

RIDE QUALITY

2025 INSTRUCTION MANUAL



**TECHNICAL TRAINING AND
CERTIFICATION PROGRAM**

TABLE OF CONTENTS

Ride Quality Training

2025

Instructors

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Iowa DOT Contact Information	iii
Class Power Point.....	1-1
IM213 Technical Training & Certification Program.....	2-1
IM216 Guidelines for Determining the Acceptability of Test Results.....	3-1
IM341 Determining Pavement & Bridge Ride Quality.....	4-1
Specifications 2301 & 2303.....	5-1
Specification 2317 Pavement Smoothness.....	6-1
Specification 2428 Smoothness of Bridge Decks and Bridge Deck Overlays.....	7-1
Specification 2529 Full Depth Finish Patches.....	8-1
Specification 2531 & 2532 Pavement Surface Repair.....	9-1

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Mike Kvach 515-450-8166
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Ankeny, Iowa 50021
Greg Mulder 515-963-0606
www.concretestate.org

Iowa Prestress Association
Dennis Drews 402-291-0733

Iowa Limestone Producers Association
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Urbandale, IA 50322
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www.limestone.org

Iowa Ready Mix Concrete Association
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Ankeny, Iowa 50021
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www.iowareadymix.org

CLASS POWER POINT




1

General
Info

- DOT employees use Function Code 141
- Restrooms
- Break room/vending machines
- Smoking areas
- Cell phones-please turn off - MUST be turned off during test
- Safety/ evacuation plan

2

 **Introductions**

- Jeff Brinkman / Jeff De Vries, P.E. / Rita Eichhorst
- Class
- Who you work for?
- Background in construction?
- Knowledge of profiling and profilographs?
 - Will you be operating a profiler?
 - Will you be analyzing data?
 - Will you be completing reports?
 - Reading final reports for project review?

Ride Quality

3

Course Objectives

- Become familiar with roughness and profiles.
- Understand Specifications 2428, 2317, IM 341, and others
- Explain 0.2" Blanking Band, MRI, ALR and which specifications cover each index.
- Identify/ look up resources: smoothness specifications and IMs.
- Report results.
- Recognize Independent Assurance Program (IAP).
- Prepare for Test. Review online through WorkDay Learning.
- Pass test.

Ride Quality

4

Section Objectives

- Understand differences between “profilograph” and “profiler”
- Recognize why smooth pavement is important.
- Identify what things cause roughness.
- Define the difference between a profilograph and a profiler.
- Determine what is being measured.
- Define the basics of profilograph and profiler operation. What to do and not do!

5

*Why Ride Quality is Important



The driving public cares about ride quality.



Smooth roads stay smooth longer.



The road will last longer before some type of treatment is required.

6



Ride Quality

- You are most likely to find roughness requiring correction at day end headers and at the beginning and end of the job.
- NOTE: We used to be more concerned with ½" defects, but now ALR is the governing factor.

7

7

- When roughness is created in the process, the contractor must correct it at an additional cost to contractor.



Ride Quality

8

8



Note: Complete the Correction before determining the Pavement thickness - 2317.04F

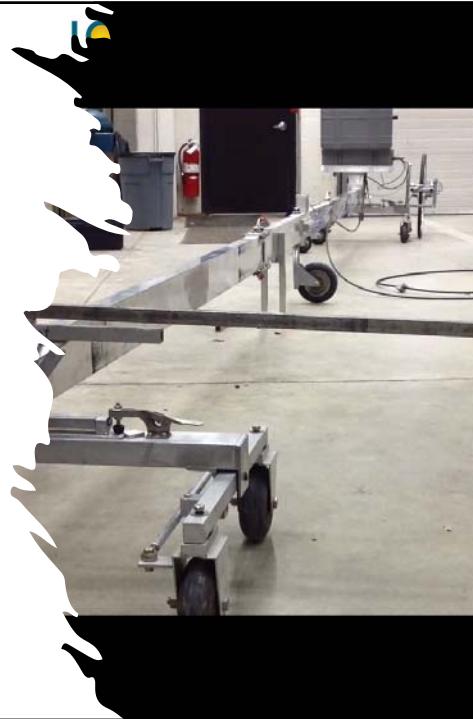
Ride Quality

9

9

25' Ames Profilograph

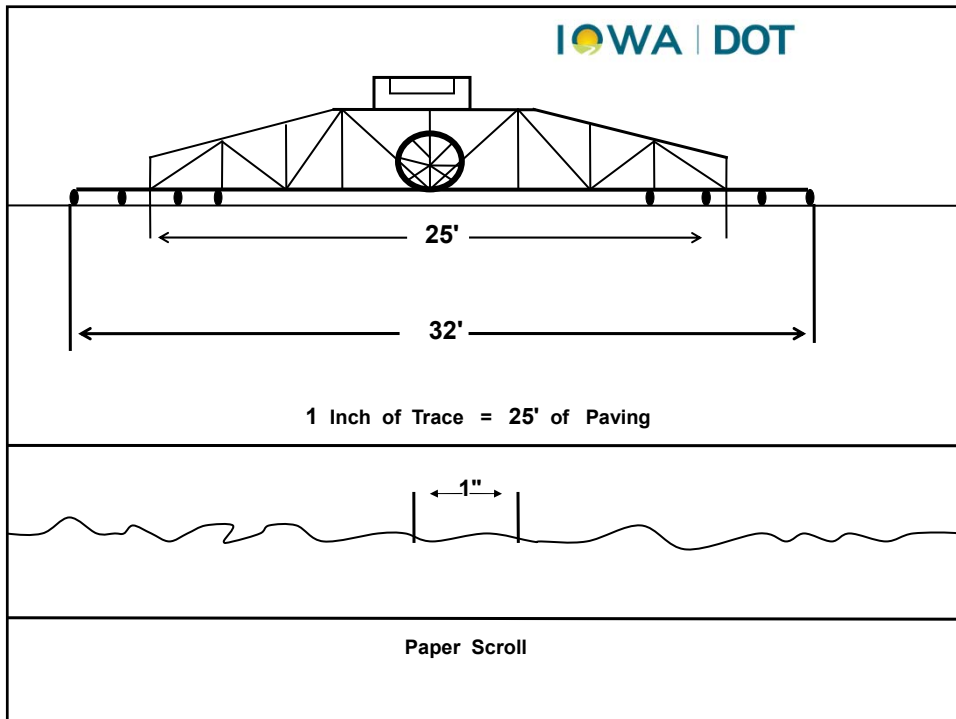
Pushed at walking speed, does not collect the "true" profile of the road.



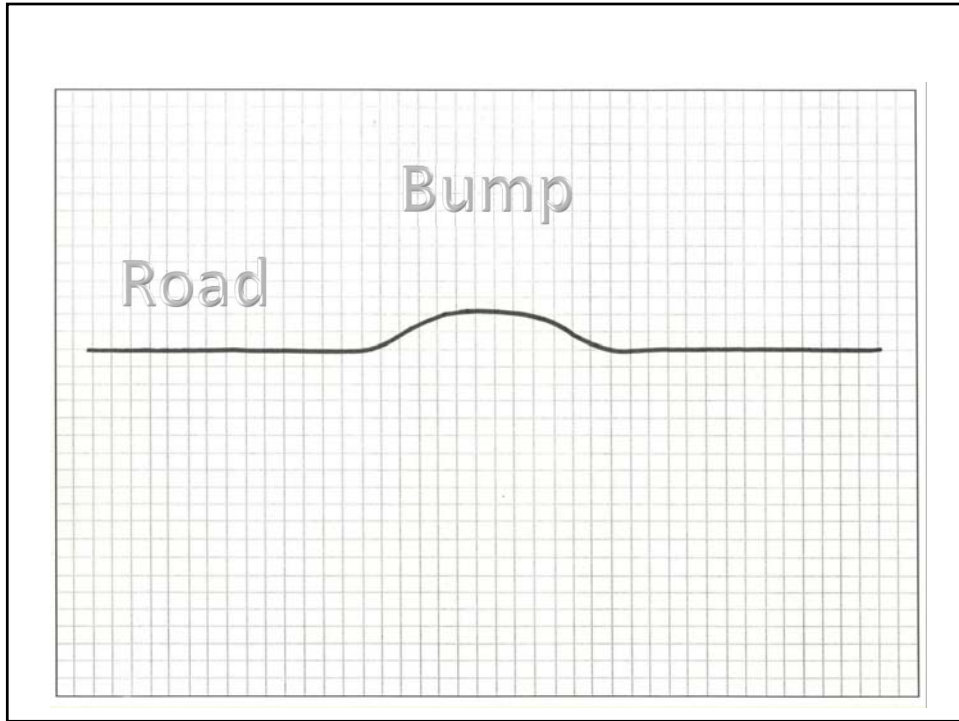
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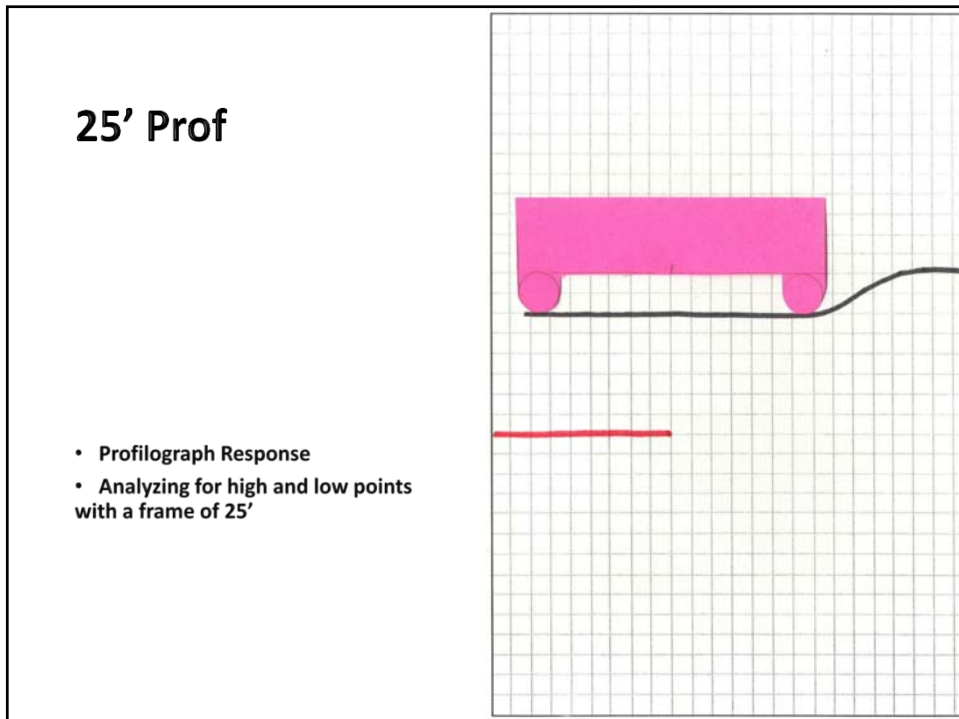
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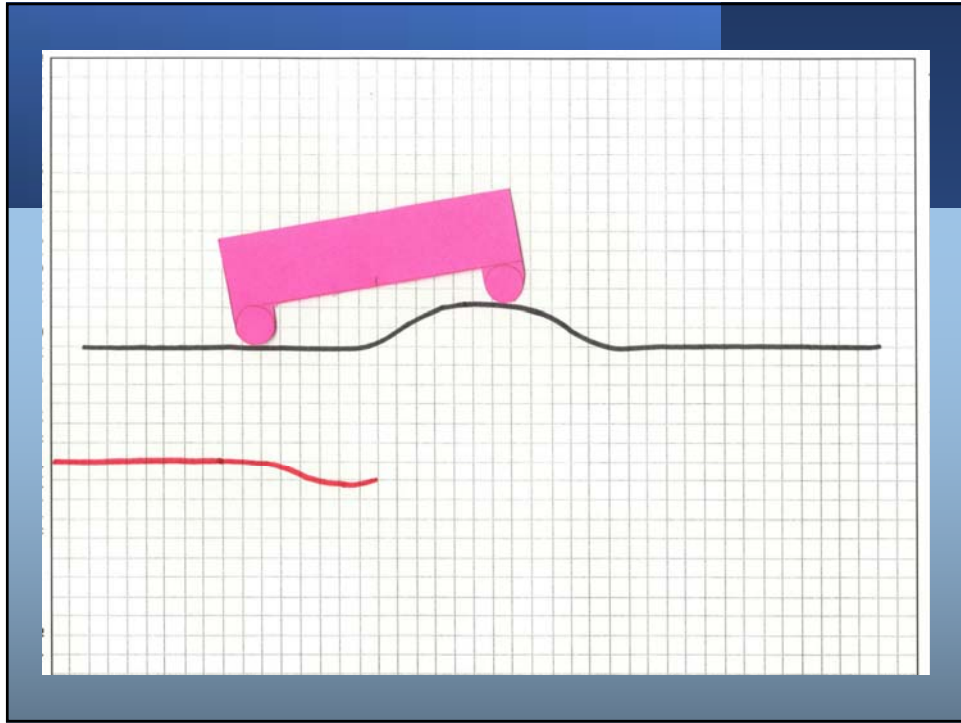
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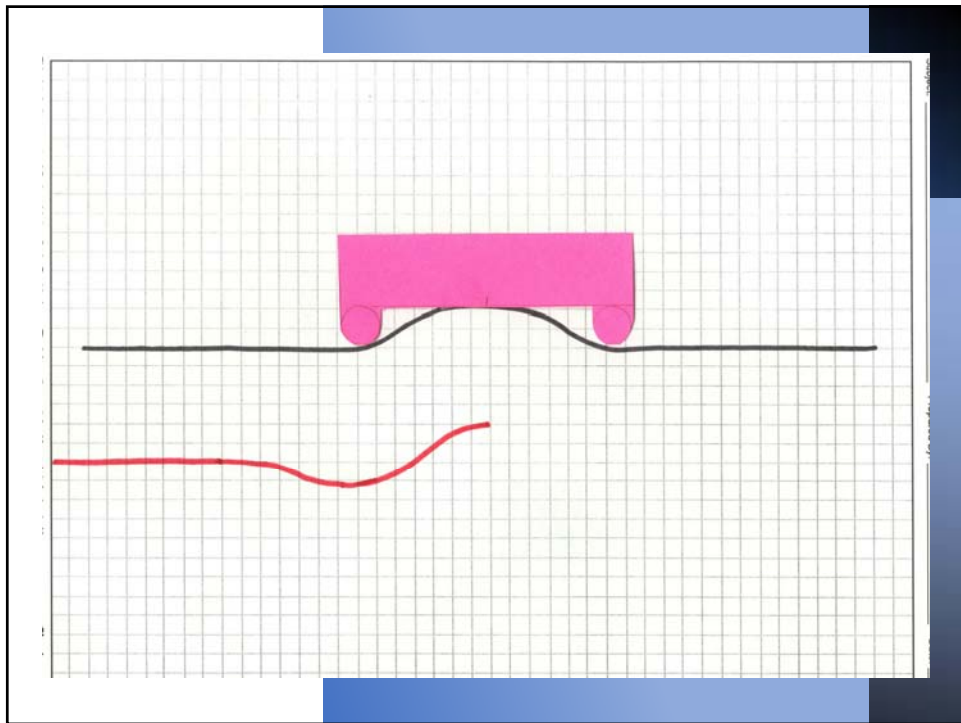
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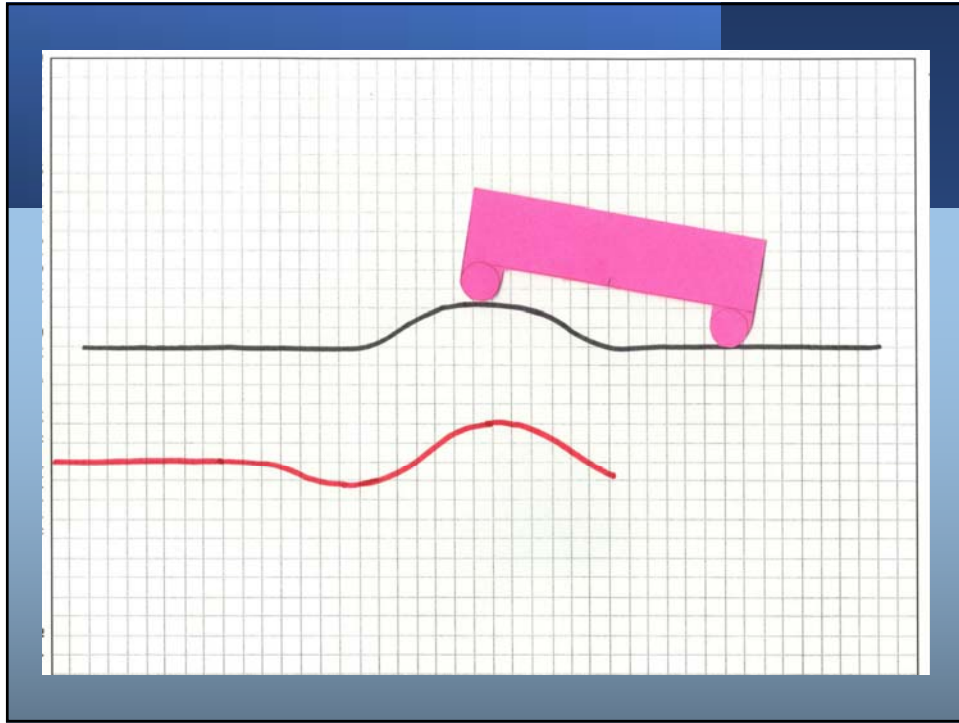
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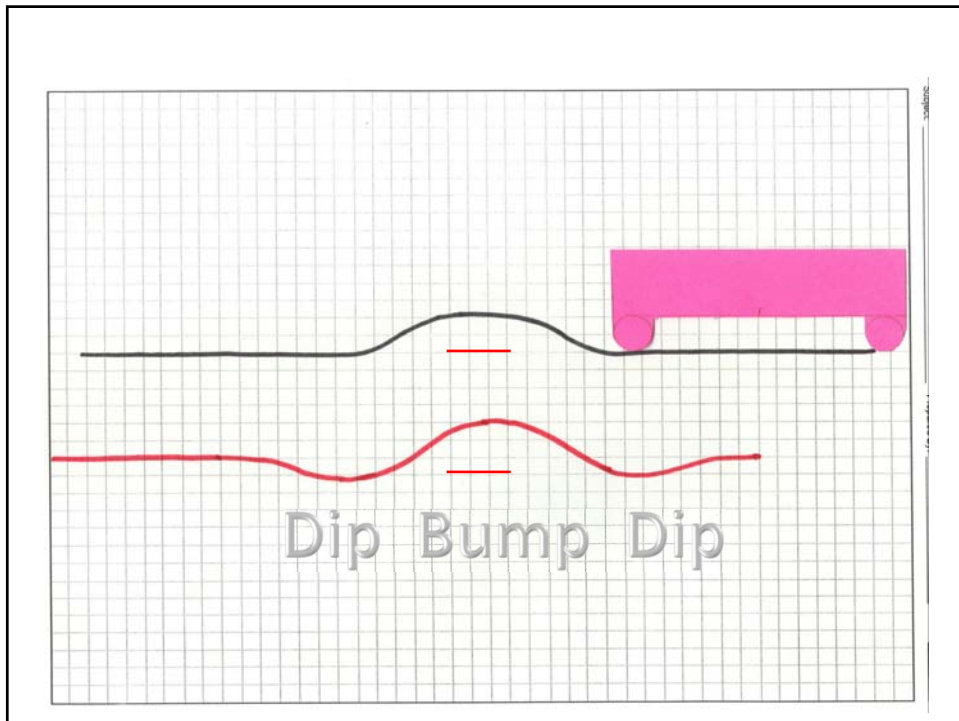
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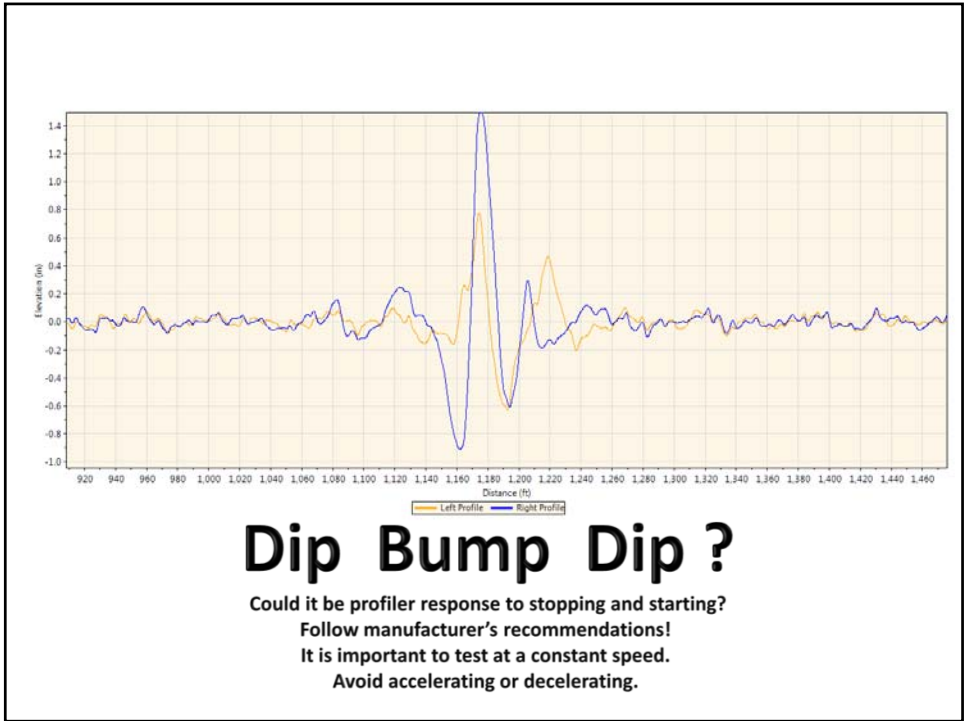
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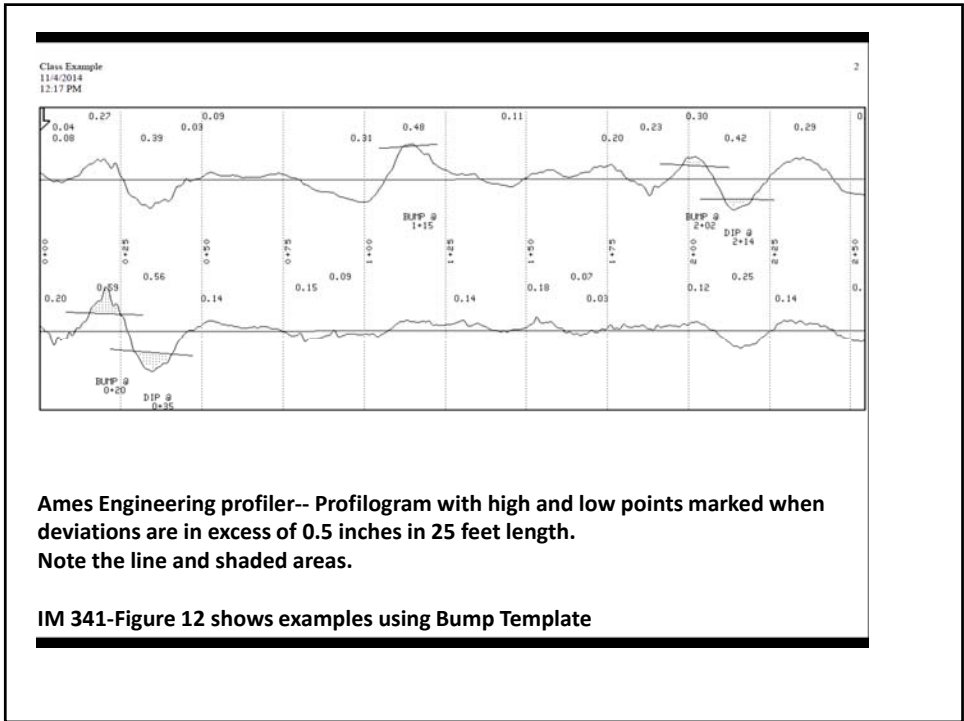
17



18



19



20



Inertial Profiler

Inertial profiler collects profile data using lasers and accelerometers.

Does not collect the “true” profile of the road.

21



22

How to **calibrate** a profilograph



SEE **IM341 D.**



VIDEO 2



[VIDEO\25FT
PROFILOGRAPH
HD1080.MOV](#)

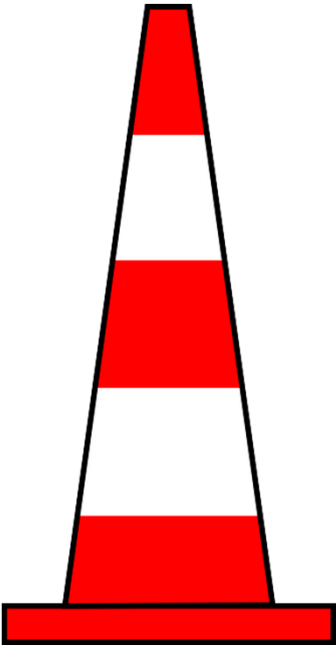
23

- Stay in your wheel path. Do not wander in your lane.
- Avoid sudden or excessive acceleration and deceleration.



24

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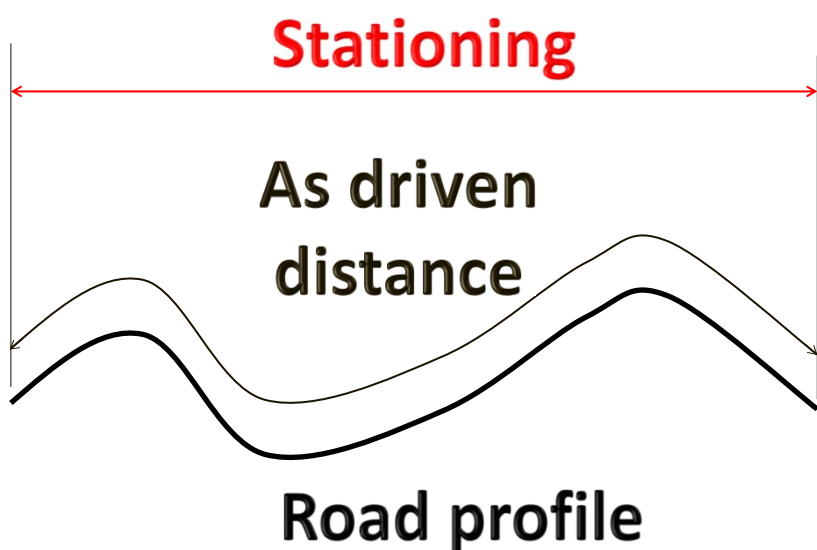
Exact start and stop locations are important!

Best practices use the auto trigger, or GPS locations

25

IOWA | DOT

*The stationing recorded on the profiler will not be exactly the same as the distance traveled on the road.



Stationing

As driven distance

Road profile

26

How to operate a profiler

Video 1

[Video\Profiler 2014 HD1080.mov](#)

27

Discussion

1. Why is a smooth pavement important?
2. What things cause roughness?
3. Where do you commonly roughness/ defects?
4. What are the differences between a profilograph and a profiler?
5. Does the profilograph collect a true profile of the road?
6. What are some things to do and not do when profiling?

28

Smoothness Specs/IMs

- IM 341-- Smoothness procedure
- 2301-- PCC Paving
- 2303-- Flexible (HMA) Paving
- 2316-- 0.2" Blanking Band
- 2317-- MRI/IRI/ALR
- 2428-- 0.2" BB (bridges/approaches)
- 2511-- Recreational Trails
- 2529/2530-- Patching
- 2331-- Milling
- 2532-- Diamond Grinding (IRI)

29

The screenshot shows the IOWA DOT Electronic Reference Library (ERL) homepage. At the top, the IOWA DOT logo is displayed. Below the logo is a navigation bar with the following links: IOWADOT, ERL HOME, SEARCH, SPECIFICATIONS HOMEPAGE, ARCHIVE PRE OCT 2022, a question mark icon, Login, and Register. The main heading is "ELECTRONIC REFERENCE LIBRARY". Below the heading, it states "Current ERL Issue - October 15, 2024. The April 16, 2024 ERL has been archived." There is a search bar with the placeholder text "Search or press enter for all records" and a search icon. To the right of the search bar is a dropdown menu labeled "Boolean" with a downward arrow. Below the search bar are four icons representing different categories: 1. Standard Specifications with GS-23003 Revisions (represented by a document icon with a gear), 2. Supplemental Specifications (represented by a pencil and a plus sign), 3. Materials I.M.s (represented by a flask and a cube), and 4. Standard Road Plans (represented by a road sign icon).

30

- **2428- Bridge Deck Smoothness**

- Look for note in county or city plans.
- 0.2" blanking band
- Wheel track testing (3' and 9' from the Centerline or lane line)
- Obtain the Engineer's approval for all correction work. After all required correction work is completed, determine the final profile index.
- ½" defects considered satisfactory when corrected below 0.5"

31



2428- Bridge Deck Smoothness

Profile Index- For 2428

- Number used for quantifying ride quality.
- Profile index = measured roughness (inches [2 places past the decimal point]) divided by length (miles [3 places past the decimal point])
- PI = in./mi. ([2 places past the decimal point])
For example, PI = 0.47 inches/0.100 miles=4.70 inches/miles

Why didn't we say

PI= 0.47inches/0.1miles=4.7inches/miles?

32

2428- Bridge Deck Smoothness

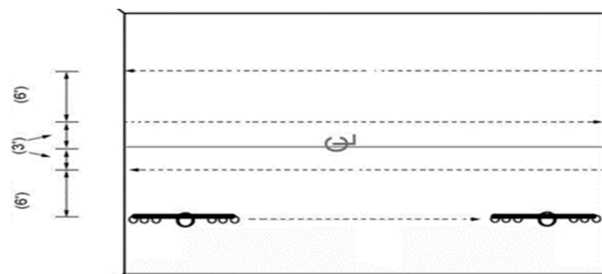
- What is a “Segment”?
- Length **0.100** mi
- If a “short” segment is greater than 250 feet, it stands alone for penalty and incentive
- If a “short” segment is 250 feet or less, it is added to the previous full segment
- There is no prorating of incentive pay in 2428

If the last, or odd length segment measures 7.60 inches of trace (190 feet) in length from testing the days paving (0.036miles) you should add it to the previous segment. Therefore, you would have 528 feet + 190 feet = 718 feet (0.136 miles)

33

Test Unit Positioning- IM 341

- On bridge decks and bridge deck overlays, the California or Ames Engineering type, 25-foot profilograph should start with the rear wheel at beginning of the bridge deck. The California or Ames Engineering type, 25-foot profilograph should stop with the front wheel at end of the bridge deck (Figure 1). If using an inertial profiler, start evaluating 16 feet onto the bridge deck. If using an inertial profiler, stop evaluating 16 feet from the end of the bridge deck.



34

2428- Bridge Deck Smoothness

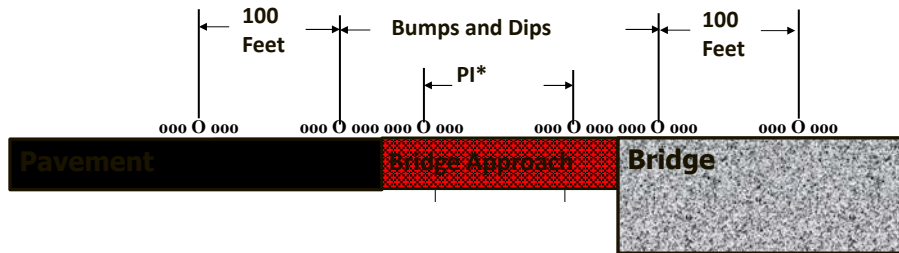
Bridge Approaches

- Shall be tested
- Each lane is an individual segment.
- Test past bridge and 100' beyond header with pavement (when there).
- Calculate PI if 100' or more.
- No incentive.

35

2428- Bridge Deck Smoothness

Bridge Approaches



36

2428-Bridge Deck Smoothness

2428.02.D.1. Exceptions from PI

- A. decks/ overlays less than 100 feet
- B. approaches less than 100 feet
- C. slab bridges
- D. 16' at ends of bridges
- E. 16' each side of **not new or replaced** expansion joints

37

2428- Bridge Deck Smoothness

2428.02D.2 -limits

- New bridge deck-less than 22.1 in./mi.
- Bridge deck overlay-less than 15.1 in./mi.
- Any approaches-less than 22.1 in./mi.
- No ½" defects are allowed- bumps corrected to below 0.5" (with engineer's approval 2428.03B)

38

2428- Bridge Deck Smoothness

Average Profile Index
(Average Wheel Tracks)

Average Profile Index= total inches/ total miles

Example: Avg PI= $\frac{IWT(\text{inches})+OWT(\text{inches})}{IWT(\text{miles})+OWT(\text{miles})}$

Avg PI= $\frac{0.65\text{in.} + 1.25\text{in.}}{0.278\text{mi.} + 0.277\text{mi.}}$

Avg PI= $\frac{1.90 \text{ in.}}{0.555 \text{ mi.}}$

Avg PI=3.4234234234234234 in./mi.

Ave PI≈3.42 in./mi.

39

2428 example
Bridge Deck Overlay

Inside Wheeltrack (IWT)			Outside Wheeltrack (OWT)			Average PI
Length	Roughness	Profile Index	Length	Roughness	Profile Index	
(mi.)	(in.)	(in./mi.)	(mi.)	(in.)	(in./mi.)	(in./mi.)
0.049	0.52	_____	0.049	0.60	_____	_____

Calculate the Profile Index. Fill in the blanks. What is the incentive/
disincentive pay for the bridge deck overlay mentioned above? _____

40

2428 example

2428 worksheet and Table 2428.05-1

Inside Wheeltrack (IWT)			Outside Wheeltrack (OWT)			Average PI (in./mi.)
Length	Roughness	Profile Index	Length	Roughness	Profile Index	
(mi.)	(in.)	(in./mi.)	(mi.)	(in.)	(in./mi.)	
0.049	0.52	10.61	0.049	0.60	12.24	(0.52+0.60) in (0.049+0.049)mi =11.43 in / mi

Table 2428.05-1: Incentives

New Bridge Decks		Bridge Deck Overlays	
Initial Profile Index Inches Per Mile Per Segment	Dollars Per Segment	Initial Profile Index Inches Per Mile Per Segment	Dollars Per Segment
0 - 6.0	6000	0 - 2.0	2000
6.1 - 12.0	3000	2.1 - 4.0	1000
12.1 - 22.0	Unit Price	4.1 - 15.0	Unit Price

41

MANATTS, INC. District 1 Materials
P.O. BOX 535
BROOKLYN, IOWA 52211

PROFILOGRAPH REPORT

Revised Report
Changes Lab. No.

For Information Only Preliminary Final Corrected

Lab No. 02-HW/YES(158)-2022 Route No. HWY 65 Project No. BFFN-065-4(158)-39-77
Date Reported 7/29/2022 Date Paved NA County POLK
Tested at 14 point Wheel Track Contractor JASPER CONSTRUCTION
Tested By [Redacted] Date 7/29/2022
Trace Reduced By COMPUTERIZED Date 7/29/2022

Schedule A Wheel path PCC
Schedule B HMA

Roadway Type: 2-Lane 4-Lane Ramp Other BRIDGE DECK

N.B. Inside Lane E.B. Centerline Direction S.B. Outside Lane W.B. 14 Point

Measured Length (Miles)	Roughness (Inches)	Profile Index (Inches/Miles)	Location (Station)	Measured Length (Miles)	Roughness (Inches)	Profile Index (Inches/Miles)	Avg.	Specification Incentive Numbers Used From:
ENGLISH								Income Deduct
BRIDGE DECK			516+47					
0.059	0.56	9.49		0.059	1.03	17.46	13.47	
			519+60					
0.059	0.56	9.49		0.059	1.03	17.46	13.47	\$0 \$0

NO CORRECTIVE WORK REQUIRED \$0
CORRECTIVE WORK REQUIRED \$2" Bump Locations
CORRECTIVE WORK COMPLETED


Copies:
Special Investigations, Ames
District Materials Engineer
Resident Construction Engineer
Manatts, Inc. - Job Superintendent

Signed By: [Redacted]

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract specifications and requirements.

42

Profile Verification Sheet



Older version of profile verification sheet

Project Number	BRFN-065-4(158)-39-77		
Date Measured	8/10/2022		
Tested By	JEFF BRINKMAN		
Report Number	1JB220810-77-0654-158		
Evaluation Method	Bridge Profile Index (0.2" blanking band)		

Stationing	Section 1	Section 2	Section 3
Direction	Northbound		
Lane Description			
Beginning	516+70		
Ending	519+80		
Length (ft.)	310	0	0

Contractor Report #	02-HWV65(158)-2022		
Contractor Index	13.47		
DOT Index	15.58		
Difference	2.11	0.00	0.00
Tolerance	3.00	2.00	2.00
Verified	Yes	Yes	Yes

Total Project Length	310
Total Lanes	2
Total Lane Length	620

Verification Length (ft.)	310.00
10 % of Project?	Yes
Verified	YES


Area of Localized Roughness (ALR)	
200.0 ≤ ALR < 250.0 (ft.)	
ALR ≥ 250.0 (ft.)	

Comments:

THIS IS FROM THE NORTHBOUND INSIDE LANE

Data Entered By	JEFF BRINKMAN
Signature/Certification #	JEFF BRINKMAN Certification # CI 429

43

30-Aug-2024 **Profile Verification Sheet** 

Project Number	BRFN-065-4(158)-39-77		
Date Measured	8/10/2022		
Tested By	Brinkman		
Direction	Northbound		
Lane Description	Mainline: Lane 2		

Report Number	1JB220810-77-0654-158 Jasper		
Surface Type	PCC		
Posted Vehicle Speed	> 45 mph		
Specification	2428		

Stationing	Section 1	Section 2	Section 3
Beginning	516+47		
Ending	519+60		
Length (ft.)	313	0	0

Contractor PI	13.47		
DOT PI	15.58		
Difference	2.11	0.00	0.00
Tolerance	3.00	2.00	2.00
Verified	Yes		

Totals	
Length (ft.)	313
Contractor PI (in.mi.)	13.47
DOT PI (in.mi.)	15.58
Difference	2.11
Tolerance	3.00
Verified	Yes

1/2" Bumps and Dips	
Contractor Bumps/Dips	none
DOT Bumps/Dips	none

Contractor Area of Localized Roughness (ARL)	
200.0 ≤ ARL < 250.0 (ft)	
ARL ≥ 250.0 (ft)	

DOT Area of Localized Roughness (ARL)	
200.0 ≤ ARL < 250.0 (ft)	
ARL ≥ 250.0 (ft)	

Comments:

Jasper Construction- correlates to contractor report 02-Hwy65(158)-2022

Data Entered By	Jeff Brinkman
Signature/Certification #	CI429

44

Discussion (2428)

- What height do ½” bumps need to be corrected to?
- Can you get incentive for really smooth bridge approaches?
- What are the exceptions from profile index evaluation?
- How much incentive would you get for a segment if you have a PI of 2.20 in / mi on a bridge deck overlay?



45



2317- Objectives

- Determination of testing limits
- Where to look in plans
- Where to look in specifications

46

2317- PAVEMENT

- Evaluate pavement smoothness for all Interstate and Primary main line pavement surfaces, and all other road surfaces included on Primary projects, except when specifically excluded or modified by the contract documents. For non-Primary projects, do not evaluate pavement smoothness unless specified in the contract documents. If this specification is required by contract documents on non-Primary projects let by the Department, it will be added in its entirety. Selected portions of the specification will not be deleted.



47

2317- Pavement

NO	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE	REMARKS
21	2303-7000610 PAYMENT ADJUSTMENT INCENTIVE/DISINCENTIVE FOR HMA MIXTURE LABORATORY VOIDS (FORMULA - BY PAY FACTOR)	EACH	8,372.34	2,983.14	11,355.48	For mainline paving excludes shoulders. For overlay of safety shoulder widening.
22	2303-7000620 PAYMENT ADJUSTMENT INCENTIVE/DISINCENTIVE FOR HMA MIXTURE FIELD VOIDS (FORMULA - BY PAY FACTOR)	EACH	8,372.34	2,983.14	11,355.48	
23	2317-7000120 PAYMENT ADJUSTMENT INCENTIVE/DISINCENTIVE FOR HMA PAVEMENT SMOOTHNESS (BY SCHEDULE)	EACH	45,954.56		45,954.56	
24	2416-0100024 APRONS, CONCRETE, 24 IN. DIA.	EACH	6		6	Refer to Tab. 104-3 on Sheet C.17. Apron includes guard.
25	2416-0101036 REMOVE AND REINSTALL CONCRETE PIPE APRONS LESS THAN OR EQUAL TO 36 IN.	EACH	6		6	Refer to Tab. 104-3 in the C sheets. This work will be measured and paid for at the contract unit price per each of aprons removed and reinstalled per the Engineer's satisfaction. All excavation, incidental to this item.
26	2416-0101136 REMOVE AND REINSTALL CONCRETE PIPE APRONS GREATER THAN 36 IN.	EACH	2		2	Refer to Tab. 104-3 in the C sheets. This work will be measured and paid for at the contract unit price per each of aprons removed and reinstalled per the Engineer's satisfaction. All excavation, incidental to this item.



48

2317- Pavement

		INCENTIVE/DISINCENTIVE FOR HMA MIXTURE LABORATORY VOIDS (FORMULA - BY PAY FACTOR)			does not include surface course, base widening, or fillet areas.
15	2303-7000620	PAYMENT ADJUSTMENT INCENTIVE/DISINCENTIVE FOR HMA MIXTURE FIELD VOIDS (FORMULA - BY PAY FACTOR)	EACH	4,055.78	Refer to Tab. 100-25. Estimated at a factor of 0.5 of the total tons of leveling, base, and intermediate mixes. Quot does not include surface course, base widening, or fillet areas.
16	2315-0275025	SURFACING, DRIVEWAY, CLASS A CRUSHED STONE	TON	14.97	Refer to Tab. 102-3.
17	2316-0000120	PAYMENT ADJUSTMENT INCENTIVE/DISINCENTIVE FOR HMA PAVEMENT SMOOTHNESS (BY SCHEDULE)	EACH	4,950.05	Refer to Tab. 100-25. Item is estimated at a factor of 0.15 per square yard of surface paving.
18	2505-6000111	HIGH TENSION CABLE GUARDRAIL	LF	800	Item is for protection from waterway / culvert hazards. Refer to Tab. 108-9A.
19	2505-6000121	HIGH TENSION CABLE GUARDRAIL, END ANCHOR	EACH	8	Refer to Tab. 108-9A.
20	2505-6000131	HIGH TENSION CABLE GUARDRAIL, SPARE PARTS KIT	EACH	1	Refer to Tab. 108-9A.
21	2527-9263109	PAINTED PAVEMENT MARKING, WATERBORNE OR SOLVENT-BASED	STA	265.65	Item is for final pavement markings. Refer to Tab. 108-22.
22	2528-2518000	SAFETY CLOSURE	EACH	1	Refer to Tab. 108-13A.

Read the plans so that you know what is expected!!!!



49



2317- PAVEMENT—NOTE*

- If 2317 is not specified: Specification 2301(PCCP)or 2303 (HMA) describes minimally acceptable work. (1/2" defects)

2301.03, H

4. Smoothness.

- Construct the pavement to have a smooth riding surface within the following tolerances:
 - Periodically check the pavement longitudinally with a 40-foot straightedge. The surface is not to deviate from a straight line by more than 1/8 inch in 10 feet.
 - The Engineer may determine and identify irregularities of 1/2 inch or more in 25 feet longitudinally.
 - The contractor shall correct areas over 1/2 inch in 25 feet identified by the Engineer.
 - If slip form methods are used, the 6 inches nearest the edge may exceed the 1/8 inch tolerance, but is not to exceed 1/2 inch deviation in 10 feet.
 - Where abutting pavement is to be placed adjacent to the pavement being checked, the surface is not to deviate by more than 1/4 inch when checked 1 inch from the edge with:
 - A 3 foot straightedge used transversely, and
 - A 10 foot straightedge used longitudinally.
- Apply [Section 2317](#) to all PCC Pavement bid items of a Primary project or when specifically required for other projects.

50

2317- PAVEMENT—NOTE*

- If 2317 is not specified: Specification 2301(PCCP)or 2303 (HMA) describes minimally acceptable work. (1/2” defects)

2303.03, D, 6, e, Smoothness.

Replace the Article:

- 1) Apply [Section 2317](#) to HMA surface mixture bid items of a Primary project or when specifically required for other projects.
- 2) On all projects, the Engineer may determine and identify irregularities of 1/2 inch or more in 25 feet longitudinally. Correct the irregularities identified by the Engineer in accordance with Section 2317.

51

2317- PAVEMENT--IM 204

TESTS	METHOD OF ACCEPTANCE & RELATED IMs	QUALITY CONTROL		INDEPENDENT ASSURANCE & VERIFICATION S&T			
		SAMPLE	SAMPLE	S&T	SAMP.	SAMPLE	TEST
		BY	SIZE	TYPE	BY	SIZE	BY
Smoothness	341	CONTRACTOR	100%	V	DME	10%	DME

52

2317- PAVEMENT

- A section terminates at day's work joint, bridge, similar interruption or when it crosses to a section with a different smoothness designation.
- PCC, HMA, and different speed limits have different incentive schedules.
- Must be tested, evaluated, and reported by trained and certified people.
- 2317—Pavement will be evaluated in 528 feet segments using the inertial profiler

53

2317 PAVEMENT**“Evaluated” vs. “Tested”**

- Not all surfaces are “evaluated”.
- Some areas are “tested” for ½” surface defects.
- **2317.03 B 1 & 2** spells out what is tested and what is evaluated

B. Evaluation.

- Determine an MRI using the latest version of the ProVAL “Ride Quality” or “Smoothness Assurance” analysis and following the procedures shown in [Materials I.M. 341 Appendix A](#) for each segment of finished pavement surface with a posted speed or advisory speed over 45 mph except for:
 - Roads intersecting the mainline pavement less than 600 feet in length.
 - Road connections 150 feet before an intersection that end at a stop sign (or a yield sign at roundabouts).
 - Twenty feet on either side of bridges, bridge approaches, existing EF joints, manholes, or water valve boxes in the lane that the obstruction is located.
 - Ramps and loops.
 - Bridge approaches (evaluated according to [Section 2420](#)).
 - Storage lanes, turn lanes, and other auxiliary lanes less than 1000 feet.
 - Pavement less than 8.5 feet in width.
 - Single lift pavement overlays 2 inches thick or less, unless the existing surface has been corrected by milling or scarification.
 - Single lift pavement overlays 2 inches thick or less placed directly on PCC pavement.
 - Paved shoulders.
 - Detour pavement.
 - Crossovers.
 - Individual sections of pavement less than 100 feet in length.
 - Roundabouts.
- Determine ALR using the latest version of the ProVAL “Smoothness Assurance” analysis and following the procedures shown in [Materials I.M. 341 Appendix A](#) for each segment of finished pavement surface with a posted or advisory speed over 35 mph except for:
 - Side road connections 150 feet before an intersection that end at a stop sign (or a yield sign at roundabouts).
 - Twenty feet on either side of bridges, bridge approaches, manholes, existing EF joints, or water valve boxes in the lane that the obstruction is located.
 - Bridge approaches (evaluated according to [Section 2420](#)).
 - Pavement less than 8.5 feet in width.
 - Paved shoulders (unless used as a temporary driving surface).
 - Detour pavement.
 - Crossovers.
 - Individual sections of pavement less than 50 feet in length.


54

A slide with a background of overlapping, semi-transparent circles in shades of blue, teal, and green. The word "Discussion" is centered in a dark blue, underlined font. Below it are two numbered questions.

Discussion

1. Is smoothness evaluation required on all paving projects?
2. If on a secondary asphalt project, what specifications should you review to determine what is required with respect to testing and or evaluation of smoothness?

55



2317- Objectives

- Recognize and Interpret MRI and ALR.
- Locate the exceptions and exclusions from MRI and ALR determination.
- Determine pay adjustments for smoothness.
- Identify information on the Profile Summary Sheet.

56

2317- Objectives

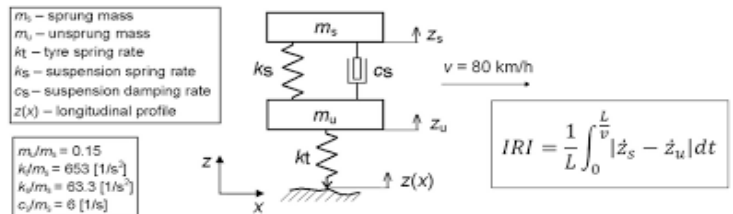
*Mean Roughness Index

- Better number used for quantifying ride quality.
- An international index (IRI). Used by most state DOT's.
- Computer simulation of a car tire, spring, and shock absorber. (1/4 Car)
- Accumulation of the suspension motion over the distance traveled.
- MRI= in./mi.

57

2317- Objectives

¼ Car model



58

2317-Objectives

Segment (MRI) 2317.01.D.

- 528 feet
- Pay adjustments will be prorated for partial segments.
- If a segment is less than 100 feet in length and requires corrective work, Engineer will waive corrective work requirement for segment and instead assess a prorated disincentive.

Section- a day's worth of paving

59

2317-Objectives

Pavement Segment:

- A Pavement Segment is defined as a continuous area of finished pavement 528 feet in length and one lane (10 to 12 foot nominal) in width.
- A partial segment may result from an interruption of the continuous pavement surface (in other words, bridge approaches, side road tie-ins, the completion of the daily paving operations, and so forth).
partial segment
- Pay adjustments will be prorated for partial segments. If a segment is less than 100 feet in length and requires corrective work, Engineer will waive corrective work requirement for segment and instead assess a prorated disincentive.
- Contracting Authority will subject the segment to ALR correction in accordance with Table 2317.05-1

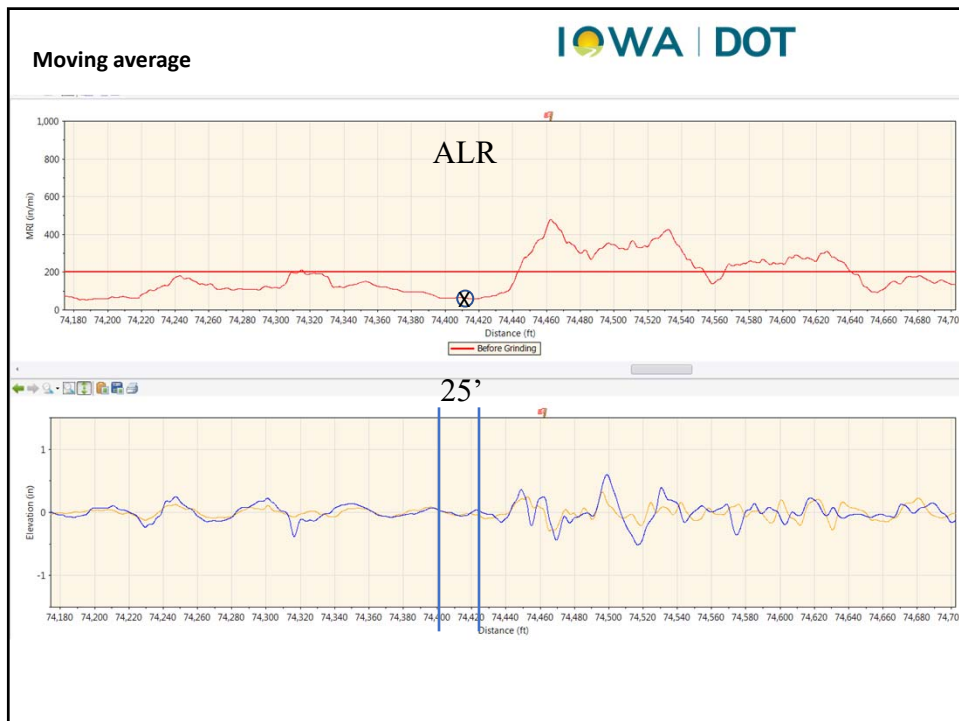
60

2317- Objectives

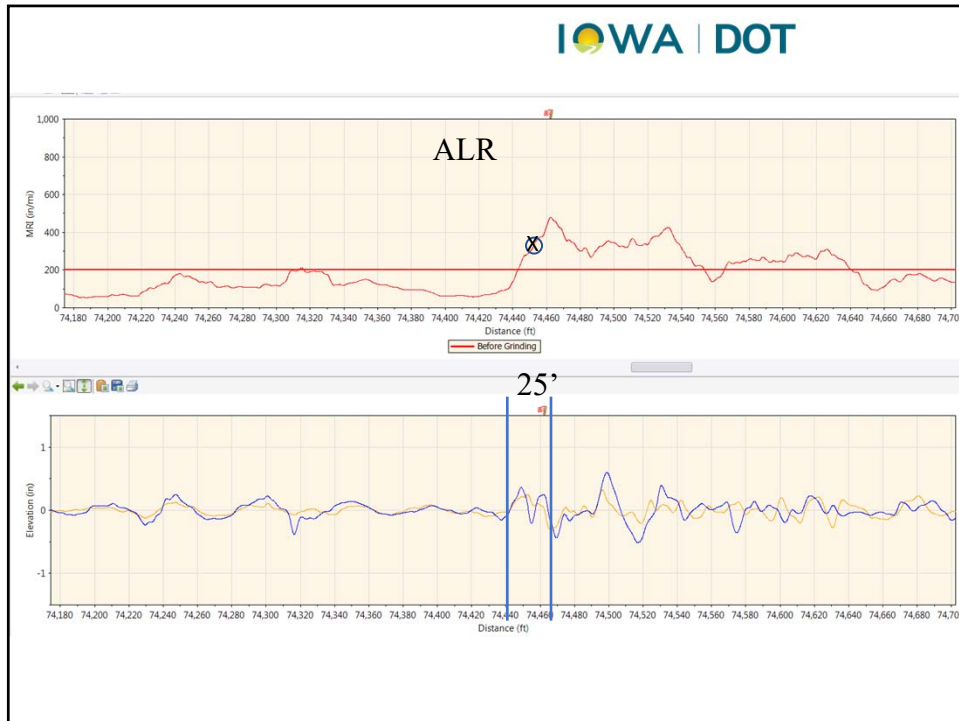
Recognize MRI and ALR terms

- MRI is the Mean Roughness Index
- MRI is the average IRI for the two-wheel paths.
- ALR is the Area of Localized Roughness.
- ALR is a 25' moving average of the MRI.

61



62



63

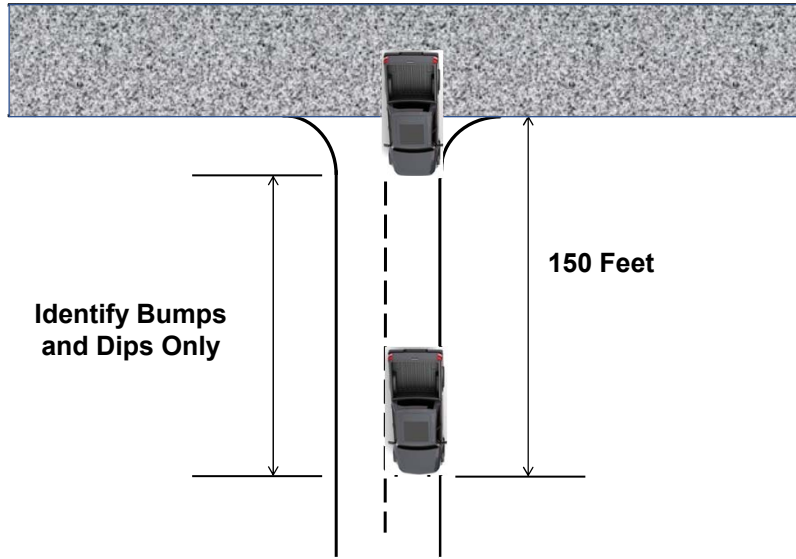
IOWA | DOT

2317
Test Unit positioning IM 341

- j. When utilizing an inertial profiler on paving, begin collecting profile data for ALR 50' before the beginning header from old to new surface and 50' beyond the header from new to old surface. Correction of ALR determined to be beyond the control of the Contractor will be paid according to Article 1109.03
- k. Testing is to be done with the sensors in the wheel paths, 3 feet and 9 feet from the centerline or lane line, for lanes 11 feet to 12 feet wide unless noted otherwise in the contract documents.
- l. For testing on wider lanes such as ramps and loops, position the driver side sensor 3 feet from the left edge line. If the passenger side sensors are within 1 foot of a longitudinal joint, adjust the travel path to the right so the sensor is 2 feet from the joint line.
- m. For testing tapers to and from a full lane, begin or end the section testing when the pavement is either 12' or at the full lane width whichever is less.
- o. Follow the profiler manufacture's recommendations with respect to run-in runouts. Most manufactures require not less than a 300-foot run-in/runout distance. The run-in allows the accelerometers, lasers, and computer to stabilize before the start of the section.

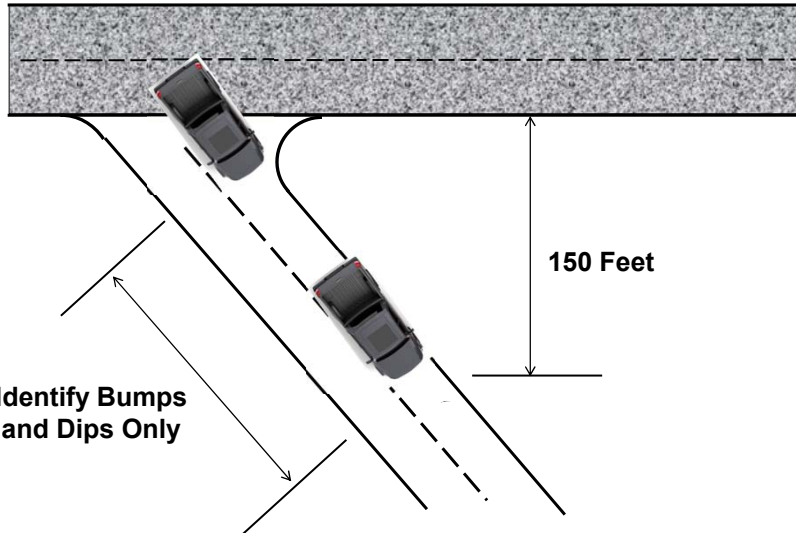
64

Sideroad exceptions over 600'



65

Sideroad exceptions over 600'



66

2317Specification 2317 says:

- Determine MRI when speed >45mph.
- MRI Exceptions—2317.03,B,1.
- Determine ALR when speed >35mph.
- ALR Exceptions—2317.03,B,2.
- What if <=35mph

(The engineer may determine and identify irregularities of ½” or more in 25’ longitudinally)— “bump check”

67

2317.03**2317.03 TESTING AND EVALUATION.****A. Testing.**

4. Test the pavement within 5 working days of completion of paving.

2317.03 TESTING AND EVALUATION.**B. Evaluation**

4. Submit all final profile summary sheets and all ALR graphs to the engineer within 14 calendar days following completion of paving on the project. If requested by the engineer, provide the ProVAL files. When all the testing is done at the completion of paving on the project, provide the engineer the ProVal files along with the profile summary sheets.

68

2317.03

2317.03 B. Evaluation.

1. Determine an MRI using the latest version of the ProVAL “Ride Quality” or “Smoothness Assurance” analysis and following the procedures shown in [Materials I.M. 341](#) for each segment of finished pavement surface with a posted speed or advisory speed over 45 mph except for:
 - a. Roads intersecting the mainline pavement less than 600 feet in length.
 - b. Road connections 150 feet before an intersection that end at a stop sign (or a yield sign at roundabouts).
 - c. Twenty feet on either side of bridges, bridge approaches, existing EF joints, manholes, or water valve boxes in the lane that the obstruction is located.

69

2317.03b Evaluation continued

- d. Ramps and loops.
- e. Bridge approaches (evaluated according to [Section 2428](#)).
- f. Storage lanes, turn lanes, and other auxiliary lanes less than 1000 feet.
- g. Pavement less than 8.5 feet in width.
- h. Single lift pavement overlays 2 inches thick or less, unless the existing surface has been corrected by milling or scarification.
- i. Single lift pavement overlays 2 inches thick or less placed directly on PCC pavement.
- j. Paved shoulders.
- k. Detour pavement.
- l. Crossovers.
- m. Individual sections of pavement less than 100 feet in length.
- n. Roundabouts

70

2317.03 B Evaluation

2. Determine ALR using the latest version of the ProVAL “Smoothness Assurance” analysis and following the procedures shown in [Materials I.M. 341](#) for each segment of finished pavement surface with a posted or advisory speed over 35 mph **except for**:
- a. Side road connections 150 feet before an intersection that end at a stop sign (or a yield sign at roundabouts).
 - b. Twenty feet on either side of bridges, bridge approaches, manholes, existing EF joints, or water valve boxes in the lane that the obstruction is located.
 - c. Bridge approaches (evaluated according to [Section 2428](#)).
 - d. Pavement less than 8.5 feet in width.
 - e. Paved shoulders (unless used as a temporary driving surface).
 - f. Detour pavement.
 - g. Crossovers.
 - h. Individual sections of pavement less than 50 feet in length.



71

Pay Adjustments



Table 2317.05-1: Schedule for Adjustment Payment for Areas of Localized Roughness for Primary and Interstate Projects

ALR in 25 Foot Continuous Mean International Roughness Index (MRI) Inches per mile	Dollars per foot of pavement length per lane
200.0 to 250.0	-30.00 or grind ¹
Greater than 250.0	Grind ¹
1. Correct these areas to below 200.0 inches per mile	

Table 2317.05-2: Schedule for Adjustment Payment for Areas of Localized Roughness for Non-Primary Projects

Segment Speed/Type	ALR in 25 Foot Continuous Mean International Roughness Index (MRI) Inches per mile	Dollars per foot of pavement length per lane
Speed greater than 45mph	200.0 to 250.0	-15.00 or grind ¹
	Greater than 250.0	Grind ¹
	1. Correct these areas to below 200.0 inches per mile	
Speed less than or equal to 45mph or curbed	250.0 to 300.0	-15.00 or grind ¹
	Greater than 300.0	Grind ¹
	1. Correct these areas to below 250.0 inches per mile	

72

Table 2317.05-3: Schedule for Adjustment Payment for PCC Pavements for Primary and Interstate Projects

MRI (inches per mile)	Dollars per 0.1 mile segment per lane	
	Design Thickness	
	Full Depth (>6")	Overlay (<=6")
Less than 47.5	1,500.00	1,250.00
47.5 to 57.5	8,625.00- (150*MRI)	5,226.596- (133.2623*MRI)
57.5 to 75	Unit Price	Unit Price
75 to 90	7,500.00- (100*MRI) (or grind ¹)	6,250.00- (83.333*MRI) (or grind ¹)
Greater than 90	Grind ¹	Grind ¹

1. Correct these areas below 75.0 inches per mile

Table 2317.05-4: Schedule for Adjustment Payment for PCC Pavements for Non-Primary Projects

MRI (Inches per mile)	Dollars per 0.1 mile segment per lane
Less than 60.0	300.00
60.0 to 70.0	2,100.00- (30*MRI)
70.0 to 80.0	0.00
80.0 to 95.0	1,600.00- (20*MRI) or grind ¹
Greater than 95.0	Grind ¹

1. Correct these areas to below 80.0 inches per mile

73

Table 2317.05-5: Schedule for Adjustment Payment for HMA Pavements for Primary and Interstate Projects

MRI (inches per mile)	Dollars per 0.1 mile segment per lane	
	Design Thickness	
	Full Depth (>4")	Overlay (<=4")
Less than 29.84	1,500.00	1,250.00
29.84 to 39.22	6,271.915- (159.915*MRI)	5,226.596- (133.2623*MRI)
39.22 to 75	Unit Price	Unit Price
75 to 90	7,500.00- (100*MRI) or grind ¹	6,250.00- (83.333*MRI) or grind ¹
Greater than 90	Grind ¹	Grind ¹

1. Correct these areas below 75.0 inches per mile

Table 2317.05-6: Schedule for Adjustment Payment for HMA Pavements for Non-Primary Projects

MRI (Inches per mile)	Dollars per 0.1 mile segment per lane
Less than 35.0	300.00
35.0 to 45.0	1,350.00- (30*MRI)
45.0 to 80.0	0.00
80.0 to 95.0	1,600.00- (20*MRI) or grind ¹
Greater than 95.0	Grind ¹

1. Correct these areas to below 80.0 inches per mile

74

Table 2317.05-3: Schedule for Adjustment Payment for PCC Pavements for Primary and Interstate Projects

MRI (inches per mile)	Dollars per 0.1 mile segment per lane	
	Design Thickness	
	Full Depth (>6")	Overlay (<=6")
Less than 47.5	1,500.00	1,250.00
47.5 to 57.5	$8,625.00 - (150 * MRI)$	$5,226.596 - (133.2623 * MRI)$
57.5 to 75	Unit Price	Unit Price
75 to 90	$7,500.00 - (100 * MRI)$ (or grind ¹)	$6,250.00 - (83.333 * MRI)$ (or grind ¹)
Greater than 90	Grind ¹	Grind ¹

1. Correct these areas below 75.0 inches per mile

Question:

A 9" PCC pavement segment has an MRI of 57.0 inches per mile.
According to 2317 what is the adjustment to payment for this segment?

Adjustment = $\$8,625 - (\$150 * 57) = -\$75$

75

Question:

A 4" HMA pavement/overlay segment has an MRI of 85.0 inches per mile.

Q: According to 2317 what is the adjustment to payment for this segment?

76

Question:

**A 4" HMA pavement segment has an MRI of 85.0 inches per mile.
According to 2317 what is the adjustment to payment for this segment?**

Table 2317.05-5: Schedule for Adjustment Payment for HMA Pavements for Primary and Interstate Projects

MRI (inches per mile)	Dollars per 0.1 mile segment per lane	
	Design Thickness	
	Full Depth (>4")	Overlay (≤4")
Less than 29.84	1,500.00	1,250.00
29.84 to 39.22	6,271.915- (159.915*MRI)	5,226.596- (133.2623*MRI)
39.22 to 75	Unit Price	Unit Price
75 to 90	7,500.00- (100*MRI) or grind ¹	6,250.00- (83.333*MRI) or grind ¹
Greater than 90	Grind ¹	Grind ¹

1. Correct these areas below 75.0 inches per mile

Solution: $\text{Adjustment} = \$6250.00 - (\$83.333 * 85) = \$-833.305$ or Grind

Rounds to \$-833.31 or Grind

77

2317.05-1 Pay Adjustment

- How many dollar incentive/disincentive are paid for a 10" PCC Primary section of highway, > 45 mph, whose segments are
- 44.40 in / mi
- 50.00 in / mi
- 62.50 in / mi
- 82.60 in / mi
- 56.90 in/ mi

78

2317.05-1 Pay Adjustment

- How many dollar incentive/disincentive are paid for a 10" PCC Primary section of highway, > 45 mph, whose segments are
- 44.40 in / mi [**\$1500**]
- 50.00 in / mi [$8625.00 - (150 * 50) =$ **\$1125.00**]
- 62.50 in / mi [Unit Price or \$0]
- 82.60 in / mi [$7500 - (100 * 82.60) =$ **-\$760**]
- 56.90 in / mi [$8625 - 150 * 56.90 =$ **\$90**]
- Total **\$1500 + \$1125 + \$0 - \$760 + \$90 = \$1955**

Table 2317.05-3: Schedule for Adjustment Payment for PCC Pavements for Primary and Interstate Projects

MRI (inches per mile)	Dollars per 0.1 mile segment per lane	
	Design Thickness	
	Full Depth (>6")	Overlay (<=6")
Less than 47.5	1,500.00	1,250.00
47.5 to 57.5	$8,625.00 - (150 * MRI)$	$5,226.596 - (133.2623 * MRI)$
57.5 to 75	Unit Price	Unit Price
75 to 90	$7,500.00 - (100 * MRI)$ (or grind ¹)	$6,250.00 - (83.333 * MRI)$ (or grind ¹)
Greater than 90	Grind ¹	Grind ¹

1. Correct these areas below 75.0 inches per mile



79

Discussion

- How is the MRI different from the P.I.?
- Difference between "segment" and "section"?
-

80

2529.03 Patching

H. Smoothness.

Apply Section 2317 to smoothness of full depth finish patches (except when the contract includes an overlay or pavement surface repair by diamond grinding or milling within the patch area) with the following modifications for Full Depth Finish Patches (50 feet or greater in length)

1. Smoothness testing and evaluation is required for each patch with a length of 50 feet or more. For full lane width patches, perform the testing near the center of the traffic lane after the patch is placed. For partial lane width patches, perform testing in the patched wheel path.
2. Patches 50 feet to 100 feet in length:
 - a. Test the patch length, and the existing pavement in that lane, for a distance of three times the patch length on both ends of the patch. If a patch occurs near a bridge, an intersection, and so forth, where the proper distance cannot be tested, make up the required total on the other end of the patch. If interference occurs on both ends, test only to the points of interference.
 - b. Establish a Mean Roughness Index for the patch, MRI_{patch} .
 - c. Establish a Mean Roughness Index for the existing pavement on both ends of the patch, $MRI_{\text{preexisting pavement}}$.

81



- d. Compare the MRI_{patch} to $MRI_{\text{preexisting pavement}}$. Perform surface correction according to Article 2317.04 so that the MRI is less than the $MRI_{\text{preexisting pavement}}$ when either of the below listed conditions exists:

1. MRI_{patch} exceeds 75.0 inches per mile and exceeds $MRI_{\text{preexisting pavement}}$ by more than 7.5 inches per mile.
2. MRI_{patch} exceeds 90.0 inches per mile and exceeds $MRI_{\text{preexisting pavement}}$.

82

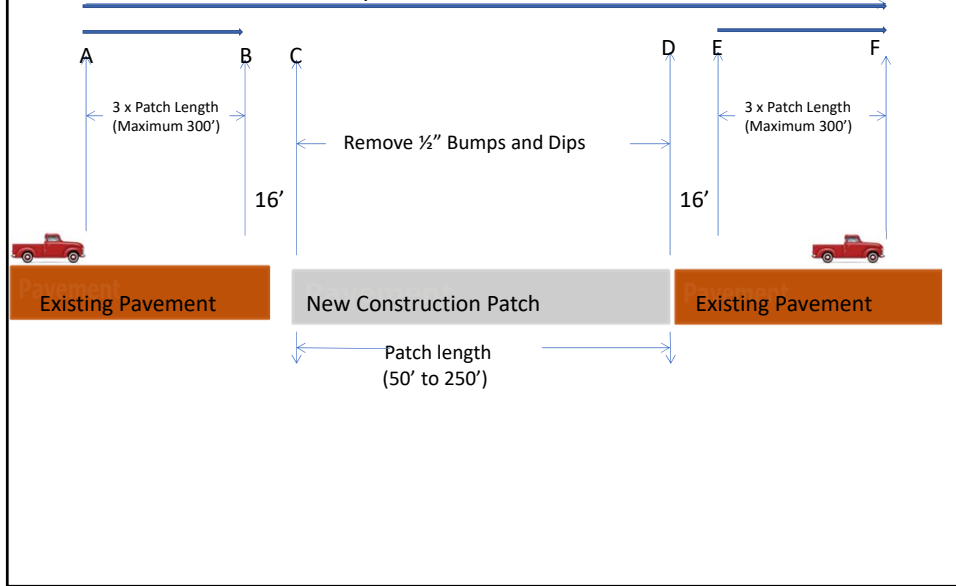
3. Patches 100 feet to 250 feet in length: Article 2529.03, H, 2, applies, except the length tested is the patch length, and the existing pavement in that lane for a distance of 300 feet on both ends of the patch.

83

4. Patches over 250 feet in length: Apply the requirements of Section 2317.

84

Pavement Patches Spec 2529.03.H



85

Discussion

1. T/F -Smoothness testing and evaluation is required for each patch with a length between 50 feet and 250'.

86

IM 341 Reporting

- Project acceptance
- Type of reports
- Lab numbers
- Corrected work
- Rounding
- Completed report
- Distribution list

87

Reporting
Rule #1.

**Make sure analysis
settings are correct.
See IM 341**

88

General Settings | Analysis Parameters | Localized Roughness | Report Options | GPS Options

Analysis Type: PRI

Units
English

Segment Settings:
Segment Length: 528 ft
 Merge last segment if it is less than: 251 ft
Exclude Paused Sections

PRI Filter
Filter Type: Butterworth
Filter Length: 2.000 ft
Filter Gain: 1.00

Parameters
Blanking Band: 0.00 in
Minimum Scallop Height: 0.030 in
Minimum Scallop Length: 2.00 ft
Scallop Resolution: 0.010 in
 Minimum Scallop Height Inclusive

89

Report Options | Analysis Options | Profile Analysis | Texture Analysis

Localized Roughness Settings
IRI Baselength: 25 ft
IRI Threshold: 200 in/mi
 Localized Roughness Enabled

Bump/Dip Detection Settings
Bump/Dip Width: 25 feet
Bump/Dip Height: 0.5 inches
 Bump Detection Enabled
 Dip Detection Enabled

Profile Filter Settings
High Pass Filter Cutoff: 0 feet
Low Pass Filter Cutoff: 0 feet

CalPro Filter Settings
Low Pass Filter Cutoff: 2 feet
 Moving Average 3rd Order Butterworth

Rolling Straightedge Simulation
Straightedge Length: 10 feet
Specification Limit: 0.125 inches

CalPro Simulation
Blanking Band Width: 0 inches
Minimum Scallop Height: 0.03 inches
Minimum Scallop Width: 2 feet
Scallop Rounding: 0.01 inches
 Count Scallops Once
 Create Short Segment Summary
Short Segment Length: 250 feet

Data Output File Sample Rate
 Use raw sample rate

90

IM 341 Reporting- Computer settings• **PROFILOGRAPH REDUCTION SETTINGS**

Blanking Band	#1 <u>0.20 in.</u>
Scallop Rounding	#2 <u>0.01 in.</u>
Minimum Scallop Height	#3 <u>0.03 in.</u>
Minimum Scallop Width	#4 <u>0.08 in.</u> on trace(<u>2.0 ft.</u> actual distance).
Filter Type	#5 <u>Butterworth.</u>
Bump/Dip Height	#6 <u>0.5 in.</u>
Bump/Dip Width	#7 <u>25 ft.</u>

91

IM 341. Analyzing and Reporting

- e. There are three types of reports:
- i. **Preliminary.** Used by the contractor to submit the report in the timeframe required in the specifications. Any defective areas shall be identified. A final report must follow. A preliminary report is required by Specification 2317.03.B5.
 - ii. **Final.** Used to indicate that the report is being submitted for acceptance.
 - iii. **Corrected.** Used to indicate that there was either an error in the original test report or that the section was corrected by grinding and retested.

92

IM 341 Reporting

- f. Roughness shall be reported in inches. Distance shall be reported in feet for MRI (paving) and reported in 1/1000th of a mile (0.001) for Profile Index (bridge decks).
- g. Test report laboratory numbers must be continuous and increasing numerically as each succeeding test is performed. Laboratory numbers shall have a letter added to the end of the original laboratory number for corrected reports (i.e., original report number 01-218L-05, corrected report number 01-218L-05-A).
- h. Submit all final and corrected reports to the Engineer. Submit copies of original profiler files to the Engineer. Label the file(s) with the project as part of the file name.
- i. Keep all original profiler files until validation of the contractor test results has been confirmed.

93

IM 341 Reporting

- Contractor test reports shall have one of the following at the bottom of the report:
 - **No Corrective Work Required.**
 - **Corrective Work Required.**
 - **Corrective Work Completed.**

94

IM 341 Reporting

- Corrected test reports shall include all the information and data from the original test report and show the retested profile index for each corrected segment.
- Identified bumps and dips shall be noted as corrected

95

IM 341 Reporting

Lab/ Report Numbers

- g. Test report laboratory numbers must be continuous and increasing numerically as each succeeding test is performed. Laboratory numbers shall have a letter added to the end of the original laboratory number for corrected reports (i.e., original report number 01-218L-05, corrected report number 01-218L-05-A).

96

IM 341 Reporting



Lab numbers

- Report lab numbers must be in continuous and increasing numerically as each succeeding test is performed.
- Lab numbers must have a letter added to the end of the original lab number for corrected reports.
- Ex: Lab Rpt. 01-Cedar(94)25021-20615S
- Corrected Rpt. 01-Cedar(94)25021-20615S-a

Note: An example of best practice file name: PROF 95-0354-244 SB OL 625+00 to 841+00

Note: An example of best practice final file name: PROF 95-0354-244 SB OL 625+00 to 841+00-A (if pavement corrections were required)

97

- IM Reporting
- PI/2428 Rounding



- Length (miles) to 3 decimal places
(EX:0.100 mi.)
- Measured Roughness (inches) to 2 decimal places. (EX:2.23 in.)
- Profile Index (in / mi) to 2 decimal places
(EX:22.30 in / mi)

98

IM 216.

- The District Materials staff will also do testing to verify that the contractor testing was done correctly.
- IM 216 is used to compare the DOT and contractor test results. (Using the Verification smoothness index from the IDOT personnel profiling)

99

2317.04. G. Verification Testing.

- 1.** The Engineer will perform verification testing to validate the Contractor's certified quality control testing. If the Engineer's verification test results validate the Contractor's test results, the Contractor's results will be used for acceptance. Disputes between the Contractor's and Engineer's test results will be resolved according to Materials I.M. 341.
- 2.** The Engineer may test the entire project length if it is determined that the Contractor certified test results are inaccurate, The Contractor will be charged for this work at a rate of \$800.00 per lane-mile, with a minimum charge of \$1500.00.
- 3.** Furnishing inaccurate tests may result in decertification of the Contractor's certified operator.

100

Independent Assurance Program (IAP)

- Double checks to make sure the testers and test equipment are working correctly
- This includes contractor, state, county, city, and consultant staff and the testing equipment
- IAP is done by central laboratory personnel.
- IM 207, IM 207 App. A

101

IM 207 Appx. A

April 21, 2015

Supersedes October 21, 2014

Matis. IM 207

Appendix A

IAP Responsibilities

HMA				
Procedure to Check	To Whom	By Whom	How	Approach(1)
Field Density Sampling	RCE	Training	Computer Program & Training	System
Field Density Testing	RCE	DME	Test same cores- IM 216	Project
Mix Sampling	CONTR, RCE	DME	Observe	Project
Mix Properties Testing	CONTR, DME	CTRL	Proficiency- IM 208	System
Binder Sampling	CONTR, RCE	Training or DME	Training or Observe	Both
Binder Properties Testing	DME	CTRL	Proficiency- IM 208	System
Aggregate Grad. Sampling	RCE, CONTR	Training or DME	Training or Observe	Both
Aggregate Grad. Testing	RCE, CONTR, DME(2)	DME, CTRL	Proficiency or Split test IM 208/216	Both
Aggregate Quality Sampling	DME	Training/Demo.	Training	System
Aggregate Quality Testing	None	None	None	
Ride Testing	CONTR, DME	CTRL	Yearly Calibration	System

Note 1- The DME may use different approaches for DOT, local agency, and contractor personnel.

Note 2- When the District Laboratory is performing the verification gradation testing for a project.

RCE-Resident Construction Engineer/Project Engineer

DME-District Materials Engineer

CTRL-Central Materials Office

CONTR-Contractor

102

IM 216

PI Example

- Example:
According to IM216 (Bridge profile Index, 0.20 in. Blanking band)
If the Contractor has a test result of 22.12 in. / mi. and the IDOT
has a result of
26.26 in. / mi., are the results within the tolerance limit?

103

IM 216 Solution

Bridge Profile Index (0.2" blanking band)	IM 341
Verification Profile Index Test Result	
<u>Inches/mile</u>	
6.0 or less	2.0 in./mi.
6.1 to 20.0	3.0 in./mi.
<u>20.1 to 40.0</u>	<u>4.0 in./mi.</u>
More than 40.0	6.0 in./mi.

IDOT (26.26 +/- 4.0) in. / mi.
Is the Contractor number (22.12 in. / mi.) within tolerance
(22.26 in. / mi.----30.26 in. / mi.)? No.

104

IM 216

IRI Example

• Example:

According to IM216 (Pavement International Roughness Index (IRI)

If the Contractor has a test result of 62.05 in. / mi. and the IDOT has a result of 59.84 in. / mi., are the results within the tolerance limit ?

105

IM 216 Solution

Pavement International Roughness Index (IRI) IM 341

Verification IRI Test Result

Inches/mile

50.0 or less

10.0% of mean

50.1 to 150.0

8.0% of mean

More than 150.0

7.0% of mean

IDOT 59.84 in/mi; Contractor 62.05 in/mi

$(59.84 \text{ in/mi} + 62.05 \text{ in/mi}) / 2 = 60.945 \text{ in/mi}$ [need to round]

$= 60.95 \text{ in/mi} \times 0.08 = 4.88 \text{ in./mi.}$ [+/- tolerance from IDOT]

Is the Contractor number within tolerance with IDOT?

$(54.96 \text{ in/mi to } 64.72 \text{ in/mi})?$ [59.84 +/- 4.88]

Yes.

106

MANATTS, INC. District 1 Materials
P.O. BOX 535
BROOKLYN, IOWA 52211
PROFILOGRAPH REPORT Changes Lab. No. Revised Report

For Information Only Preliminary Final Corrected

Lab No. 02-HWY65(158)-2022 Route No. HWY 65 Project No. BRFN-065-4(158)-39-77
Date Reported 7/29/2022 Date Paved NA County POLK
Tested at 74 point Wheel Track Contractor JASPER CONSTRUCTION
Tested By NATHAN TAYLOR CI282 Date 7/29/2022
Trace Reduced By COMPUTERIZED Date 7/29/2022

Schedule A Wheel path PCC
Schedule B HMA

Roadway Type: 2-Lane 4-Lane Ramp Other BRIDGE DECK

N.B. E.B. Direction S.B. W.B.
 Inside Lane Centerline Inside Wheel Track Outside Wheel Track Outside Lane 14 Point

Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)	Location (Station)	Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)	Avg.	Specification Incentive Numbers Used From:
ENGLISH								
			516+47					
BRIDGE DECK	0.059	0.56			0.059	1.03	17.46	13.47
			519+60					
0.059	0.56	9.49		0.059	1.03	17.46	13.47	\$0 \$0

NO CORRECTIVE WORK REQUIRED
CORRECTIVE WORK REQUIRED
CORRECTIVE WORK COMPLETED

12" Bump Locations

Copies:
Special Investigations, Ames
District Materials Engineer
Resident Construction Engineer
Manatts, Inc. - Job Superintendent

Signed By: NATHAN TAYLOR CI282

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract specifications and requirements.

111

4710250

Profile Verification Sheet

Project Number	BRFN-065-4(158)-39-77		
Date Measured	8/10/2022		
Tested By	JEFF BRINKMAN		
Report Number	1B220810-77-0654-158		
Evaluation Method	Bridge Profile Index (0.2" blanking band)		

Stationing	Section 1	Section 2	Section 1
Direction	NorthBound		
Lane Description			
Beginning	516+70		
Ending	519+80		
Length (ft.)	310	0	0

Contractor Report #	02-HWY65(158)-2022		
Contractor Index	13.47		
DOT Index	15.58		
Difference	2.11	0.00	0.00
Tolerance	3.00	2.00	2.00
Verified	Yes	Yes	Yes

Total Project Length	310
Total Lanes	2
Total Lane Length	620

Verification Length (ft.)	310.00
10 % of Project?	Yes
Verified	YES

Area of Localized Roughness (ALR)	
200.0 ≤ ALR < 250.0 (ft.)	
ALR ≥ 250.0 (ft.)	

Comments:
THIS IS FROM THE NORTHBOUND INSIDE LANE

Data Entered By	JEFF BRINKMAN		
Signature/Certification #	JEFF BRINKMAN	Certification #	CI 429

112

30-Aug-2024 **Profile Verification Sheet**

Project Number		BRFN-065-4(158)-39-77			Report Number		IJB220810-77-0654-158 Jasper		
Date Measured		8/10/2022			Surface Type		PCC		
Tested By		Brinkman			Posted Vehicle Speed		> 45 mph		
Direction		Northbound			Specification		2428		
Lane Description		Mainline: Lane 2							

Stationing	Section 1	Section 2	Section 3
Beginning	516+47		
Ending	519+60		
Length (ft.)	313	0	0

Contractor PI				13.47			
DOT PI				15.58			
Difference		2.11		0.00		0.00	
Tolerance		3.00		2.00		2.00	
Verified		Yes					

Contractor Area of Localized Roughness (ARL)	
200.0 ≤ ARL < 250.0 (ft)	
ARL ≥ 250.0 (ft)	

DOT Area of Localized Roughness (ARL)	
200.0 ≤ ARL < 250.0 (ft)	
ARL ≥ 250.0 (ft)	

Totals	
Length (ft.)	313
Contractor PI (in./mi.)	13.47
DOT PI (in./mi.)	15.58
Difference	2.11
Tolerance	3.00
Verified	Yes

Comments:

Jasper Construction- correlates to contractor report 02- Hwy65(158)-2022

Data Entered By	Jeff Brinkman
Signature/Certification #	C1429

This is to certify that all testing and evaluation herein described has been performed according to applicable contract

113

Submit all preliminary profile summary sheets and final ProVAL compatible files to the Construction and Materials Bureau via smoothness.cmb@iowadot.us following completion of paving on the project.

114

NOTICE

Whoever, knowingly makes any false statement, false representation, false report, or false claim with respect to the character, quality, quantity or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to a material fact in any statement, certificate, or report submitted pursuant to the provision of the Federal Aid Road Act approved July 11, 1916 (39 Stat. 355) as amended and supplemented, Shall be fined under this title or imprisoned not more than five years, or both.”



115



48 HOUR NOTIFICATION!!!!!!

IM 341:

The contractor (or subcontractor) responsible for smoothness testing and evaluation shall give the Project Engineer AND THE DME 48 HOURS NOTICE PRIOR TO TESTING so the Office of Materials may provide a certified technician for correlation purposes with the contractor.

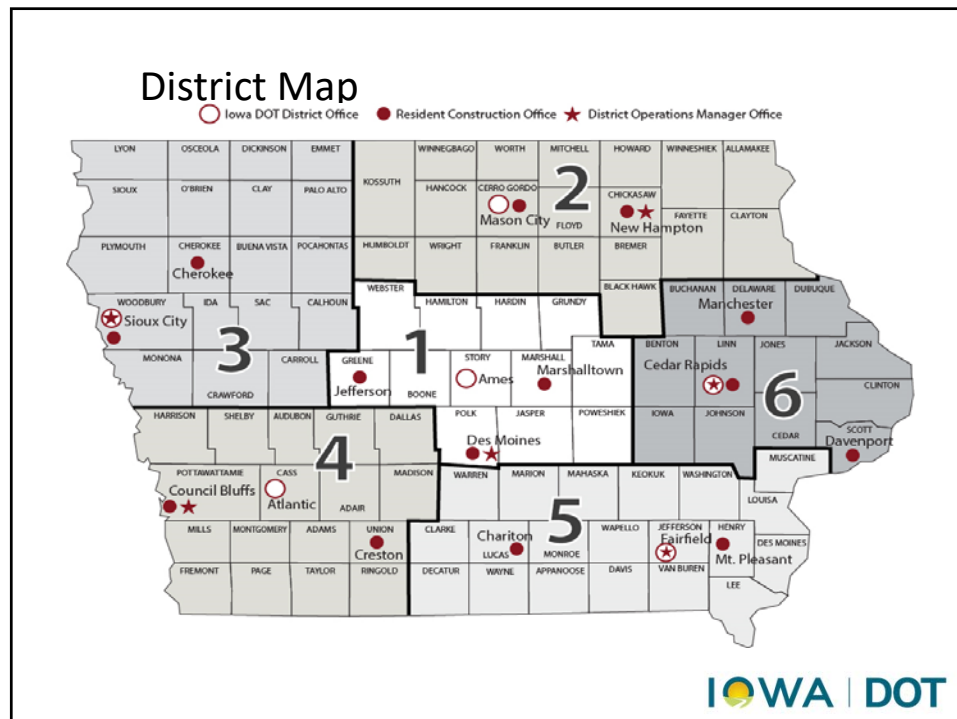
116

Discussion

1. How many places past the decimal point should the PI be reported to in 2428?
2. What important information is needed on a test report?
3. What do you do when you have to correct a report that has already been submitted?
4. T/F - you are required to submit all preliminary profile summary sheets and final ProVAL compatible files to the Construction and Materials Bureau via smoothness.cmb@iowadot.us following completion of paving on the project.



117



118

District IAP Contacts for Notifications

District 1 Materials

Jeff Brinkman
515-290-1375
Jeff.Brinkman@iowadot.us

District 2 Materials

Scott Boyle
641-422-9427
Scott.Boyle@iowadot.us

District 3 Materials

Anthony Willman
712-539-1315
Anthony.Willman@iowadot.us

District 4 Materials

Todd Blum
712-243-7629
Todd.Blum@iowadot.us

District 5 Materials

Jon Mason
641-919-5666
Jon.Mason@iowadot.us

District 6 Materials

Mustafa Qaisi
319-366-0446
Mustafa.Qaisi@iowadot.us



119

District Material Engineers for Notifications

District 1 Materials

Mike Lauritsen
515-357-4350
Michael.Lauritsen@iowadot.us

District 2 Materials

vacant
641-422-9427

District 3 Materials

Jakob Lang
712-239-4713
Jakob.Lang@iowadot.us

District 4 Materials

Tim Hensley, P.E.
712-243-7629
Timothy.Hensley@iowadot.us

District 5 Materials

Allen Karimpour
641-469-4040
Allen.Karimpour@iowadot.us

District 6 Materials

Shane Neuhaus, P.E.
319-366-0446
Shane.Neuhaus@iowadot.us



120

IM 213
CERTIFICATION

TECHNICAL TRAINING & CERTIFICATION PROGRAM

GENERAL

The purpose of the Technical Training & Certification Program is to ensure Quality Control (QC)/Quality Assurance (QA) and Acceptance of Aggregates, Hot Mix Asphalt (HMA), Portland Cement Concrete (PCC), Soils, Erosion Control, Precast and Prestressed Concrete, and Pavement Profiles and to ensure proper documentation of quality control/quality assurance and acceptance procedures and test results by industry and Contracting Authority personnel.

This Instructional Memorandum (IM) explains the requirements to become certified and to remain certified to perform inspection and testing in the State of Iowa. This IM also describes the duties, responsibilities and the authority of persons assigned the position of Certified Technician in any of the above areas for construction or maintenance projects. [Appendix C](#) of this IM lists what tests and procedures the technician is qualified to perform for each level of certification they obtain.

Through a cooperative program of training, study, and examination, personnel of the construction industry, State DOT, and other Contracting Authorities will be able to provide quality management and certified inspection. Quality control/quality assurance and acceptance sampling, testing and inspection will be performed by certified personnel and documented in accordance with the IMs.

A technician who is qualified and holds a valid certification(s) shall perform quality control/quality assurance and acceptance at a production site, proportioning plant, or project site. Responsibilities cannot be delegated to non-certified technicians. The duties of a Certified Technician may be assigned to one or more additional Certified Technicians.

The Technical Training & Certification Program will be carried out in accordance with general policy guidelines established or approved by the Highway Division Director. A Board of Certification composed of the following members will advise the Director:

- Director – Construction and Materials Bureau
- Representative of District Materials Engineers**
- Representative of District Construction Engineers**
- Representative of Associated General Contractors (AGC of Iowa)
- Representative of Iowa Concrete Paving Association (ICPA)
- Representative of Asphalt Paving Association of Iowa (APAI)
- Representative of Iowa Ready Mixed Concrete Association (IRMCA)
- Representative of Iowa Limestone Producers Association (ILPA)
- Representative of County Engineers
- Representative of American Council of Engineering Companies (ACEC-Iowa)
- Coordinator of Technical Training & Certification Program**

** Appointed by Program Director

The Director of the Construction and Materials Bureau will be the Program Director. Coordinators will be appointed by the Program Director to assist in administration of the program and to handle such planning, administration, and coordinating functions as may be needed.

TRAINING

The Iowa DOT will provide the training necessary to become certified. Producers/Contractors are encouraged to conduct their own pretraining program. A complete listing of training opportunities is available at the Technical Training & Certification Program website, <https://iowadot.gov/training/technical-training-and-certification-program>.

CERTIFICATION REQUIREMENTS

1. A candidate must attend Iowa DOT course instruction and pass the examination(s) for all levels of certification prepared and presented by the Program Director or someone designated by the Program Director. If the new candidate fails the examination, they will have one opportunity to retake the examination. The retake must be completed within six months of the original exam. If they fail the retake of the examination, they will need to attend the training again before taking the examination the third time. If an individual is recertifying they will have only one opportunity to take the examination. If they fail the examination they must take the applicable training before retaking the examination.
2. All prerequisites shall be met before the applicant may attend the next level of training for the certification desired. A listing of certification levels and prerequisites is located in [Appendix A](#).
3. Once the candidate has met all the criteria and has received certification, it is recommended the Certified Technician work under the supervision of an experienced technician until they become efficient in the inspection and testing methods they will be performing.

An individual requesting to become certified as a Precast/Prestress Concrete Technician is required to obtain forty hours of experience assisting in quality control inspection at an approved plant before certification will be issued. The experience must be documented and shall be approved by the District Materials Engineer. This experience must be completed within two years from the date the individual attended the training.

4. Registered Professional Engineers, engineering graduates, and geology graduates from accredited institutions will be exempt from the training requirement in the areas they have had instruction. It is, however, strongly recommended that they attend the certification classes. In order to obtain certification for any technical level, these persons must pass all applicable written examinations for the level of certification they wish to obtain. If the written examination attempt does not meet the required score, the candidate must take the certification class before another attempt can be made. All certificates issued in accordance with these requirements will be subject to the same regulations concerning expiration, recertification, etc., as applies to certificates obtained via training and examinations.
5. Technicians will be issued certifications by reciprocity when the following criteria are met:
 - a. The applicant must be certified in another state or certification program determined equivalent by the Program Director or someone designated by the Program Director, in each level of certification they are requesting.
 - b. The applicant must pass an examination for each level of certification desired, which will be administered by the Iowa Department of Transportation. Failure of the examination shall require the applicant to take the full certification class before they can retake the exam.

-
- c. The applicant must follow the prerequisite requirements of the Technical Training & Certification Program.

Reciprocity requests should be made through the Technical Training and Certification office in Ames. Copies of all the applicant's certifications will be required.

CERTIFICATION

Upon successfully completing the requirements for certification, the Program Director will issue a pocket certification card. The certification is not transferable. A certification earned in a training season shall be valid until March 31st of the fifth succeeding training season. A training season is defined as October 1st, XXXX to September 30th, XXXX+1.

CERTIFICATION IDENTIFICATION

The certification card will identify the certificate holder, their certification number, the level(s) of certification, and the expiration date of each level.

RENEWAL OF CERTIFICATION

A certification shall be valid through March 31st of the fifth succeeding training season. If the individual has not renewed their certification by the certification expiration date, they are automatically decertified.

All certified technicians will be required to pass an examination before recertification will be issued. Failure of the examination shall require the applicant to retake the full certification class and pass the examination. If the individual does not take the examination within one year after their certification(s) expire-they must retake the full certification class and pass the examination.

If an applicant becomes decertified in any level of certification and that certification is a prerequisite for other levels of certification the applicant will also be decertified in those related levels of certification until the prerequisite certification has once again been obtained.

The certificate holder shall be responsible for applying for certification renewal and for maintaining a current address on file.

PROVISIONAL CERTIFICATION

Provisional certification will be allowed through a special request to the TTCP Director. The request can be mailed or emailed to the TTCP Director and must include the need for a provisional certification, such as, company technician quit and they need to replace, an unforeseen workload, etc. Provisional certifications will only be granted to contractors. If the request is granted the following requirements will apply.

1. The provisional certification applicant must work under the direct supervision of a certified technician until such time that the applicant is competent in the required skills of the certification and has taken the written exam. The applicant must also take the web based review offered by the TTCP in the area they are seeking provisional certification.
2. The applicant must take and pass the written exam for the provisional certification they are requesting. There will be a testing fee in the amount of the TTCP recertification fee due at the time of the exam. CIT funds may not be used for provisional certification testing. The exams will be offered at the District Materials offices or the TTCP office in Ames.
3. The technician must demonstrate proficiency to an Iowa DOT certified technician at the first available opportunity.

4. After the provisional certification applicant has successfully completed the steps in 1 and 2, they will become provisionally certified until the end of the calendar year in which they obtained certification.
5. If the provisional certified technician wishes to keep their certification they must attend the full class at the full class cost for the certification during the training season immediately following their provisional certification.
6. A provisional certification is not intended to be an annual request. The provisional certification will only be allowed for one construction season. Repeated requests for provisional certifications for the technician will be denied.
7. Any prerequisites for the certification must be met prior to number 2 above.
8. HMA Basic Tester is a new certification that may only be used as a provisional certification. This certification follows all the requirements previously listed and the technician will be required to take Level I HMA at the first available opportunity after the provisional expires.
9. Provisional Certification will be offered for:
 - a. Aggregate Sampler
 - b. Aggregate Technician
 - c. Level I PCC
 - d. HMA Sampler
 - e. HMA Basic Tester

UNSATISFACTORY PERFORMANCE NOTICE

A certified technician failing to perform the required specified duties or inadequately performing these duties, will receive an Unsatisfactory Notice ([Materials IM 213, Appendix B](#)). The notice will be from the District Materials Engineer in the District where the failure occurred. This notice and all supporting documentation will be placed in the technician's record with the Iowa Department of Transportation's Technical Training & Certification Program (TTCP). The notice will remain in their file for five years. The notice may be removed prior to the five years upon the recommendation of the District Materials Engineer.

SUSPENSION

A technician receiving two Unsatisfactory Work Performance Notices for work performed under a specific certification will be given a three-month suspension of the applicable certification. Suspended technicians shall not perform any duties governed by the suspended certification, including any duties which require the suspended certification as a prerequisite.

Technicians are eligible to be reinstated after the three-month suspension and successful completion of the applicable recertification test(s).

Technicians are subject to decertification when they receive a third Unsatisfactory Performance Notice.

The suspension will be effective on the date the Program Director issues the suspension.

DECERTIFICATION

Certified Technicians will be decertified for any of the following reasons:

Certifications will be revoked for the following reasons:

1. Failure of the certificate holder to renew the certificate prior to regular expiration as described above.

-
2. Use of false or fraudulent information to secure or renew a certificate.
 3. Use of false or fraudulent documentation by the certificate holder.
 4. Use of misleading, deceptive, untrue or fraudulent representations by the certificate holder.
 5. Cheating on certification exams or performance evaluations. This includes removing, or attempts to remove, exam questions, answers, or other exam materials from the testing location.
 6. Receipt of 3 Unsatisfactory Performance notifications, as stated above under suspension.

The Program Director, or designee, will notify an individual in writing of the intent to suspend or revoke the individual's certification(s). Notice will also be sent to the technician's last known employer. For DOT employees, notice will also be sent to their immediate supervisor.

An individual's certifications will be suspended during the appeal process, and the individual can't perform any duties governed by the certification during this time, until the first day following the end of the appeal process described below.

Technicians that are decertified shall not perform any duties requiring certification.

APPEALS & REINSTATEMENT REQUESTS

An individual has 10 business days to respond to the revocation notice. If the individual fails to respond with an appeal within 10 days of receipt of the original revocation notice, the suspension or revocation becomes effective on the 10th day.

Appeal step 1: First step appeals will be heard by the program director and a representative panel. The individual will have an opportunity to present information to support their continued certification to the panel. The Program Director and representative panel will then render a written decision, taking into account the technician's actions or omissions, the existence of past infractions, and any mitigating factors. This step 1 appeal will become final if further action is not taken as described in appeal step 2 and the suspension or revocation will become effective on the day the decision is issued by the panel.

Appeal step 2: If the individual is not satisfied with the decision of the Program Director and representative panel, the individual shall, within 10 days of receipt of the written decision, submit a request for further review to the Program Director. This appeals request will be considered by the entire Certification Board. The decision of the Certification Board will be the final decision on behalf of Technical Training & Certification Program.

Any violation will remain on the violator's record for five years, at which time the violation will be removed from their record.

A technician may request reinstatement after one year of being decertified unless the Program Director authorized a shorter period of time, which shall not be less than three months. If a reinstatement is authorized, the individual must attend and successfully complete the applicable certification courses.

FUNCTIONS & RESPONSIBILITIES

A certificate holder at each production site, project site, proportioning plant, or laboratory will perform duties. The certified technician shall perform quality control testing in accordance with specified frequencies and submit designated reports and records.

The specification requirement for materials testing by a certified technician does not change the supplier's responsibilities to furnish materials compliant with the specification requirements.

The District Materials Engineer and/or Project Engineer will be responsible for monitoring the sampling, testing, production inspection activities and quality control performed by the contractor. A monitor shall have satisfactorily completed the training and be certified for the level of technician they are monitoring.

The District Materials Engineer and/or Project Engineer will have authority and responsibility to question and, where necessary, require changes in operations and quality control to ensure specification requirements are met.

QUALITY CONTROL, TESTING, & DOCUMENTATION

The QC Technician shall be present whenever construction work related to production activity, such as stockpiling or other preparatory work, requires record development and/or documentation is in progress. The QC Technician's presence is normally required on a continuing basis beginning one or more days before plant operation begins and ending after plant shut down at the completion of the project. The work shall be performed in a timely manner and at the established frequencies.

The QC Technician's presence is not normally required during temporary plant shut downs caused by conditions, such as material shortages, equipment failures, or inclement weather.

All quality control activities and records shall be available and open for observation and review by representatives of the contracting authority.

Reports, records, and diaries developed during progress of construction activities will be filed as directed by the Contracting Authority and will become the property of the Contracting Authority.

Quality control activities, testing, and records will be monitored regularly by Contracting Authority representatives. The Project Engineer or District Materials Engineer will assign personnel for this function.

Monitor activities will be reported and filed at prescribed intervals with the Project Engineer, District Materials Engineer, producer, contractor, and the contractor's designated producer.

At no time will the monitor inspector issue directions to the contractor, or to the QC Technician. However, the monitor inspector will have the authority and responsibility to question, and where necessary, reject any operation or completed product, which is not in compliance with contract requirements.

ACCEPTANCE

Completed work will be accepted on the basis of specification compliance documented by acceptance test records, and monitor inspection records. Specification noncompliance will require corrective action by the producer, contractor, or by the contractor's designated producer, and review of events and results associated with noncompliance by the Project Engineer.

CERTIFICATION LEVELS

CERTIFICATION LEVEL	TITLE	PRE-REQUISITES
AGGREGATE		
Aggregate Sampler	Certified Sampling Technician	None
Aggregate Technician	Certified Aggregate Technician	None
EROSION CONTROL		
Erosion Control	Erosion Control Technician	None
HOT MIX ASPHALT		
HMA Sampler	HMA Sampler	None
Level I HMA	HMA Technician	Aggregate Technician
Level II HMA	HMA Mix Design Technician	Level I HMA
PORTLAND CEMENT CONCRETE		
Level I PCC**	PCC Testing Technician	None
Level II PCC	PCC Plant Technician	Agg. Technician & Level I PCC
Level III PCC	PCC Mix Design Technician	Level II PCC
**American Concrete Institute (ACI) Grade I certification will be acceptable as a portion of the Level I PCC training.		
PRESTRESS		
Prestress	Prestress Technician	Level I PCC or ACI Grade I If the technician will be performing gradations, they will need to be Aggregate Technician certified.
RIDE QUALITY		
Ride Quality	Ride Quality Technician	None
SOILS		
Soils	Soils Technician	None

UNSATISFACTORY PERFORMANCE NOTICE

Issued To: _____

Date: _____

This notice is to inform you that your performance as a Certified Inspector/Technician was unsatisfactory for the reason(s) listed below.

This notice and all supporting documentation will be placed in your record with the Iowa Department of Transportation's Technical Training & Certification Program (TTCP).

The goal of the Technical Training and Certification Program (TTCP) is to work with contractors, producers, cities, counties, and consultants to continually improve the quality of Iowa's construction projects. We hope you will work with us to achieve this goal.

Unsatisfactory Performance:

District Materials Engineer

cc: Program Director –Construction and Materials Engineer, Ames
TTCP Coordinator
Resident Construction Engineer

RIDE QUALITY TECHNICIAN DUTIES

Duties of the Ride Quality Technician are detailed in IM 341 and consist of, but are not limited to the following:

- A. Test pavement and bridge surfaces for ride quality.
- B. Evaluate the test data.
 - 1. Identify bumps and dips.
 - 2. Summarize the roughness into segments and sections.
 - 3. Identify the segments for incentive, disincentive, or grind.
 - 4. Retest and evaluate bumps, dips, and must grid segments for specification compliance.
- C. Documentation
 - 1. Document the evaluation on a test report. A copy is sent to the Project Engineer, District Materials Engineer, and Central Materials.
 - 2. Notify the Project Engineer if the daily average profile index exceeds the specification tolerance.
 - 3. Submit the profilograms to the Project Engineer for all areas tested.

FEDERAL CODE 1020 and IOWA CODE 714.8

I.M. 213 discusses the Unsatisfactory Notice that Certified Technicians are given when they are not performing their job duties satisfactorily. This can be given for a number of reasons including, improper sampling and/or testing, not performing their duties and reporting in the time frame required, reporting incorrect information, etc. The technician is given one written notice, the second notice is three-month certification suspension, and the third notice is decertification. According to I.M. 213 the Certified Technician can automatically be decertified for false statements without going through the Unsatisfactory Notice procedure. The Certified Technician also needs to be aware of the false statement clause that is applicable to all federal-aid projects and the fraudulent practice clause that applies to all non-federal aid projects. **Certified Technicians need to read and be aware of U.S.C. 1020 and Iowa Code 714.8 since these do apply to them.** They read as follows:

FEDERAL AID PROJECTS

IX. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, the following notice shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

NOTICE TO ALL PERSONNEL ENGAGED ON FEDERAL-AID HIGHWAY PROJECTS

18 U.S.C. 1020 reads as follows:

“Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined not more than \$10,000 or imprisoned not more than 5 years or both”

NON-FEDERAL AID PROJECTS

Iowa Code 714.8, subsection 3, defines fraudulent practices. “A person who does any of the following acts is guilty of a fraudulent practice. Subsection 3, Knowingly executes or tenders a false certification under penalty of perjury, false affidavit, or false certificate, if the certification, affidavit, or certificate is required by law or given in support of a claim for compensation, indemnification, restitution, or other payment.” Depending on the amount of money claimed for payment, this could be a Class C or Class D felony, with potential fines and/or prison.

The above codes refer to the individual making the false statement. **Standard Specification Article 1102.03, paragraph C, section 5 refers to the Contractor.**

Article 1102.03, paragraph C, section 5 states, “A contractor may be disqualified from bidder qualification if or when: The contractor has falsified documents or certifications, or has knowingly provided false information to the Department or the Contracting Authority.”

IM 216
TEST RESULTS

GUIDELINES FOR DETERMINING THE ACCEPTABILITY OF TEST RESULTS

GENERAL

Criteria for determining the acceptability of test results is an integral part of the Quality Assurance Program. The comparison between two different operator's results is used in the independent assurance program and sometimes in the validation process. The tolerances in this IM are for comparing individual test results except in the case of the profile index where averages are used. When criteria for comparing test results is not established in this IM or any other IM, use of the AASHTO or ASTM test procedure precision criteria is appropriate for determining acceptability of test results.

When the tolerances are exceeded, an immediate investigation must be made to determine possible cause so that any necessary corrections can be made. Below are some steps that may be used to identify the possible cause:

1. Check all numbers and calculations.
2. Review past proficiency and validation data.
3. Review sampling and testing procedures.
4. Check equipment operation, calibrations and tolerances.
5. Perform tests on split samples or reference samples.
6. Involve the Central Materials Laboratory.

TOLERANCES

<u>TEST NAME</u>	<u>TEST METHOD</u>	<u>TOLERANCE</u>
Slump of PC Concrete 1" or less on IA or Verification More than 1" on IA or Verification	<u>IM 317</u>	1/4 in. 3/4 in.
Air Content of PC Concrete	<u>IM 318</u>	0.4% 0.5% for air >8%
Length of Concrete Cores	<u>IM 347</u>	0.10 in.)
NDT Pavement Thickness (MIT)		<=0.15 in.
Free Moisture in Aggregate, by Pycnometer	<u>IM 308</u>	0.2%
Specific Gravity of Aggregate, by Pycnometer	<u>IM 307</u>	0.02
Moisture in Aggregate, by Hot Plate		0.3%
Moisture in Soil	<u>IM 335</u> , <u>IM 334</u>	1.5%
Proctor Optimum Moisture Content	<u>IM 309</u>	2.0%
Proctor Maximum Dry Density	<u>IM 309</u>	5.0 lb./ft ³

In-Place Wet Density, Soils & Bases	IM 334 , 326 , other approved	2.0 lb./ft ³
G _{mm} Maximum Specific Gravity	IM 350	0.010
G _{mb} Density of HMA Concrete, by Displacement	IM 321	0.020
G*/Sin Delta	T315	17% of mean
% Binder, Ignition Oven	IM 338	0.33%
G _{sa} Apparent Specific Gravity	IM 380	0.010
G _{sb} Bulk Specific Gravity	IM 380	0.028
Percent Absorption	IM 380	0.37%
Fine Aggregate Angularity	T304	2.0%
Sand Equivalency	T176	10 % of mean
Pavement Profile Index (0.2" blanking band) Verification Profile Index Test Result <u>Inches/mile</u> 6.0 or less 6.1 to 20.0 20.1 to 40.0 More than 40.0	IM 341	1.0 in./mi. 2.0 in./mi. 3.0 in./mi. 5.0 in./mi.
Pavement Profile Index (0.0" blanking band) Verification Profile Index Test Result <u>Inches/mile</u> 25.0 or less 25.1 to 40.0 More than 40.0	IM 341	3.0 in./mi. 4.0 in./mi. 5.0 in./mi.
Bridge Profile Index (0.2" blanking band) Verification Profile Index Test Result <u>Inches/mile</u> 6.0 or less 6.1 to 20.0 20.1 to 40.0 More than 40.0	IM 341	2.0 in./mi. 3.0 in./mi. 4.0 in./mi. 6.0 in./mi.
Pavement International Roughness Index (IRI) Verification IRI Test Result <u>Inches/mile</u> 50.0 or less 50.1 to 150.0 More than 150.0	IM 341	10.0% of mean 8.0% of mean 7.0% of mean

IM 341
DETERMINING QUALITY

DETERMINING PAVEMENT RIDE QUALITY**SCOPE**

This IM describes procedures used to perform smoothness testing on pavement and bridge surfaces. A certified person is required to perform the testing, evaluation, and reporting. An approved apparatus must be used to test and evaluate all surfaces.

PROCEDURE

1. Apparatus
 - a. Inertial Profiler meeting the requirements of AASHTO M328 (this requires an auto start/stop) and currently certified on the Iowa DOT test strips or other state test strips approved by the Iowa DOT. For all surfaces other than dense graded HMA, a large footprint laser is required.
 - b. California or Ames Engineering type, 25-foot profilograph. See Figure 1 or Figure 2.

REWRITE, PLEASE READ CAREFULLY



Figure 1 Ames Engineering profilograph



Figure 2 California profilograph

Note: a California or Ames Engineering type, 25-foot profilograph may only be used for internal information or for testing and evaluation under Section

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2428, Smoothness of Bridge Decks and Bridge Deck Overlays.

- c. Ten-foot straight edge or a 10-foot straight edge software simulation.
 - d. Distance measuring wheel or tape.
 - e. Latest version of ProVAL software. <http://www.roadprofile.com/proval-software/current-version/>
 - f. Latest version of the Iowa DOT Spreadsheet, Profile Summary Sheet and the current ProVAL template.
https://iowadot.gov/construction_materials/Materials-forms
2. Profiler Approval-All profilers must be checked and approved by the Iowa DOT Materials Laboratory before each construction season for proper operation. Profilers checked and approved in another state in the current year may be approved. Submit a request to Special Investigations Engineer for consideration of approval.
- a. Inertial Profilers
 - i. ProVAL will be used to analyze the inertial profiler files. The criterion for approval includes High pass and low pass filters set to 0. All other settings according to manufacturer’s recommendation (The settings used for approval will be the same used throughout the season).
 - ii. Submittal of 10 good runs of the test strip as ProVAL readable files.
 - iii. The DMI distance shall be within 0.15% of the actual test strip distance.
 - iv. The equipment repeatability score with the IRI filter shall be 0.90 or greater.
 - v. The equipment accuracy score with the IRI filter shall be 0.88 or greater when compared to the reference profiler.
 - vi. The average IRI shall be within 5% of the reference profiler IRI.
 - b. California or Ames Engineering type, 25-foot profilograph.
 - i. Contact the Special Investigations Engineer to arrange for verification of calibration with the Iowa DOT test equipment. The units shall be within 0.5 inches per mile on the 0.2-inch blanking band. Re-evaluation may be required if the unit fails to correlate with the Iowa DOT monitor testing.
 - ii. Only computer reductions will be allowed for official reports.
 - iii. Settings-Below are the settings that shall be used for testing in Iowa.

Table (1)-PROFILOGRAPH FACTORS / PROFILER CALIBRATION

		Filter Settings	Tire Pressure	
			LOW PASS/ DATA	OTHER
MANUFACTURER	COMPUTER	2.0	170kPa (25 PSI)	---
AMES or CA PROFIOGRAPH	X	2.0	X	---
AMES LISA	X	2.0	---	10 PSI

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MCCRACKEN	X	2.0	X	---
SSI	X	2.0	X	---
HIGH SPEED PROFILER	X	2.0	---	As Calibrated

Table (2)-PROFILOGRAPH/ PROFILER REDUCTION SETTINGS

Blanking Band*	0.20 inches
Scallop Rounding	0.01 inches
Minimum Scallop Height	0.03 inches
Minimum Scallop Width	0.08 inches on trace (2.0 ft. actual distance)
Filter Type	Butterworth
Bump/Dip Height	0.50 inches
Bump/Dip Width	25 feet actual distance

Note: The current versions of the McCracken profilograph software and the Ames LISA software have a filter called a blanking band filter factor or high pass filter. The filter shall be set to “0” (off) for profilograph testing unless otherwise directed by the DME.

- c. Checks, calibrations, and verification of subsystems vary by manufacturer. Follow the manufacturer’s recommended procedures and frequencies at an interval no longer than the Iowa DOT’s required interval to ensure proper profile collection.
3. Test Procedure
- a. The contractor (or sub-contractor) responsible for smoothness testing shall give the Project Engineer and the DME, District Materials Engineer, 48-hour notice prior to testing so the District Materials Office may provide verification testing.
 - b. Dirt and debris may affect collection of the profile. Excessive mud or caked mud must be removed prior to testing. A grader blade or power broom will knock concrete crumbs off longitudinal or transverse grooving.
 - c. Perform the warmup and checks of the profiler.
 - d. For most profilers, the tire pressures should be maintained at the same pressures as when the distance was last calibrated.
 - e. For inertial profilers it is advisable to do a bounce test and vertical height test on the sensors before beginning testing.
 - f. Ensure computer settings are the same as when the unit was approved by the DOT. The high-pass and low pass filter settings should be “0”.
 - g. Test in the direction of traffic whenever possible.
 - h. Test unit positioning and starting points.
 - i. On bridge decks and bridge deck overlays, the California or Ames Engineering type, 25-foot profilograph should start with the rear wheel at beginning of the

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bridge deck. The California or Ames Engineering type, 25-foot profilograph should stop with the front wheel at end of the bridge deck (Figure 3). If using an inertial profiler, start evaluating 16 feet onto the bridge deck. If using an inertial profiler, stop evaluating 16 feet from the end of the bridge deck.

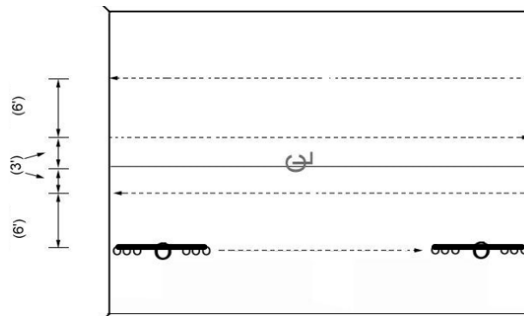


Figure 3- wheel positioning for bridge decks.

- j. When utilizing an inertial profiler on paving, begin collecting profile data for ALR 50' before the beginning header from old to new surface and 50' beyond the header from new to old surface. Correction of ALR determined to be beyond the control of the Contractor will be paid according to [Article 1109.03, B](#). (See Figure 4)
- k. Testing is to be done with the sensors in the wheel paths, 3 feet and 9 feet from the centerline or lane line, for lanes 11 feet to 12 feet wide unless noted otherwise in the contract documents.
- l. For testing on wider lanes such as ramps and loops, position the driver side sensor 3 feet from the left edge line. If the passenger side sensors are within 1 foot of a longitudinal joint, adjust the travel path to the right so the sensor is 2 feet from the joint line.
- m. For testing tapers to and from a full lane, begin or end the section testing when the pavement is either 12' or at the full lane width whichever is less.
- n. Figures 5 and 6 show examples of how to analyze ALR at obstructions defined in [2317.03,B,2,b](#).

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Figure 4-Area of Localized Roughness (ALR) at the beginning of a project. Same at the end of a project.

Note: The ALR at any point covers profile 12.5' back and 12.5' forward.

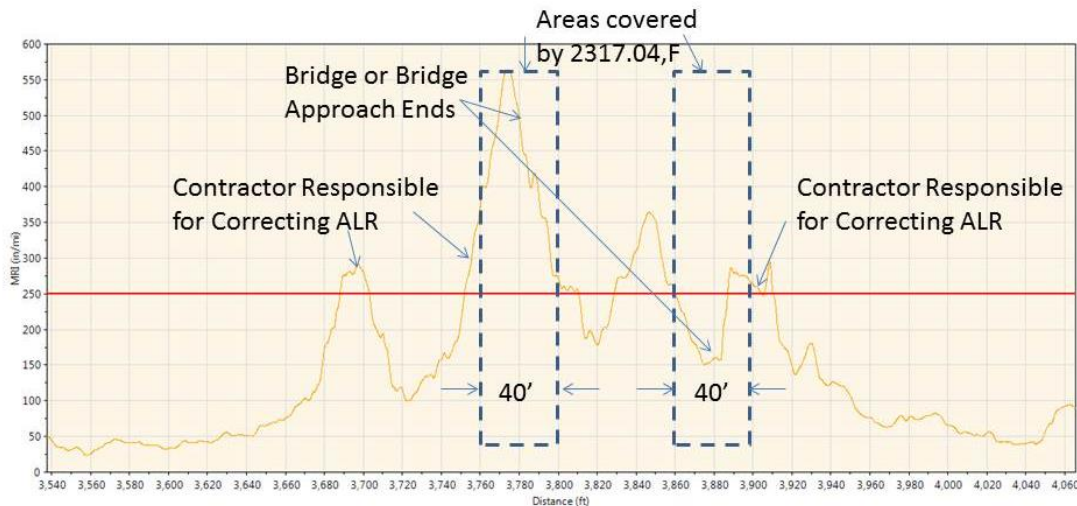


Figure 5-ALR Analysis at the Bridge/Bridge Approach

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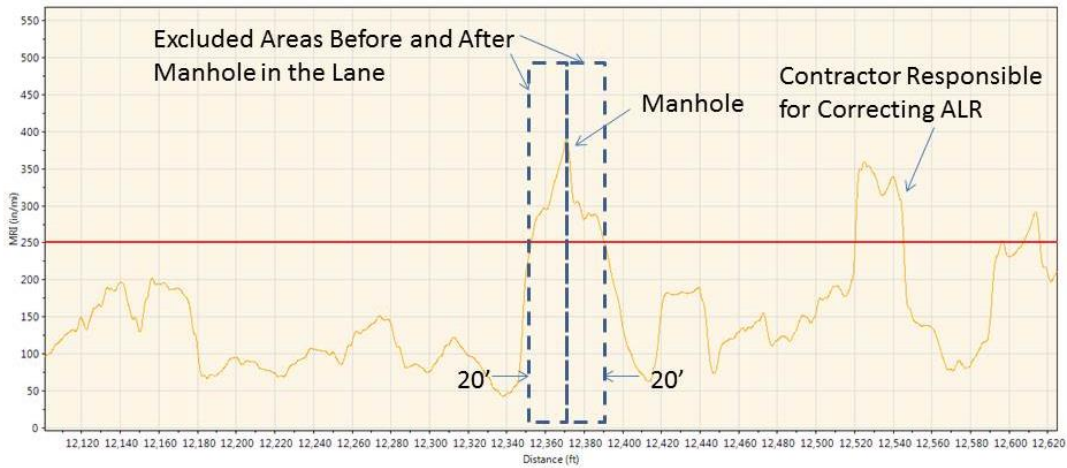


Figure 6-ALR Analysis at the Manhole and Water Valve Boxes

- o. Follow the profiler manufacturer’s recommendations with respect to run-in runouts. Most manufactures require not less than a 300-foot run-in/runout distance. The run-in allows the accelerometers, lasers, and computer to stabilize before the start of the section.
- p. Either mark the intended start and stop location of the section and place reflective cones or strips to trigger the auto start/stop sensor on the profiler or utilize a GPS for accurate location determination.
- q. Use the event feature to mark on the file any reference points such as side road intersections, roadway signs, maintenance markers, stations markers, and mileposts. In the event of rough segments or ALR, this will help the grinding personnel locate the area to grind. (The as driven stationing from the profiler will rarely match the stationing on the roadway unless the roadway is completely flat with no curves. The longer the run of the profiler, the farther the profiler stationing will be off from the plan stationing.)
- r. During the profiler run, use the ignore feature at bridges and bridge approaches to mark areas on the file and exclude the data from the analysis. The profiler still collects data, and it can be recovered later during analysis if the key is pressed inadvertently.
- s. Label the file so it can be easily found and retrieved later. (Project number, direction of traffic, lane, beginning station, ending station in the file name is one way to label)

Note: An example of best practice file name: PROF 95-0354-244 SB OL 841+00 to 625+00

- t. When a segment is corrected by grinding to improve the segment MRI and/or

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ALR, the entire segment must be retested, and a new MRI and/or ALR shall be determined to verify that the corrected segment is in specification compliance.

Note: An example of best practice final file name: PROF 95-0354-244 SB OL 841+00 to 625+00-A (if pavement corrections were required)

- u. Areas identified and corrected in accordance with 2317.04D may be reviewed by the Engineer.

4. Analyzing and Reporting

- a. Use the profiler software export function to export an unfiltered “ERD” file or use any other unfiltered ProVAL readable file.
- b. Use the latest version of ProVAL to perform the MRI and ALR analysis on the files.
- c. Report results on the DOT provided Excel spreadsheet (Figure 6). The sheet can be downloaded at https://iowadot.gov/construction_materials/Materials-forms. The test report is required on this form for project acceptance.
- d. Any areas needing correction will be noted by the software on the spreadsheet. For segments that are ground to correct the MRI, show the corrected MRI and mark the box to the left of the segment to show grinding has been completed on that spreadsheet.
- e. There are three types of reports:
 - i. **Preliminary.** Used by the contractor to submit the report in the timeframe required in the specifications. Any defective areas shall be identified. A final report must follow. A preliminary report is required by Specification 2317.03.B5. If no pavement corrections are required a final report may be issued in lieu of a preliminary report.
 - ii. **Final.** Used to indicate that the report is being submitted for acceptance.
 - iii. **Corrected.** Used to indicate that there was either an error in the final report or that the section was corrected by grinding and retested after the final report was issued.
- f. Roughness shall be reported in inches. Distance shall be reported in feet for MRI (paving) and reported in 1/1000th of a mile (0.001) for Profile Index (bridge decks).
- g. Test report laboratory numbers must be continuous and increasing numerically as each succeeding test is performed. Laboratory numbers shall have a letter added to the end of the original laboratory number for corrected reports
- h. Submit all reports to the Engineer. Submit copies of original profiler files to the Engineer. Label the file(s) with the project as part of the file name.
- i. Keep all original profiler files until validation of the contractor test results has been confirmed.

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j. Example of a completed reports form are shown in Figures 7 through 9.

MANATTS, INC.
P.O. BOX 535
BROOKLYN, IOWA 52211

District 1 Materials
PROFILOGRAPH REPORT

Changes Lab. No. Revised Report

For Information Only Preliminary Final Corrected

Lab No. Route No. 180 Project No.
 Date Reported 7/27/2023 Date Paved NA County POLK
 Tested at: 1/4 point Wheel Track Contractor
 Tested By _____ Date 7/13/2023
 Trace Reduced By COMPUTERIZED Date 7/13/2023

Schedule A Wheel path PCC
 Schedule B HMA

Roadway Type: 2-Lane 4-Lane Ramp Other _____

N.B. Inside Lane E.B. Direction S.B. Outside Lane W.B.
 Centerline Inside Wheel Track Outside Wheel Track 1/4 Point

Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)	Location (Station)	Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)	Avg.	Specification Incentive Numbers Used From:
ENGLISH								Income Deduct
CHECKED APPROACH FOR DEFECTS			32589+95	0.011	0.08	7.55	3.77	
0.011	0.00	0.00	32590+51	0.034	0.24	6.98	6.54	\$3,000
BRIDGE DECK			32592+33	0.011	0.58	54.72	45.75	
0.034	0.21	6.10	32592+33	0.011	0.39	36.79		
0.011	0.39	36.79	32592+94					
0.056	0.60	10.79		0.056	0.90	16.19	13.49	\$3,000 \$0
1/2" Bump Locations								\$3,000

NO CORRECTIVE WORK REQUIRED
 CORRECTIVE WORK REQUIRED
 CORRECTIVE WORK COMPLETED

Copies:
 Special Investigations, Ames
 District Materials Engineer
 Resident Construction Engineer
 Manatts, Inc. - Job Superintendent

Signed By: _____

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract specifications and requirements.

Figure 7-Bridge deck report.


11-May-2023		Profile Summary Sheet			 <small>SMARTER SIMPLER CUSTOMER DRIVEN</small>	
Project Number	xxxxxxxxxxxxxx			Route Type	Primary and Interstate Projects	
Date Measured	9/25/2024			Report Type	Final	
Tested By	xxxx xxxxxx xxxxx			Report Number	xxxxxxxxxxxx	
Direction	Northbound			Smoothness Equation	HMA	
Lane Description	Mainline: Lane 1			Posted Vehicle Speed	> 45 mph	
Design Type/Thickness				HMA>4"		
Stationing	Section 1	Section 2	Section 3	Area of Localized Roughness (ALR)		
Beginning	261+51	424+30		200.0 ≤ ALR < 250.0 (ft.)		
Ending	421+56	470+75		ALR ≥ 250.0 (ft.)		
<small>For use with SS-10013 or 2317 revised for GS-13016</small>						
Grind	Beginning Sta.	Ending Sta.	Segment Length (ft)	Final Smoothness (in/mi)	Segment Pay Adjustment	
<input type="checkbox"/>	261+51	266+79	528	49.81	\$0.00	
<input type="checkbox"/>	266+79	272+07	528	36.91	\$369.45	
<input type="checkbox"/>	272+07	277+35	528	38.45	\$123.18	
<input type="checkbox"/>	277+35	282+63	528	28.42	\$1,500.00	
<input type="checkbox"/>	282+63	287+91	528	29.37	\$1,500.00	
<input type="checkbox"/>	287+91	293+19	528	23.88	\$1,500.00	
<input type="checkbox"/>	293+19	298+47	528	25.25	\$1,500.00	
<input type="checkbox"/>	298+47	303+75	528	26.47	\$1,500.00	
<input type="checkbox"/>	303+75	309+03	528	26.65	\$1,500.00	
<input type="checkbox"/>	309+03	314+31	528	28.62	\$1,500.00	
<input type="checkbox"/>	314+31	319+59	528	25.03	\$1,500.00	
<input type="checkbox"/>	319+59	324+87	528	24.97	\$1,500.00	
<input type="checkbox"/>	324+87	330+15	528	25.45	\$1,500.00	
<input type="checkbox"/>	330+15	335+43	528	22.73	\$1,500.00	
<input type="checkbox"/>	335+43	340+71	528	21.65	\$1,500.00	
<input type="checkbox"/>	340+71	345+99	528	25.11	\$1,500.00	
<input type="checkbox"/>	345+99	351+27	528	26.44	\$1,500.00	
<input type="checkbox"/>	351+27	356+55	528	26.69	\$1,500.00	
<input type="checkbox"/>	356+55	361+83	528	30.28	\$1,429.69	
<input type="checkbox"/>	361+83	367+11	528	26.96	\$1,500.00	
<input type="checkbox"/>	367+11	372+39	528	27.59	\$1,500.00	
<input type="checkbox"/>	372+39	377+67	528	23.99	\$1,500.00	
<input type="checkbox"/>	377+67	382+95	528	20.10	\$1,500.00	
<input type="checkbox"/>	382+95	388+23	528	22.70	\$1,500.00	
<input type="checkbox"/>	388+23	393+51	528	23.87	\$1,500.00	
<input type="checkbox"/>	393+51	398+79	528	23.90	\$1,500.00	
<input type="checkbox"/>	398+79	404+07	528	25.88	\$1,500.00	
<input type="checkbox"/>	404+07	409+35	528	27.69	\$1,500.00	
<input type="checkbox"/>	409+35	414+63	528	28.00	\$1,500.00	
<input type="checkbox"/>	414+63	419+91	528	36.22	\$479.79	
<input type="checkbox"/>	419+91	421+56	165	63.68	\$0.00	
<input type="checkbox"/>	424+30	429+58	528	46.44	\$0.00	
<input type="checkbox"/>	429+58	434+86	528	24.49	\$1,500.00	
<input type="checkbox"/>	434+86	440+14	528	26.45	\$1,500.00	
<input type="checkbox"/>	440+14	445+42	528	28.51	\$1,500.00	
<input type="checkbox"/>	445+42	450+70	528	23.46	\$1,500.00	
<input type="checkbox"/>	450+70	455+98	528	19.50	\$1,500.00	
<input type="checkbox"/>	455+98	461+26	528	27.78	\$1,500.00	
<input type="checkbox"/>	461+26	466+54	528	25.75	\$1,500.00	
<input type="checkbox"/>	466+54	470+75	421	27.21	\$1,196.02	
Total Pay Adjustment					\$51,598.14	
Areas of Localized Roughness Deduction					\$0.00	
Total Pay Adjustment + Areas of Localized Roughness Deduction					\$51,598.14	
Data Entered By	xxxxxxxxxxxxxx	Avg. MRI	27.95	This is to certify that all testing and evaluation herein described has been performed according to applicable contract specifications and requirements.		
Signature/Certification #	xxxxxxxxxxxxxx	Total Distance (ft)	20650.0			

Figure 8-Paving profile summary sheet.

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30-Aug-2024

Profile Verification Sheet

Project Number	XXXXXXXXXX	Report Number	ABC-35-1
Date Measured	9/27/2024	Surface Type	PCC
Tested By	XXXXXXXXXX	Posted Vehicle Speed	> 45 mph
Direction	Northbound	Specification	New 2317
Lane Description	Mainline: Lane 1		

Stationing	Section 1	Section 2	Section 3
Beginning	100+00		
Ending	200+00		
Length (ft.)	10000	0	0

Contractor MRI			
Contractor MRI	40.00		
DOT MRI	42.00		
Difference	2.00	0.00	0.00
Tolerance	4.10	0.00	0.00
Verified	Yes		

1/2" Bumps and Dips	
Contractor Bumps/Dips	
DOT Bumps/Dips	

Contractor Area of Localized Roughness (ARL)	
200.0 ≤ ARL < 250.0 (ft)	
ARL ≥ 250.0 (ft)	

DOT Area of Localized Roughness (ARL)	
200.0 ≤ ARL < 250.0 (ft)	
ARL ≥ 250.0 (ft)	

Totals	
Length (ft.)	10000
Contractor PI (in./mi.)	40.00
DOT PI (in./mi.)	42.00
Difference	2.00
Tolerance	4.10
Verified	Yes

Comments:

Verified as tested- xxx

Data Entered By	XXXXXXXXXX
Signature/Certification #	XXXXXXXXXX

This is to certify that all testing and evaluation herein described has been performed according to applicable contract specifications and requirements.

Figure 9-profile verification sheet. To be used by the Iowa DOT Staff.

- k. Certification -Use a trained, certified person to do the testing, evaluation, and reporting. The certification information is in [Materials IM 213](#).

5. **VALIDATION OF CONTRACTOR TEST RESULTS**

- A. In order to use the Contractor test results in the acceptance decision, the results must be validated by District Materials Staff.
- b. The Contractor (or subcontractor responsible for testing) shall contact the appropriate District Materials office 48 hours prior, but in the case District Materials cannot be present the District Materials Office will perform verification

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- testing within 1 month from receiving final test reports provided that the pavement is available and suited for testing. The validation tolerances are in [IM 216](#).
- c. When the Contractor test results cannot be validated, the District Materials Office will promptly notify the Contractor and begin the dispute resolution process. Testing disputes arising between the Contracting Agency and the Contractor shall be resolved in a reliable, unbiased manner. This may involve an evaluation performed by the Iowa DOT Central Materials Laboratory. Resolution decisions by the Iowa DOT Central Materials Laboratory will be final.
 - d. The District Materials Engineer will select some or all the following steps for the dispute resolution:
 - i. Check all numbers and calculations.
 - ii. Review testing procedures.
 - iii. Compare profiles and dates of testing.
 - iv. Check equipment operation, calibrations and tolerances.
 - v. Perform side-by side tests.
 - vi. Involve the Central Materials Laboratory.
 - vii. If the discrepancy cannot be resolved using the steps listed above, or if it is determined that the Contractor's testing is in error, then the Agency test results will be used for the acceptance decision for the project.

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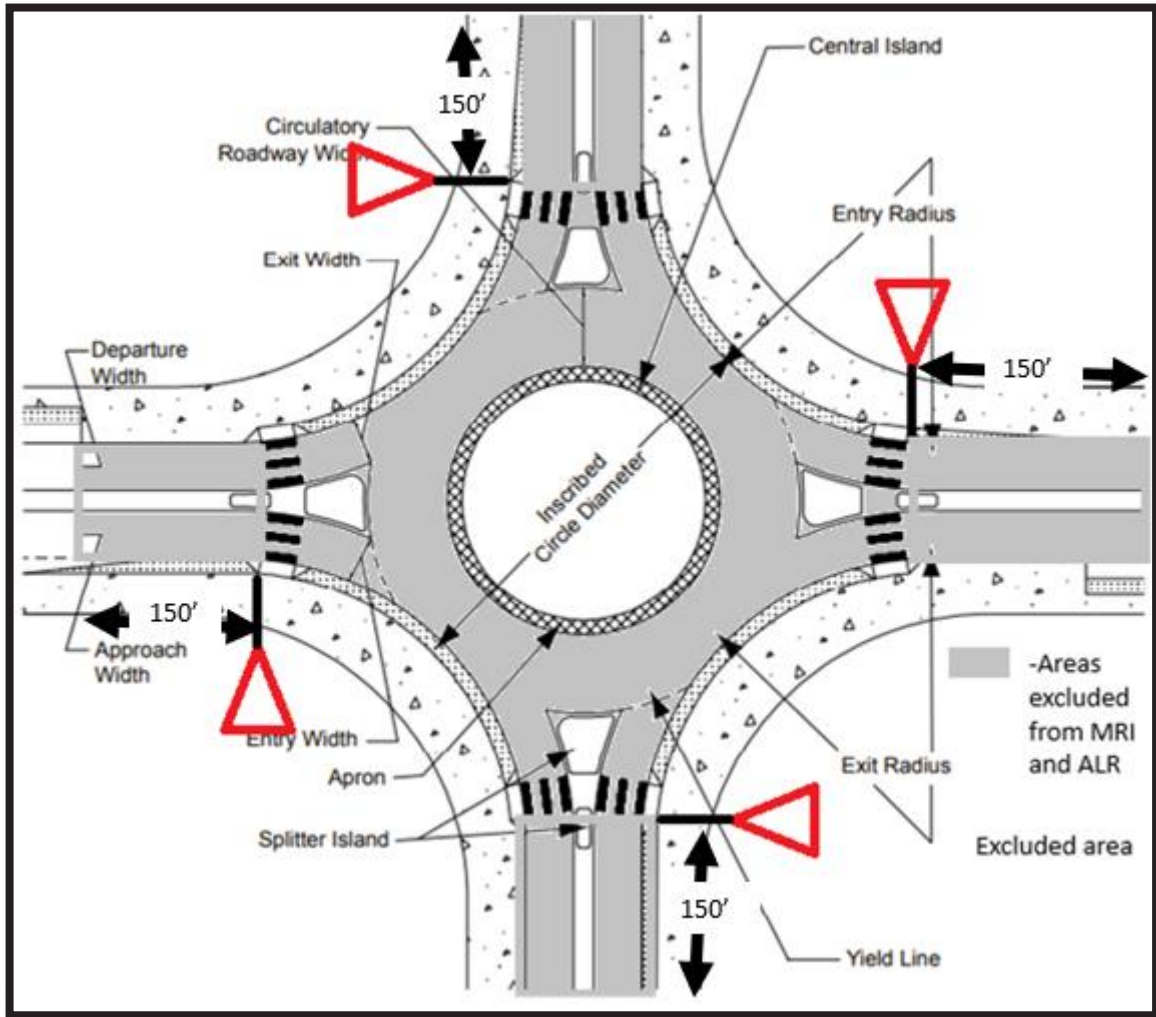


Figure 10- Basic Geometric Elements of a Roundabout

Note: Unless otherwise specified, the greater of the length of the tapered approaches and returns, or the first 150' of road connections are excluded from MRI and ALR evaluation.

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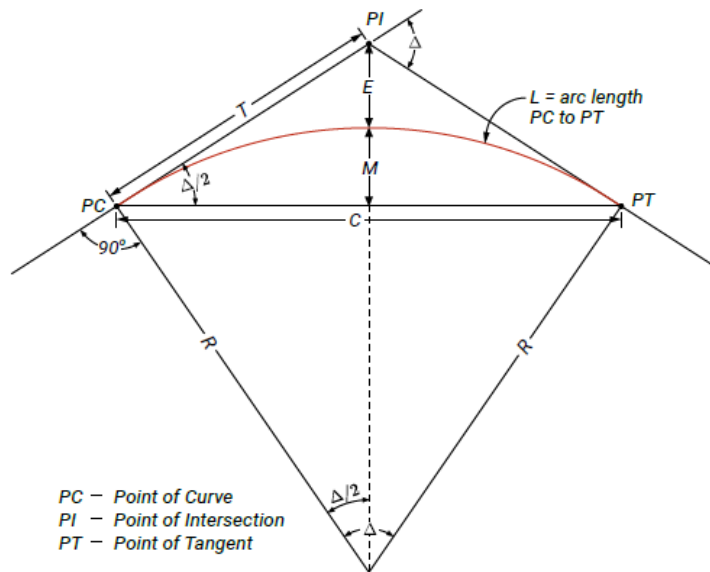


Figure 11- Basic Geometric Elements of a Simple Ramp Curve (image from Chapter 2 of the IA DOT Design Manual)

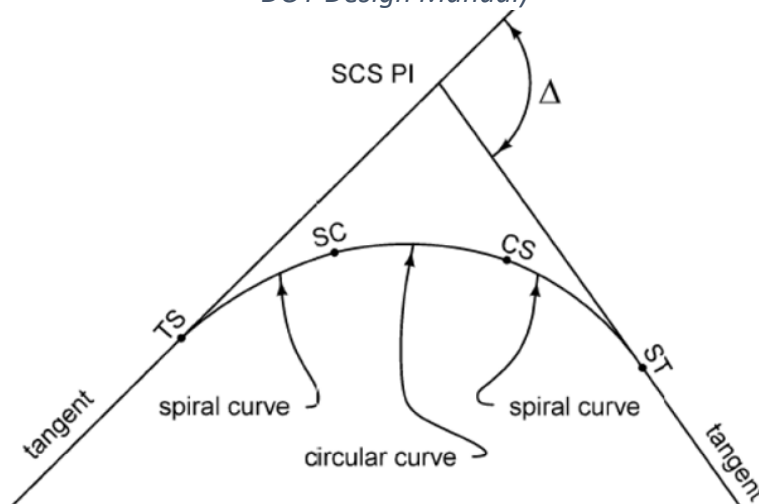


Figure 12- Basic Geometric Elements of a Ramp Spiral (image from Chapter 2 of the IA DOT Design Manual)

TS=Point of change from a Tangent to a Spiral curve
 SC=Point of change from Spiral curve to Circular curve.
 CS=Point of change from Circular curve to Spiral curve.
 ST=Point of change from Spiral curve to Tangent.

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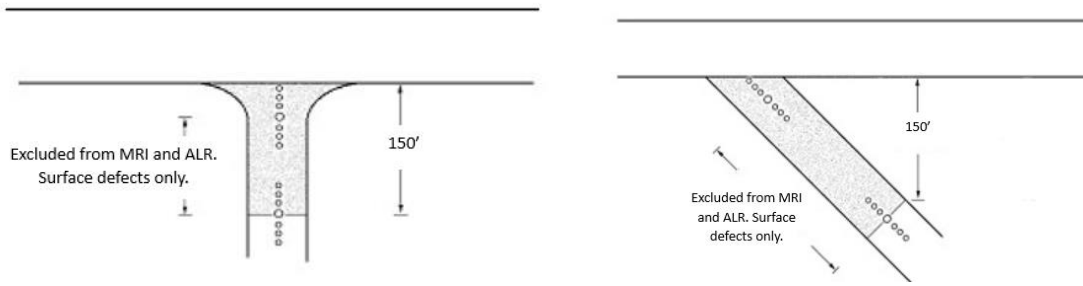


Figure 13-SIDE ROAD CONNECTIONS

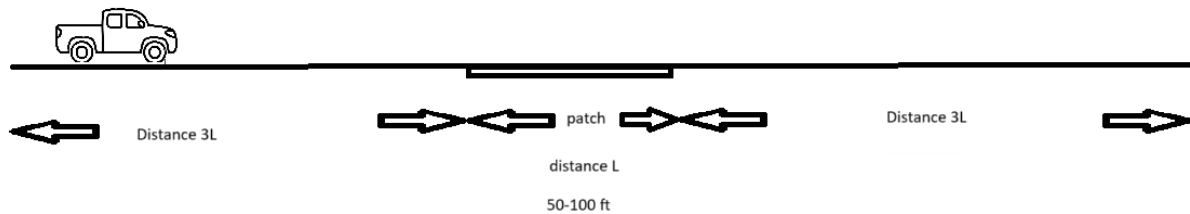


Figure 14-Testing of patches (50-100').

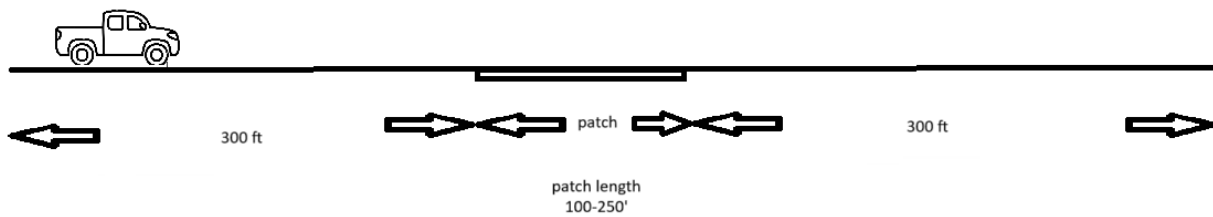


Figure 15-testing of patches (100-250').

Terms and Definitions

Acceleration lane	A short traffic lane designed to permit vehicles entering a road to accelerate to the speed limit of the road prior to merging with existing traffic.
ALR	the Area of Localized Roughness (ALR) based on a continuous MRI computed over a 25-foot distance as determined by the latest version of ProVAL.
Auxiliary lane	A lane other than a through lane, used to separate entering, exiting or turning traffic from the through traffic.

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Auxiliary lanes	Supplemental lanes that provide additional capacity between interchange ramps or along a series of interchanges.
Average Profile Index	Total Inches divided by Total Miles for each segment. Used in Specification 2428.
Corrected Report	A report that indicates an error on the original final report has been corrected.
Final Report	A report that is submitted after the testing, evaluating and surface corrections have been done.
MRI	The index used for determining the pavement smoothness is the Mean Roughness Index (MRI) per segment as determined by the latest version of the FHWA’s software, ProVAL.
Notification	The contractor or sub-contractor responsible for smoothness testing shall give the Project Engineer and District Materials Engineer 48 hours notice prior to testing.
Partial Segment	A partial segment may result from an interruption of the continuous pavement surface with the previous adjacent segment.
PI	The Profile Index often abbreviated as the PI. Measured roughness in inches divided by the length in miles. Utilized under specification 2428.
Preliminary report	A report that is submitted prior to any surface corrections.
Ramp	A short section of road that allows vehicles to enter or exit a controlled-access highway. Defined as the area between the PC, Point of Curvature, or TS, Point of change from Tangent to Spiral curve, and PT, Point of Tangency, or ST, Point of change from Spiral curve to Tangent.
Roundabout	A roundabout, a rotary and a traffic circle are types of circular intersection or junction in which road traffic is permitted to flow in one direction around a central island. Unless otherwise specified, the first 150’ of road connections are excluded from MRI and ALR evaluation.
Section	A section of the total of all segments in a day’s run per lane. Each lane is tested and evaluated separately.
Segment	A segment is a continuous area of finished pavement of 0.100 mile in length (PI) or 528 feet (MRI) and one lane in width.

REWRITE, PLEASE READ CAREFULLY

Testing Direction	Testing direction may be performed in either direction of traffic. Whenever possible, it is desirable to test and reduce traces in the direction of traffic.
Travel Lane	A lane for the movement of vehicles travelling from one destination to another, not including shoulders.
Turn Lane	A lane used primarily to separate turning traffic from through traffic. Turn lanes can also be used by vehicles as a deceleration area when leaving the major street.

**2301 & 2303
PAVING SPECS**

Section 2301. Portland Cement Concrete Pavement

2301.03 CONSTRUCTION

H. Finishing and Texture

4. Smoothness.

- a. Construct the pavement to have a smooth riding surface within the following tolerances:
 - 1) Periodically check the pavement longitudinally with a 10-foot straightedge. ~~The surface is not to deviate from a straight line by more than 1/8 inch in 10 feet.~~
 - a. The Engineer may determine and identify irregularities of 1/2 inch or more in 25 feet longitudinally.
 - b. Correct the irregularities identified by the Engineer.
 - 2) If slip form methods are used, the 6 inches nearest the edge may exceed the 1/8-inch tolerance but is not to exceed 1/2-inch deviation in 10 feet.
 - 3) Where abutting pavement is to be placed adjacent to the pavement being checked, the surface is not to deviate by more than 1/4 inch when checked 1 inch from the edge with:
 - A 3-foot straightedge used transversely, and
 - A 10-foot straightedge used longitudinally.
- b. Apply [Section 2317](#) to all PCC Pavement bid items of a Primary project or when specifically required for other projects.

Section 2303. Flexible Pavement

2303.03 Construction.

D. Quality Assurance Program.

6. Acceptance of Asphalt Mixtures.

e. Smoothness.

- 1) Apply [Section 2317](#) to HMA surface mixture bid items of a Primary project or when specifically required for other projects.
- 2) On all projects, the Engineer may determine and identify irregularities of 1/2 inch or more in 25 feet longitudinally. Correct the irregularities identified by the Engineer in accordance with [Section 2317](#).

2317

PAVEMENT SMOOTHNESS

Section 2317. Pavement Smoothness

2317.01 GENERAL.

Evaluate pavement smoothness for all Interstate and Primary main line pavement surfaces, and all other road surfaces included on Primary projects, except when specifically excluded or modified by the contract documents. For non-Primary projects, do not evaluate pavement smoothness unless specified in the contract documents. If this specification is required by contract documents on non-Primary projects let by the Department, it will be added in its entirety. Selected portions of the specification will not be deleted.

- A. Main line pavement is defined as all permanent pavement for through lanes.
- B. The index used for determining the pavement smoothness is the Mean Roughness Index (MRI) per segment as determined by the latest version of the FHWA's software, ProVAL.
- C. The other measure of pavement smoothness is the Area of Localized Roughness (ALR) based on a continuous MRI computed over a 25-foot distance as determined by the latest version of ProVAL.
- D. A pavement segment is defined as a continuous area of finished pavement 0.1 mile in length and one lane (10 to 12 foot nominal) in width. A partial segment may result from an interruption of the continuous pavement surface (in other words, bridge approaches, side road tie-ins, the completion of the daily paving operations, and so forth). Pay adjustments will be prorated for partial segments. If a segment is less than 100 feet in length and requires corrective work, the Engineer will waive the corrective work requirement for the segment and instead assess a prorated disincentive. The Contracting Authority will still subject the segment to ALR correction in accordance with Table 2317.05-1 and Table 2317.05-2.

2317.02 EQUIPMENT.

- A. Provide and operate an inertial profiler meeting the requirements of AASHTO M328 and [Materials I.M. 341, Appendix A](#). Ensure the operator is trained and certified to operate the profiler as required by the Contracting Authority.
- B. For corrective work by diamond grinding, use grinding and texturing equipment meeting the requirements of [Section 2532](#).

2317.03 TESTING AND EVALUATION.

A. Testing.

1. Obtain profiles of both wheel paths for each lane according to the procedures shown in [Materials I.M. 341, Appendix A](#). The wheel paths are defined as 3 feet and 9 feet from the center line or lane line. Average the two wheel path profile indexes for each segment.
2. The Engineer may use an inertial profiler, 10 foot straightedge, or other means to detect irregularities in excluded surface areas or areas outside the required wheel paths for required corrective action.
3. Test bridge approaches according to [Section 2428](#).
4. Test the pavement within 5 working days of completion of paving.
5. Paved shoulders will be excluded from smoothness testing. When used as a temporary driving surface, evaluate paved shoulders for ALR. Take corrective action for ALR greater than 250.0 inches/ mile.

B. Evaluation.

1. Determine an MRI using the latest version of the ProVAL "Ride Quality" or "Smoothness Assurance" analysis and following the procedures shown in [Materials I.M. 341, Appendix A](#) for each segment of finished pavement surface with a posted speed or advisory speed over 45 mph except for:
 - a. Roads intersecting the mainline pavement less than 600 feet in length.
 - b. Road connections 150 feet before an intersection that end at a stop sign (or a yield sign at roundabouts).
 - c. Twenty feet on either side of bridges, bridge approaches, existing EF joints, manholes, or water valve boxes in the lane that the obstruction is located.
 - d. Ramps and loops.
 - e. Bridge approaches (evaluated according to [Section 2428](#)).
 - f. Storage lanes, turn lanes, and other auxiliary lanes less than 1000 feet.
 - g. Pavement less than 8.5 feet in width.
 - h. Single lift flexible pavement overlays 2 inches thick or less, unless the existing surface has been corrected by milling or scarification.
 - i. Single lift flexible pavement overlays 2 inches thick or less placed directly on PCC pavement.

- j. Paved shoulders.
 - k. Detour pavement.
 - l. Crossovers.
 - m. Individual sections of pavement less than 100 feet in length.
 - n. Roundabouts
2. Determine ALR using the latest version of the ProVAL "Smoothness Assurance" analysis and following the procedures shown in [Materials I.M. 341, Appendix A](#) for each segment of finished pavement surface with a posted or advisory speed over 35 mph except for:
 - a. Side road connections 150 feet before an intersection that end at a stop sign (or a yield sign at roundabouts).
 - b. Twenty feet on either side of bridges, bridge approaches, manholes, existing EF joints, or water valve boxes in the lane that the obstruction is located.
 - c. Bridge approaches (evaluated according to [Section 2428](#)).
 - d. Pavement less than 8.5 feet in width.
 - e. Paved shoulders (unless used as a temporary driving surface).
 - f. Detour pavement.
 - g. Crossovers.
 - h. Individual sections of pavement less than 50 feet in length.
 3. The Engineer may determine and identify irregularities of 1/8 inch or more in 10 feet longitudinally for excluded surface areas or areas outside the required wheel paths.
 4. Submit all final profile summary sheets and all ALR graphs to the engineer within 14 calendar days following completion of paving on the project. If requested by the engineer, provide the ProVAL files. When all the testing is done at the completion of paving on the project, provide the engineer the ProVal files along with the profile summary sheets.
 5. Submit all preliminary profile summary sheets on provided form (https://iowadot.gov/Construction_Materials/materialsforms/ProfileSummarySheet.xlsx) and final ProVAL compatible files to the Construction and Materials Bureau via email to smoothness.cmb@iowadot.us following completion of paving on the project.

2317.04 CORRECTIVE ACTIONS.

A. General.

1. Pavement will be evaluated in 0.1 mile segments using the inertial profiler, to determine pavement segments where corrective work or pay adjustments will be necessary.
2. Within each 0.1 mile segment, correct all ALR identified as grind in table 2317.05-1 or table 2317.05-2 regardless of the MRI value. Take corrective action.
3. Separately identify ALR.
4. On lanes over 8.5 feet in width, for through traffic which requires matching the surface of the new pavement to the surface of an existing pavement, Determine the MRI and ALR for the existing lane. Compare the MRI values and ALR areas according to [Materials I.M. 341, Appendix A](#). If the MRI and ALR for the new pavement are less than the MRI and ALR for the existing surface, no negative payment adjustment or correction for MRI or ALR will be required.

B. MRI Correction.

Correct all 0.1 mile segments having an initial MRI of greater than those tolerances shown in Article 2317.05. Correct these segments to reduce the MRI to that shown in Table 2317.05-3 through Table 2317.05-6. The Contractor has the option to replace these segments. On segments where corrections are made, test the entire 0.1 mile segment of pavement to verify that corrections have met the MRI as shown in Table 2317.05-3 through Table 2317.05-6.

C. ALR Correction.

Correct ALR greater than those tolerances shown in Article 2317.05. Correct these segments to reduce the ALR to that shown in Table 2317.05-1 or Table 2317.05-2. The Contractor has the option to replace these areas. On segments where corrections are made, test the entire 0.1 mile segment of pavement to verify that corrections have met ALR level shown in Table 2317.05-1 or Table 2317.05-2.

Provide the engineer an image file for each area of ALR greater than 250 Inches per mile. Use the 0.1 mile scale setting and label the file with the station location, lane, and direction.

D. Engineer Identified Irregularities.

Correct areas over 1/8 inch in 10 feet identified by the Engineer.

E. Bridge Approach Sections.

Correct bridge approach sections according to [Section 2428](#).

F. Corrective Work.

When the Contractor is not responsible for the adjoining surface, ALR in the 45 feet at the beginning or end of a section will be reviewed by the Engineer. Correction of ALR determined to be beyond the control of the Contractor will be paid according to [Article 1109.03, B](#). Correct ALR determined to be under the control of the Contractor and resulting from the Contractor's operations. Complete the corrective work prior to determining pavement thickness. Do not use bush hammers or other impact devices.

1. PCC Pavement.

On PCC pavement, make corrections using an approved profiling device or by removing and replacing the pavement. Apply corrective methods to the full lane width. Ensure, when completed, the corrected area (full lane width) has uniform texture and appearance, with the beginning and ending of the corrected area squared normal to centerline of the paved surface. Where surface corrections are made, grooving will not be required.

2. HMA Pavement.

- a. On HMA pavement, make corrections by diamond grinding, by overlaying the area, by replacing the area, or by inlaying the area. If the surface is corrected by diamond grinding, perform the same work and use the same equipment as specified for PCC pavement, except cover the ground surface with a seal coat according to [Section 2307](#), with the following modifications:
 - 1) The binder bitumen may be the emulsion or cutback asphalt used for tack coat, applied at a rate of 0.10 gallon per square yard. Hand methods may be used for spraying.
 - 2) Apply a cover aggregate consisting of sand (slightly damp, but with no free moisture as determined by visual inspection) at a rate of 10 pounds per square yard. Hand methods may be used for spreading. Embed cover aggregate with at least one complete pneumatic roller coverage.
 - 3) This seal coat is intended to be placed immediately after the diamond grinding is completed in the travel lane. Do not place when road surface temperatures are below 60°F, unless approved by the Engineer.
 - 4) Labor, equipment, and materials used for this seal coat are incidental to other items and will not be paid for separately.
- b. If the surface is corrected by overlay, replacement, or inlay, begin and end the surface correction with a transverse saw cut normal to the pavement lane lines or edge lines within any one area. The profile of the surface must be smooth with no bumps or dips at the beginning or end of correction.
- c. Overlay correction must be for the entire pavement width. Pavement cross slope must be maintained through the corrected areas.

G. Verification Testing.

1. The Engineer will perform verification testing to validate the Contractor's certified quality control testing. If the Engineer's verification test results validate the Contractor's test results, the Contractor's results will be used for acceptance. Disputes between the Contractor's and Engineer's test results will be resolved according to [Materials I.M. 341, Appendix A](#).
2. The Engineer may test the entire project length if it is determined that the Contractor certified test results are inaccurate. The Contractor will be charged for this work at a rate of \$800.00 per lane-mile, with a minimum charge of \$1500.00.
3. Furnishing inaccurate tests may result in decertification of the Contractor's certified operator.

2317.05 PAY ADJUSTMENTS.

A. General.

1. Pay adjustments will be based on the initial MRI determined for the segments prior to performing any corrective work. Areas excluded from Inertial profiler testing and bridges approaches will not be subject to price adjustments.
2. If the Contractor elects to remove and replace the segments, the Contractor will be paid the price adjustment that corresponds to the initial index obtained on the pavement segments after replacement.
3. When the plans dictate that an area of pavement is to be hand finished, the area will not be subject to reduced payment. However, the area is to be profiled and corrected as necessary to meet these specifications.

B. Areas of Localized Roughness

The payment for areas of localized roughness will be adjusted as shown in Table 2317.05-1 and Table 2317.05-2.

Table 2317.05-1: Schedule for Adjustment Payment for Areas of Localized Roughness for Primary and Interstate Projects

ALR in 25 Foot Continuous Mean International Roughness Index (MRI) Inches per mile	Dollars per foot of pavement length per lane
200.0 to 250.0	-30.00 or grind ¹
Greater than 250.0	Grind ¹
1. Correct these areas to below 200.0 inches per mile	

Table 2317.05-2: Schedule for Adjustment Payment for Areas of Localized Roughness for Non-Primary Projects

Segment Speed/Type	ALR in 25 Foot Continuous Mean International Roughness Index (MRI) Inches per mile	Dollars per foot of pavement length per lane
Speed greater than 45mph	200.0 to 250.0	-15.00 or grind ¹
	Greater than 250.0	Grind ¹
	1. Correct these areas to below 200.0 inches per mile	
Speed less than or equal to 45mph or curbed	250.0 to 300.0	-15.00 or grind ¹
	Greater than 300.0	Grind ¹
	1. Correct these areas to below 250.0 inches per mile	

C. PCC Pavement.

The payment for MRI for PCC pavement will be adjusted as shown in Table 2317.05-3 and Table 2317.05-4.

Table 2317.05-3: Schedule for Adjustment Payment for PCC Pavements for Primary and Interstate Projects

MRI (inches per mile)	Dollars per 0.1 mile segment per lane	
	Design Thickness	
	Full Depth (>6")	Overlay (<=6")
Less than 47.5	1,500.00	1,250.00
47.5 to 57.5	8,625.00-(150*MRI)	5,226.596-(133.2623*MRI)
57.5 to 75	Unit Price	Unit Price
75 to 90	7,500.00-(100*MRI) (or grind ¹)	6,250.00-(83.333*MRI) (or grind ¹)
Greater than 90	Grind ¹	Grind ¹
1. Correct these areas below 75.0 inches per mile		

Table 2317.05-4: Schedule for Adjustment Payment for PCC Pavements for Non-Primary Projects

MRI (Inches per mile)	Dollars per 0.1 mile segment per lane
Less than 60.0	300.00
60.0 to 70.0	2,100.00-(30*MRI)
70.0 to 80.0	0.00
80.0 to 95.0	1,600.00-(20*MRI) or grind ¹
Greater than 95.0	Grind ¹
1. Correct these areas to below 80.0 inches per mile	

D. HMA Pavement.

The payment for MRI for HMA pavement will be adjusted as shown in Table 2317.05-5 and Table 2317.05-6.

Table 2317.05-5: Schedule for Adjustment Payment for HMA Pavements for Primary and Interstate Projects

MRI (inches per mile)	Dollars per 0.1 mile segment per lane	
	Design Thickness	
	Full Depth (>4")	Overlay (<=4")
Less than 29.84	1,500.00	1,250.00
29.84 to 39.22	6,271.915-(159.915*MRI)	5,226.596-(133.2623*MRI)
39.22 to 75	Unit Price	Unit Price
75 to 90	7,500.00-(100*MRI) or grind ¹	6,250.00-(83.333*MRI) or grind ¹
Greater than 90	Grind ¹	Grind ¹
1. Correct these areas below 75.0 inches per mile		

Table 2317.05-6: Schedule for Adjustment Payment for HMA Pavements for Non-Primary Projects

MRI (Inches per mile)	Dollars per 0.1 mile segment per lane
Less than 35.0	300.00
35.0 to 45.0	1,350.00-(30*MRI)
45.0 to 80.0	0.00
80.0 to 95.0	1,600.00-(20*MRI) or grind ¹
Greater than 95.0	Grind ¹
1. Correct these areas to below 80.0 inches per mile	

2428
BRIDGE DECKS

Section 2428. Smoothness of Bridge Decks and Bridge Deck Overlays

2428.01 DESCRIPTION.

Test and evaluate smoothness of bridge decks and bridge deck overlays. Perform surface correction if required.

2428.02 TESTING AND EVALUATION.

A. General.

1. Except when specifically excluded in the contract documents, evaluate smoothness for all:
 - a. Interstate and Primary bridge decks, new approaches and bridge deck overlays, and overlaid approaches.
 - b. Non-Primary bridge decks, new approaches and bridge deck overlays, and overlaid approaches for projects where the Department is the Contracting Authority.
2. If this specification is required by contract documents on non-Primary projects let by the Department, it will be added in its entirety. Selected portions of the specification will not be deleted.

B. Measurement.

Provide and operate an Ames type or California profilograph or an inertial profiler to produce a profilogram (profile trace) of the surface tested according to [Materials I.M. 341](#).

C. Profilograph Testing.

1. Remove all objects and foreign material from the deck surface, including protective covers, if used, prior to testing by the Engineer. If appropriate, properly replace protective covers after testing.
2. A profilogram will be made by a test in each wheel path of each traffic lane. The profilogram will include a minimum of 16 feet beyond the bridge section when there is adjoining pavement. Bridge decks and bridge deck overlays will be treated as one section. The profilogram will include a minimum of 100 feet beyond the approach section when there is adjoining pavement.
3. For bridge lengths of 778 feet or less, each traffic lane is a segment. For bridges longer than 778 feet, a segment shall be 0.1 miles of the traffic lane. If the remaining segment is 250 feet or less in length, it is included in the adjacent bridge segment. If the remaining segment is more than 250 feet in length, it is evaluated on its own. When bridge deck overlay expansion joints are not new or replaced, segments begin and end at the expansion joints.
4. Each bridge approach lane is a separate segment.
5. Perform quality control testing and furnish the profilogram results to the Engineer. Ensure:
 - Testing and evaluation are done by a trained and certified person, and
 - The evaluation is certified according to [Materials I.M. 341](#).

D. Profile Index.

1. Calculate an average profile index for each segment from the two wheel path profilograms, according to [Materials I.M. 341](#), except for:
 - a. Bridge decks or bridge deck overlays less than 100 feet in length.
 - b. New bridge approach sections or bridge approach overlays less than 100 feet in length.
 - c. Bridge decks for new concrete slab bridges.
 - d. The 16 feet at the ends of the section.
 - e. The 16 feet on each side of the expansion joints that are not new or replaced.
2. Limits for average profile index per 0.1 mile are as follows:

New Bridge Deck	less than 22.1 inches/mile
Bridge Deck Overlay	less than 15.1 inches/mile
Bridge Approach (New or Overlaid)	less than 22.1 inches/mile
3. The Engineer will perform verification testing to validate the Contractor's certified quality control testing. If the Engineer's verification test results validate the Contractor's test results, The Contractor's results will be used for acceptance. Disputes between the Contractor's and the Engineer's test results will be resolved according to [Materials I.M. 341](#). The Engineer may test the entire project length if it is determined the Contractor's certified test results are inaccurate. The Contractor will be charged for this work at a rate of \$500 per bridge deck. In addition, providing inaccurate test results may result in decertification.

4. On deck placements less than 100 feet, test and evaluate each lane of placements. Provide the Engineer with the final trace and index and the final evaluation within 14 calendar days of deck completion.
5. On deck placements of 100 feet or more, provide the Engineer with the initial profile trace and index for each lane by noon of the fifth working day following each of the first row placements. On subsequent placements, provide the Engineer with the trace and index following every third placement until the deck is completed. On single-pour bridges, provide the Engineer with the final profile trace and index and the final evaluation within 2 weeks of deck completion.

2428.03 SURFACE CORRECTION.

- A. Perform surface correction for the full segment width of the paved surface.
- B. Obtain the Engineer's approval for all correction work. After all required correction work is completed, determine the final profile index.
- C. Accomplish surface correction by grinding or by other methods the Engineer approves. Perform the work as identified in [Section 2532](#).
- D. Perform surface correction parallel to lane lines or edge lines as directed by the Engineer. Make each pass parallel to the previous passes. Grind the surface to a uniform texture.
- E. Do not overlap adjacent passes more than 1 inch or have a vertical difference of more than 1/8 inch as measured from bottom of groove to bottom of groove.
- F. Begin and end smoothness correction at lines normal to the lane lines or edge lines within any one corrected area. Proceed from the center line or lane line toward the edge to maintain cross slope.
- G. Maintain cross slope throughout the corrected area.
- H. Perform corrective grinding prior to longitudinal grooving.

2428.04 BUMPS AND DIPS.

Bumps and dips, including those at headers, on all surfaces for which smoothness is designated will be evaluated.

A. Bumps.

1. Correct all bumps exceeding 0.5 inch within a 25 foot span, as indicated on the profilogram, except as stated in [Article 2428.04, C](#).
2. Corrected bumps will be considered satisfactory when profilograph measurement shows that the bumps were ~~0.3~~ 0.5 inch or less in a 25 foot span.

B. Dips.

1. Correct all dips exceeding 0.5 inch in a 25 foot span, as indicated on the profilogram, only when the Engineer requires, except as stated in [Article 2428.04, C](#). The Contractor will be assessed a price adjustment of \$1600 for each dip exceeding 0.5 inch that is not corrected, except as stated in [Article 2428.04, C](#). When the Engineer requires correction of a dip by grinding, and grinding would result in a cover concrete thickness less than 2 inches, use the following method to correct the dip:
 - Identify limits of dip area,
 - Saw cut 3/4 inches deep at the perimeter,
 - Remove deck concrete to 1 inch below top mat of deck reinforcing, and
 - Place a deck overlay patch in accordance with [Articles 2413.03, D](#); [E, 2 & 3](#); [F](#); [G](#); and [H](#).
2. A dip in both wheel paths at a lane location will be considered a single dip when assessing a price adjustment.
3. Corrected dips will be considered satisfactory when the profilogram shows the dips are less than ~~0.3~~ 0.5 inch in a 25 foot span.

C. Exceptions.

When the Contractor is not responsible for the adjoining surface, bumps and dips in the 16 feet at the end of a section will be reviewed by the Engineer. Correct bumps and dips determined to be under the control of the Contractor and resulting from the Contractor's operations. Correction of bumps and dips determined to be beyond the control of the Contractor will be paid according to [Article 1109.03, B](#).

2428.05 SCHEDULE OF PAYMENT.

The cost of certified profilograph testing and associated traffic control is incidental to the contract unit price for the item for which the testing is required.

A. Incentives.

1. New bridge decks or bridge deck overlays which are designated for smoothness will be evaluated for incentives using the initial profile index and the number of segments on the bridge.
2. For each segment of a bridge to be qualified for an incentive payment, the profilogram for that segment before correction must meet the specification requirement so there is no price reduction.
3. For each segment of the bridge deck or bridge deck overlay, the incentive index is 12.0 inches per mile for new bridge decks, and 4.0 inches per mile for bridge deck overlays. The incentive payment will be according to Table 2428.05-1:

Table 2428.05-1: Incentives

New Bridge Decks		Bridge Deck Overlays	
Initial Profile Index Inches Per Mile Per Segment	Dollars Per Segment	Initial Profile Index Inches Per Mile Per Segment	Dollars Per Segment
0 - 6.0	6000	0 - 2.0	2000
6.1 - 12.0	3000	2.1 - 4.0	1000
12.1 - 22.0	Unit Price	4.1 - 15.0	Unit Price

B. Price Reduction.

1. New bridge decks or bridge overlays which are designated for smoothness will be evaluated for price reduction assessment using the final profile index and the number of segments.
2. The Contractor may grind the surface of the bridge deck to a final index of 22.0 inches per mile or less, or the surface of a bridge deck overlay to a final index of 15.0 inches per mile in lieu of a price reduction.
3. Each segment of bridge deck with a final index of 22.1 inches per mile or greater or bridge deck overlay with a final index of 15.1 inches per mile or greater will be assessed a price reduction according to Table 2428.05-2:

Table 2428.05-2: Price Reduction

New Bridge Decks		Bridge Deck Overlays	
Profile Index Inches Per Mile Per Segment	Dollars Per Segment	Profile Index Inches Per Mile Per Segment	Dollars Per Segment
22.1 - 30.0	2000	15.1 - 20.0	1000
30.1 - 35.0	4000	20.1 - 25.0	2000
35.1 - 40.0	6000	25.1 - 30.0	3000
over 40.0	(a)	over 30.0	(a)
(a) Correction is required to an index of 15.0 inches per mile for overlays and to an index of 22.0 inches per mile for new decks.			

C. Bridge Approach Sections and Overlay of Bridge Approach Sections.

Correct bridge approach sections and overlays of bridge approach sections for smoothness as specified in [Article 2428.03](#) in lieu of a price reduction.

2529
FINISH PATCHES

Article 2529.03, H Full Depth Finish Patches

H. Smoothness.

Apply [Section 2316](#) to smoothness of full depth finish patches (except when the contract includes an overlay or pavement surface repair by diamond grinding or milling within the patch area) with the following modifications for Full Depth Finish Patches (50 feet or greater in length):

1. Smoothness testing and evaluation is required for each patch with a length of 50 feet or more. For full lane width patches, perform the testing near the center of the traffic lane after the patch is placed. For partial lane width patches, perform testing in the patched wheel path.
2. Patches 50 feet to 100 feet in length:
 - a. Test the patch length, and the existing pavement in that lane, for a distance of three times the patch length on both ends of the patch. If a patch occurs near a bridge, an intersection, and so forth, where the proper distance cannot be tested, make up the required total on the other end of the patch. If interference occurs on both ends, test only to the points of interference.
 - b. Establish one Average Base Index (ABI) of the pavement for both ends of patch.
 - c. Calculate a new index for the entire length.
 - d. Compare the new index with the ABI. Perform surface correction according to [Article 2316.03](#) to a profile index less than the ABI when:
 - 1) New profile index exceeds 12.0 inches per mile and exceeds ABI by more than 2.0 inches per mile.
 - 2) New profile index exceeds 30.0 inches per mile and exceeds ABI.
 - e. Corrective action involves correction of bumps and dips exceeding a vertical height of 0.5 inch in a 25 foot span in the patch, if identified from the trace, plus appropriate surface correction within the patch and existing pavement, or both, on either end of the patch within the limits tested.
3. Patches 100 feet to 250 feet in length: [Article 2529.03, H, 2](#), applies, except the length tested is the patch length, and the existing pavement in that lane for a distance of 300 feet on both ends of the patch.
4. Patches over 250 feet in length: Apply the requirements for Chart B pavement, [Section 2316](#).

**2531 & 2532
PAVEMENT SURF. REPAIR**

Section 2531. Pavement Surface Repair (Milling)

Smoothness.

1. The Engineer will partly profile the pavement on the initial trace using the procedure described in [Article 2316.02, B](#). The average profile index for each area may be shown in the contract documents. The bidder is also advised that all profilograph information is available for inspection at the Office of Contracts by a request to the Contracts Engineer.
2. After the contract is awarded, the profilograph information will be available from the Engineer. This information represents a summary of conditions found to exist at the time the survey was made. The availability of this information will not constitute a guarantee that a profile other than that indicated will not be encountered at the time of milling.
3. Provide a control profilograph trace as described in [Article 2316.02, B](#) prior to performing any grinding work. This control trace will be used to identify the required smoothness for the project. Each segment of the finished ground surface is to:
 - Have a final profile index of 35% of the control profilograph trace or 10 inches per mile, whichever is greater, and
 - Not include any bumps exceeding 0.5 inches in 25 feet.
4. When the Engineer approves, the following areas will be excluded from profilograph testing:
 - Depressed pavement areas due to subsidence or other localized causes, and
 - Areas where the maximum cut at mid panel or a fault restricts further milling.
5. End profilograph testing 15 feet prior to excluded areas and resume 15 feet following excluded areas.
6. Test and evaluate the milled surface according to [Section 2316](#), with the following modifications:
 - a. Run the test and evaluate the profilograph using the same procedure as for the control trace.
 - b. Each segment for which continuous milling is designated will be evaluated individually, and it shall meet the smoothness and bump requirements specified above, regardless of its length.
 - c. In excluded areas, smoothness requirements will be modified or may be waived by the Engineer.
 - d. Certify smoothness of the finished surface according to [Article 2316.02, C](#).
 - e. The Engineer may test for smoothness and bumps near the center line and at other spot locations where compliance is questioned. Additional milling may be required.
 - f. Do not use the original and final profilograph trace to determine milling depth.

Section 2532. Pavement Surface Repair (Diamond Grinding)

2532.01 DESCRIPTION.

- A. Use a diamond grinder to grind an existing PCC pavement surface, used as traffic surface, for profile improvement. Perform grinding and texturing at the locations shown in the contract documents. Refer to [Article 2532.03, B, 3](#) for grinding bridge decks.
- B. The existing surface and the coarse aggregate will be described in the contract documents.
- C. This work may involve using a diamond grinder to grind a newly constructed deck surface for temporary surface texture. Perform grinding prior to opening the deck segment to traffic.

2532.02 MATERIALS.

None.

2532.03 CONSTRUCTION.

A. Equipment.

1. Perform grinding and texturing using diamond blades mounted on a self propelled machine that has been designed for grinding and texturing concrete surfaces. Ensure the equipment will not cause strain or damage to the underlying pavement.
2. Provide equipment with an effective wheelbase, or the distance between front wheel assembly transverse pivot point to the profile depth control drive wheels transverse pivot point, of no less than 12 feet.
3. Do not use grinding and texturing equipment that causes excessive ravels, aggregate fractures, spalls, or disturbance of the transverse and/or longitudinal joints.
4. Use grinding equipment with a minimum effective head width of 48 inches. For corrective work, use a minimum effective head of 36 inches.
5. Select the blade type and number of blades per foot (meter) to provide proper surface texture based on the concrete being ground, in particular, the coarse aggregate type.

B. Pavement Surface Repair.

1. General.

- a. Grind and texture the concrete surface in a longitudinal direction.
- b. Ensure the surface, after grinding, is of uniform texture.
- c. When using more than one grinding machine in the same travel lane, use similar blade segment thicknesses, blade spacings, and blade diameters on all machines so the texture of the ground surface is reasonably uniform across the lane.
- d. To be in compliance, the land area and the texture depth shall be within the specified ranges. It may be necessary to adjust the blade spacing during a project to stay within specified ranges.
- e. For multiple passes, carefully control the equipment to minimize the overlap. Ensure overlaps do not exceed 2 inches.
- f. Ensure that, after grinding, the transverse slope of the concrete surface is uniform to a degree that there are no depressions or misalignment of slope greater than 1/4 inch in 12 feet when tested by stringline or straightedge placed perpendicular to the center line.
- g. In order to match the outside edge of the pavement, grind adjacent paved areas (for example shoulders, curb and gutter, turn lanes, tapers, paved crossovers, and so forth) to minimize vertical projections.
- h. The Contractor is responsible for quality control of the texture. The Engineer will conduct random Quality Assurance inspections.
- i. When the coarse aggregate used in the existing pavement is limestone, longitudinally groove the surface after grinding in accordance with [Section 2557](#).

2. PCC Pavement.

- a. Grind and texture entire surface area of the pavement until:
 - The pavement surface on both sides of the transverse joints and all cracks are substantially in the same plane with no greater than 1/16 inch difference between adjacent sides of joints or cracks, and
 - The pavement surface meets the smoothness required.

- b. In each lane, ensure at least 95% of the area in each 100 foot section has a newly textured surface. Depressed pavement areas and areas of excess faulting as identified in [2532.03, C, 1, b, 4](#) will be exempt from this requirement.
- c. Meet the following requirements for grinding:
 - 1) Ensure all construction traffic entering or leaving the work area moves in the direction of traffic of the open lane.
 - 2) Begin and end at lines normal to the pavement center line within any one ground area and at the project limits. This will not be required at the end of each shift.
 - 3) Maintain good transverse drainage at all times.
 - 4) Assemble the grinding head to produce the tolerances in Table 2532.03-1 on pavements with the indicated coarse aggregates.

Table 2532.03-1: Grinding Head Tolerances

	Limestone	Gravel/Quartzite
Land area between grooves ^(a)	0.090 to 0.110 inches	0.080 to 0.095 inches
Texture depth ^(b)	Target of 1/8 inch with average between 1/16 inch to 3/16 inches	
(a) Based on an average of a minimum of ten measurements across the ground width for one pass.		
(b) Based on an average of a minimum of six measurements across the ground width for one pass.		

- 5) A test area 500 feet long and the width of the grinding head will be allowed for each new or restacked head, provided a surface texture in reasonable conformance with the specification is being produced.

3. Bridge Deck.

- a. When specified in the contract documents, grind and longitudinally groove the entire surface of the bridge deck according to [Article 2412.03, D, 4, a](#). No areas greater than 2 feet in length shall be left without texture. Total depth of concrete surface ground shall not exceed 1/4 inch. For other projects, re-establish transverse grooving through corrected areas using diamond blades to provide a surface similar to a new deck except the area within approximately 2 feet from the curb.
- b. Assemble the grinding head to produce the tolerances in Table 2532.03-1 on bridge decks.

C. Smoothness.

1. PCC Pavement.

- a. The Engineer may partly profile the pavement using an inertial profiler. The latest inventory average international roughness index (IRI) for each area may be shown in the contract documents. The bidder is also advised that any available profile information is available electronically from the Office of Contracts by contacting the Contracts Engineer. This information represents a summary of conditions found to exist at the time the survey was made. The availability of this information will not constitute a guarantee that a profile other than that indicated will not be encountered at the time of grinding.
- b. Prior to performing grinding work, provide a profile using an inertial profiler meeting the requirements of [Materials I.M. 341](#). This control profile will be used to identify the required smoothness for the project if a percent improvement is the controlling factor. Obtain a final average IRI for each 0.1 lane-mile segment as follows:
 - 1) For speeds greater than 45 mph: 65.0 in/mile or less and no bumps exceeding 0.5 inches in 25 feet.
 - 2) For speeds 45 mph or less: 115.00 in/mile and or less and no bumps exceeding 0.5 inches in 25 feet.
 - 3) For extremely rough conditions: the greater of 35% of the pre-grind profile or the aforementioned requirement shall be the required smoothness or less and no bumps exceeding 0.5 inches in 25 feet.
 - 4) Identify depressed pavement areas and localized areas with excess faulting greater than 1 inch. Review these areas with the Engineer to determine the limits for exclusion from the profile index calculation.
- c. Obtain the profile in both wheel paths of each mainline lane using a certified operator. A pavement segment is defined in [Article 2317.03](#). Compute an average IRI for each segment of each lane by averaging the two wheel path IRI values. The wheel paths are at 3 feet and 9 feet from center line or lane line.
- d. Verification testing requirements will be according to [Article 2317.04, F](#).

2. Bridge Deck.

Ensure the smoothness requirements of [Section 2428](#) are met prior to performing the texturing. After texturing, test the bridge deck again according to [Article 2428.02, C](#). Ensure the resulting profile index does not exceed the corrected profile index prior to the texturing.

D. Limitations.

1. **General.**
 - a. When nighttime work is required, include lighting at each work area. Ensure lighting does not glare into oncoming motorists.
 - b. Continuously remove all slurry or residue resulting from the grinding operations. Do not deposit on the slab or shoulder. Leave pavement and paved shoulders in a clean condition. Ensure residue from grinding operations does not flow across lanes occupied by public traffic. This residue may be spread on the foreslope or removed according to [Article 1104.08](#). When residue is deposited on the foreslope in areas where cable guardrail is present, spread the residue in a manner that prevents it from collecting in the sockets for the cable guardrail system. Take measures to prevent damage to vegetation during spreading of residue. If damage occurs, repair at no cost to the Contracting Authority. Do not allow discharge of slurry or residue into gutters, drainage facilities, or waterbodies.
2. **PCC Pavements.**
 - a. Uncompleted sections may be opened to traffic without completion of grinding across an entire lane.
 - b. During nighttime grinding operations, progress in the direction with normal traffic flow.
 - c. When the following work is included in the contract, sequence the operations in the following order:
 - 1) Undersealing,
 - 2) Longitudinal subdrains,
 - 3) Patching,
 - 4) Retrofit load transfer,
 - 5) Diamond grinding, and then
 - 6) Crack and joint sealing.
3. **Bridge Decks.**
Prior to opening to traffic, complete the work under this specification and meet the smoothness requirements.

2532.04 METHOD OF MEASUREMENT.

Measurement will be as follows:

A. PCC Pavement.

1. Square yards of Pavement Surface Repair, of the type specified, shown in the contract documents.
2. Adjacent paved areas ground to minimize vertical projections will be measured for payment. Payment will be in square yards of Pavement Surface Repair based upon a width of 2 feet times the length of the required feather pass.

B. Bridge Deck.

Square yards of Pavement Surface Repair, of the type specified, shown in the contract documents.

2532.05 BASIS OF PAYMENT.

Payment will be as follows:

- A. Contract unit price per square yard for Pavement Surface Repair (Grinding Limestone) or Pavement Surface Repair (Grinding Gravel).
- B. Payment is full compensation for furnishing all equipment, materials, and labor to:
 - Grind the concrete surface,
 - Test for smoothness according to the contract documents, and
 - Remove slurry and residue from this operation.
- C. In addition to the payments above, the Contractor may receive an incentive payment based upon the number of qualifying segments. The incentive payment will be based upon the following schedule:

Table 2532.05-1: Incentives for Pavement Surface Repair (Diamond Grinding)

International Roughness Index for greater than 45 mph	International Roughness Index for 45 mph or less	Dollars per 0.1 mile segment per lane
Inches per mile	Inches per mile	
0.00 – 30.00	-	400
30.01 - 50.00	-	1000-(20 X IRI)
50.01 - 65.00	0.00 - 115.00	Contract Unit Price
>65.01*	>115.01*	Grind

* For extremely rough conditions, this limit may be higher as noted above.

