile road after smoothing.
5. Analyze profile. If additional smoothing is required, perform additional road smoothing. After smoothing, profile road and analyze again until no additional road smoothing is required.
6. Contractor will provide to Agency beginning and final road profiles within 24 hours from when they are taken.

## Profiling

Pavement Smoothness will be measured by a Decay Detector 100 or equivalent high-speed inertial profiler. The inertial profiler shall collect 10 samples per inch at up to 65 miles per hour. Inertial Profiler equipment will also be able to collect accurate road profile at 2-5 miles per hour.

RSI (Road Smoothness Index) is a value from 1 to 100 with 100 indicating a smooth road. RSI is a value calculated from IRI and the posted maximum speed for the road.

### IRI to RSI Conversion

Speed, mph	IRI max	IRI min
80	152	30
75	160	31.5
70	168	33
65	176	34.5
60	184	36
55	192	37.5
50	200	39
45	208	40.5
40	216	42
35	224	43.5
30	232	45
25	240	46.5
20	248	48

$$RSI = 100 * \frac{IRI \text{ max} - IRI}{IRI \text{ max} - IRI \text{ min}} \quad , \text{ if } 0 \leq 100 * \frac{IRI \text{ max} - IRI}{IRI \text{ max} - IRI \text{ min}} \leq 100$$

$$RSI = 0 \quad , \text{ if } 100 * \frac{IRI \text{ max} - IRI}{IRI \text{ max} - IRI \text{ min}} < 0$$

$$RSI = 100 \quad , \text{ if } 100 < 100 * \frac{IRI \text{ max} - IRI}{IRI \text{ max} - IRI \text{ min}}$$

## RSI Ranges for Ride Quality

Ride Quality	Very Good	Good	Fair	Poor	Very Poor
RSI	100-90	90-70	70-50	50-30	30-0

## Road Smoothing

### Minimum Road Smoothing:

In every 1-mile section there should be at least 3 intervals per wheel path identified for road smoothing. If there are less than 3 intervals per wheel path in each 1-mile section, then the 3 worst intervals shall be smoothed.

Smoothing before asphalt overlay, chipseal, microsurface, slurry seal, fog seal, open graded sealcoat, or bonded wearing course:

### RSI minimum acceptable limits

Maintenance Type	Section Length - Feet	RSI – Minimum Acceptable Limit
Asphalt overlay $\leq 1.5$	150	30
Asphalt overlay $>1.5$	150	20
Chipseal	150	50
Microsurface	150	40
Slurry seal	150	40
Fog Seal	150	40
Open Graded Friction Course	150	30
Bonded Wearing Course	150	30

### MRSI minimum acceptable limits

Maintenance Type	Section Length - Feet	MRSI – Target
Asphalt overlay ≤ 1.5 inches	528	70
Asphalt overlay > 1.5 inches	528	60
Chipseal	528	90
Microsurface	528	80
Slurry Seal	528	80
Fog Seal	528	80
Open Graded Friction Course	528	70
Bonded Wearing Course	528	70

**Execution**

- a. Areas smoothed will be ground with taper-in and taper-out methods to improve the smoothness of the road in its entirety.
- b. Provide a uniform finished texture.
- c. Finished texture shall increase pavement skid resistance and decrease tire noise.
- d. The road to be smoothed shall be profiled by an inertial profiler. Said profiler shall pass Class 1 profiler specifications (AASHTO M328). The road smoothing equipment shall have the capability of accepting data from the profiler and compensate for the roughness identified by the inertial profiler.
- e. The surface profile of the road textured by the equipment shall have peaks and valleys of various heights from 1 mm to 3 mm. The peaks and valleys shall be durable by nature and have final angles of approximately 45 degrees.
- f. Provide uniform transverse slope of the pavement with no depressions or misalignment of slope greater than ¼ inch in 10 ft when tested with a 10 ft straightedge.
- g. All residue from the grinding process becomes property and responsibility of the Contractor.

**Equipment**

- a. Road smoothing equipment shall be a self-contained machine specifically designed to quickly and accurately smooth roads.
- b. Road smoothing equipment shall have the capability to travel between road smoothing areas at a speed of at least 5 mph and start road smoothing again in less than thirty seconds.

- c. Road smoothing equipment shall be mounted on a semi-truck and trailer and be able to transition from highway speeds to grinding in two minutes or less.
- d. Road smoothing equipment shall include averaging arms with a minimum length of 32 feet, which holds and controls drum height.
- e. Road smoothing equipment shall have dual parallel averaging arms that are independent and said averaging arms shall have no influence on the opposite side.
- f. Road smoothing equipment shall have a minimum cutting width of eight feet to insure a uniform cross slope.
- g. Road smoothing equipment shall have a drum that is tapered on the outer edges to eliminate vertical edges.
- h. The teeth used for smoothing shall be diamond tipped to maintain a uniform texture on the road.
- i. Provide road smoothing equipment with the capability to read common profiler data in real time to aid the operator in correcting the road profile.
- j. Road Smoothing equipment shall be designed to operate continuously without stopping while smoothing to insure an even road surface.

## Alternate equipment

- a. Provide and operate equipment utilizing diamond blades mounted on a self-propelled machine designed for grinding and texturing pavement.
- b. Provide a uniform finished texture.
- c. Provide equipment designed to operate continuously without stopping while grinding to insure an even road surface.
- d. All residue from the grinding process becomes property and responsibility of the Contractor.
- e. Provide resultant surface in a parallel, corrugated type texture consisting of grooves between 0.090 and 0.150 inches wide. Create a distance between the grooves of between 0.060 and 0.13 inches. Make peaks of the ridges approximately 1/16 inch higher than the bottom of the grooves. Maintain cross slope drainage.
- f. Provide uniform transverse slope of the pavement with no depressions or misalignment of slope greater than ¼ inch in 10 ft when tested with a 10 ft straightedge.

## Pay Items

1. MRSI Improvement points

Profile shall be taken before and after road smoothing. Pay shall be calculated first from all full 528-foot section then from all partial 528-foot sections based on percent improvement for each section.

2. RSI Improvement points.

Profile shall be taken before and after road smoothing. Pay for this item shall be for each 150-foot section rougher than specified RSI tolerances. Pay shall be calculated for each 150-foot section based on that section's percent improvement. Pay for MRSI improvement for the 528-foot section in the same area shall also be made.

3. Inertial profiling: lump sum bid.