IOWA DOT

RIDE QUALITY

2024 INSTRUCTION MANUAL

TECHNICAL TRAINING AND CERTIFICATION PROGRAM

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DMACC-Ride Quality Training

2023-2024

Instructors

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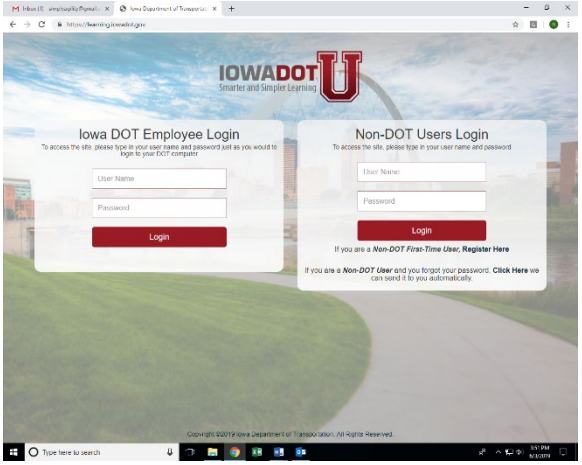
WEBSITES USED IN TTCP CLASSES

There are 2 websites you will use as a TTCP Student. You will set yourself up as a user of each of these websites. It's important that you remember your user name and password for each site (hint: since you are setting each of them up yourself, you could use the same password for each site.)

IOWADOTU

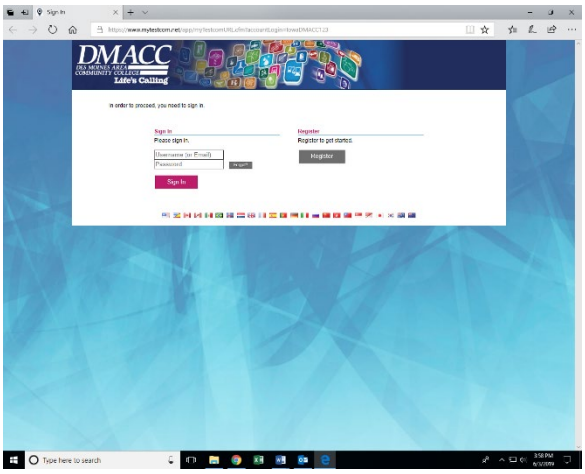
https://learning.iowadot.gov/

This is where you register for classes and take web-based training. You can also print your training records transcripts here. Step-by-step instructions are available at https://iowadot.gov/training/technical-training-and-certification-program



COMPUTER TESTING

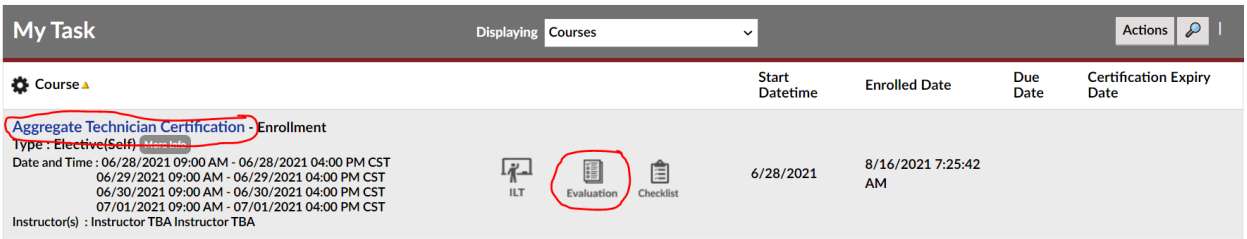
All TTCP Exams will be done on the computer. Your instructor will guide you to the Test.Com website and assist with any registration requirements. Questions are multiple choice, and you will be able to see your score immediately as well as the questions that you missed.



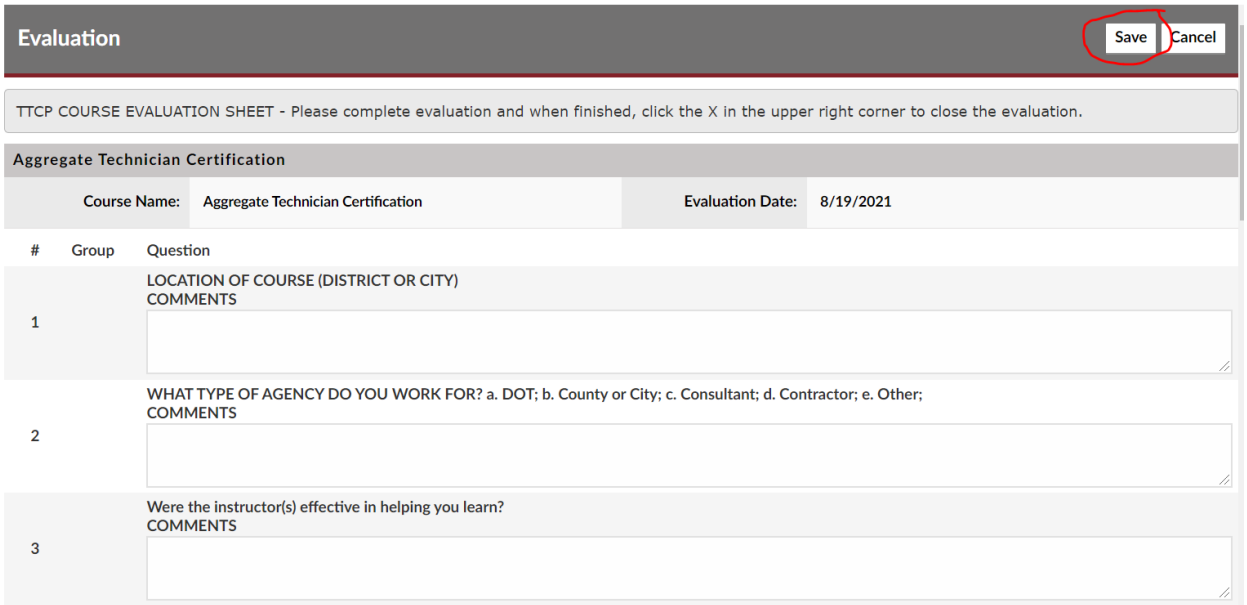
CLASS EVALUATIONS

Evaluations will now be completed outside of the classroom. They are available in IowaDOTU and can be found at this web address: https://learning.iowadot.gov/

Please login to the system and then scroll down to where you see the “My Task” line. Locate the class that you were enrolled in and completed. To the right of the class name, you will see an icon for the Evaluation. Click the Evaluation icon and it will open the evaluation for you to complete electronically.



Once you have completed the 11 questions on the evaluation, scroll to the top of the page and click the “Save” button. Thank you for completing this evaluation!



CLASS POWER POINT

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

1

Introductions

Jeff Brinkman / Jeff De Vries, P.E.

- 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?

2

Course Objectives

- Become familiar with roughness and profiles.
- Define **NEW** 2317 vs. **HISTORICAL** IM 2317
- Explain MRI, ALR, 0.0" Blanking Band and 0.2" Blanking Band and which specifications cover each (this is going to be a change)
- Identify/ look up resources: smoothness specifications and IM.
- Report results.
- Recognize Independent Assurance Program (IAP).
- Prepare for Test. Review online through DOTU.
- Pass test.

3

Roughness, Profiles, and Profilers

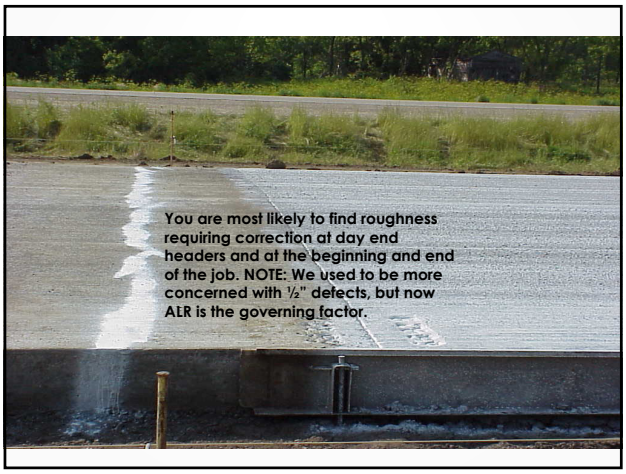
- Recognize why smooth pavement is important.
- Identify what things cause roughness.
- Define the difference between a profilograph and a profiler.
- Determine what is being measured.
- Define the basics of profilograph and profiler operation. What to do and not do!

4

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.

5



6


When roughness is created in the process,
the contractor must correct it at an
additional cost to contractor.
PC 390S

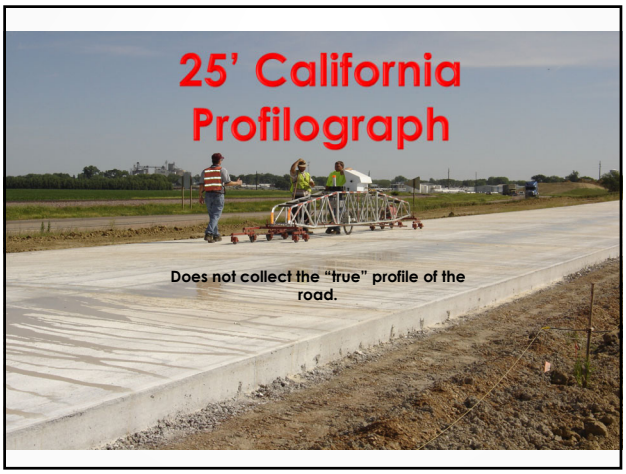
7


Note: Complete the Correction before determining the
Pavement thickness (2316.03A.1. Historical 2317.04E.,
or New 2317.04F

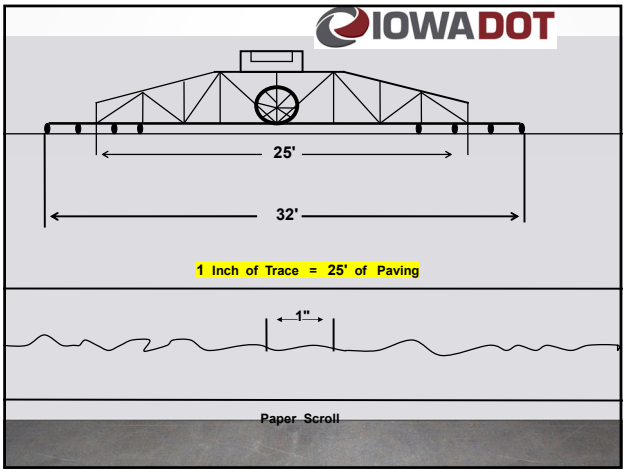
8


25' Ames
Profilograph
Pushed at walking speed, does not
collect the "true" profile of the road.

9


25' California Profilograph
Does not collect the "true" profile of the road.

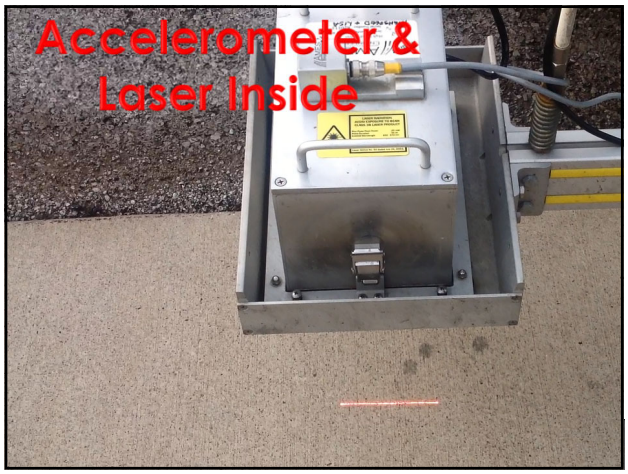
10


IOWA DOT
25'
32'
1 Inch of Trace = 25' of Paving
1"
Paper Scroll

11


Does not collect the "true" profile of the road.
Inertial Profiler

12



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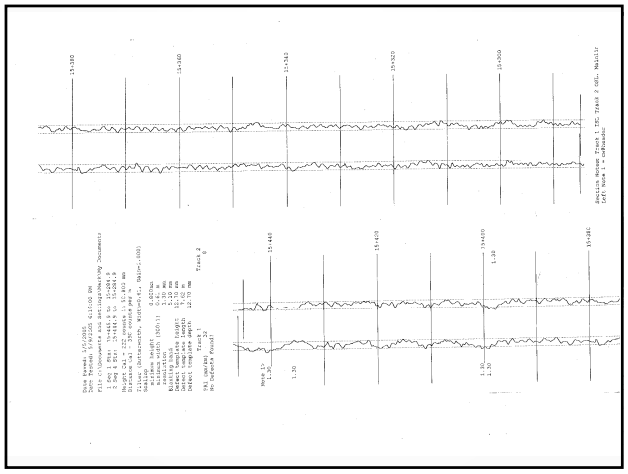

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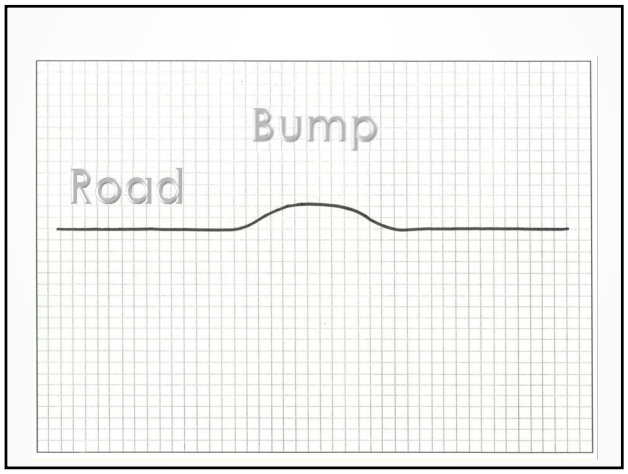

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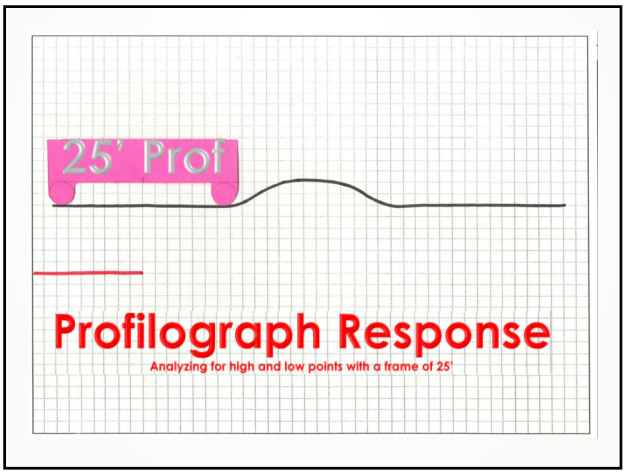
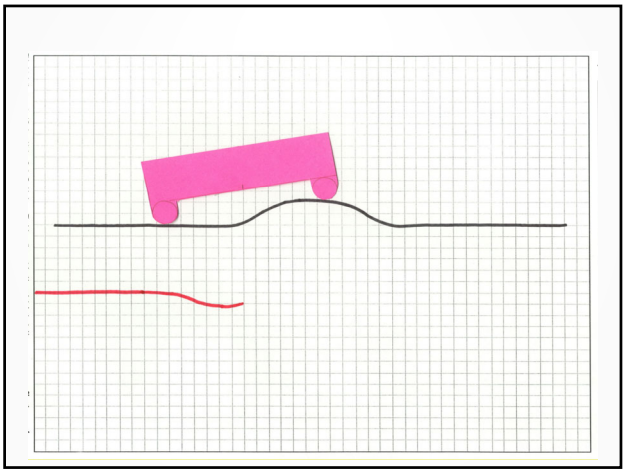

25' Prof
Profilograph Response
Analyzing for high and low points with a frame of 25'

16



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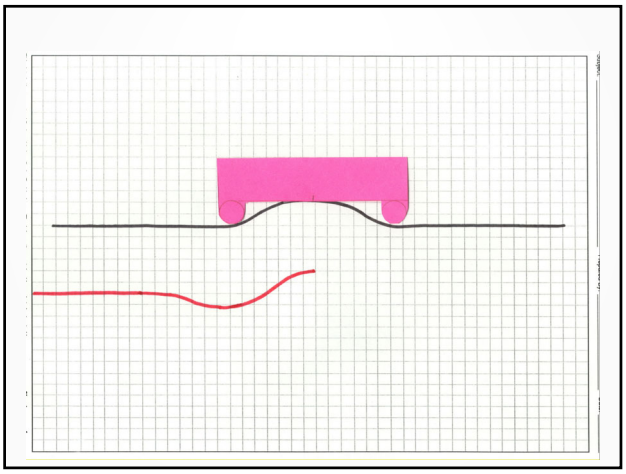

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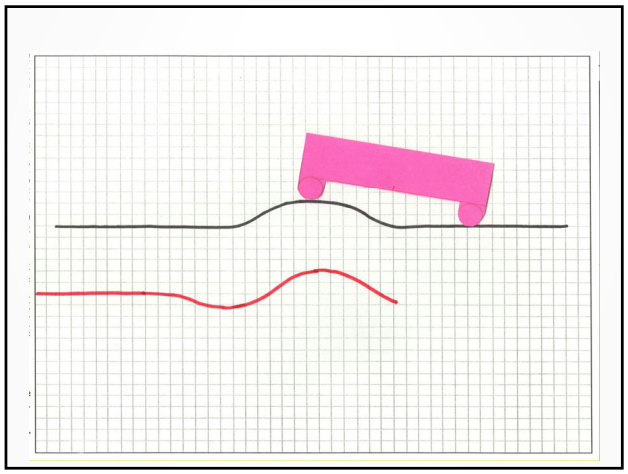

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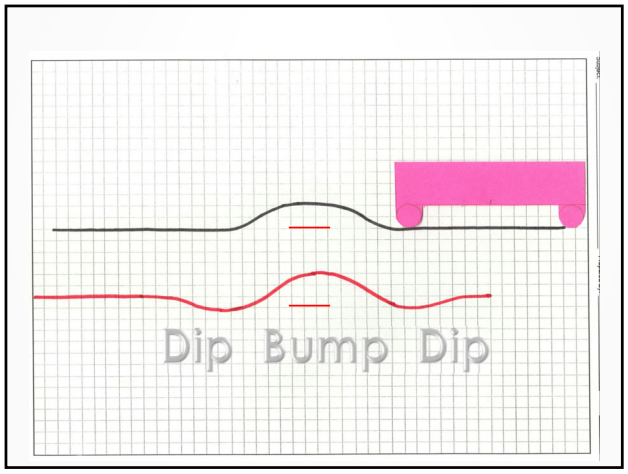
Dip Bump Dip

20


Dip Bump Dip ?
Profiler response to stopping and starting.

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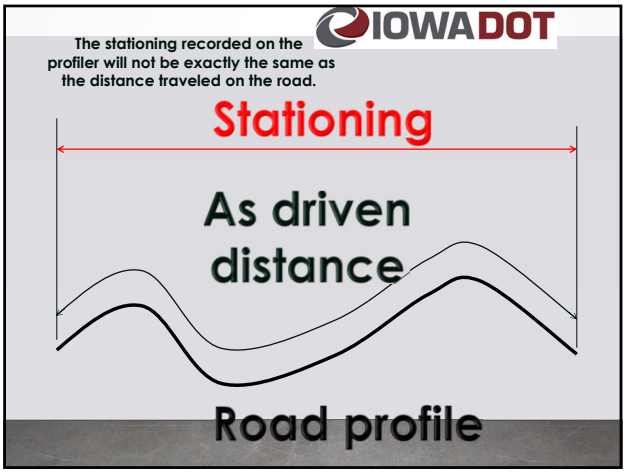
IOWA DOT
Exact start
and
stop locations
are important!
Best practices use the auto trigger,
or GPS locations

22


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

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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?

Profile Index- For 2428 and Historical 2317

- Number used for quantifying ride quality.
- Profile index = measured roughness (inches) divided by length (miles)
- PI = in./mi. (2 decimals past "0")

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Mean Roughness Index (MRI)-New 2317

- 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.

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Segment (PI)-Historical 2317

- Normally 1/10 mile (0.100 mi) or 528 feet
- 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

Example IM341 G.6. : If the last, or odd length segment measures 7.60 inches (190feet) 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)

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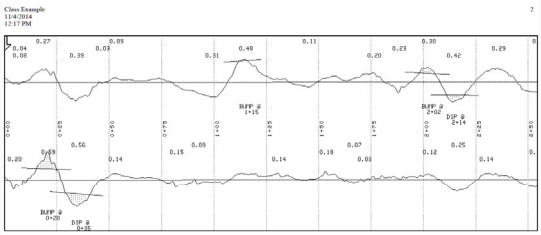
Segment (MRI)
New 2317.01.D.

- Normally 1/10 mile (0.100 mi) or 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.

30



Ames Engineering profiler-- Profilogram with high and low points marked when deviations are in excess of 0.5 inches in 25 feet length. Note the line and shaded areas.

IM 341-Figure 12 shows examples using Bump Template

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Exercises

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Problem 1

Length	Roughness	Profile Index
0.100 mi.	0.10 in.	_____in./mi.
0.100 mi.	0.10 in.	_____in./mi.
0.100 mi.	0.00 in.	_____in./mi.
0.142 mi.	0.45 in.	_____in./mi.
_____mi.	_____ in.	_____in./mi.

How many feet _____is 0.142 miles?

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Problem 1 Answers

Length	Roughness	Profile Index
0.100 mi.	0.10 in.	1.00 in./mi.
0.100 mi.	0.10 in.	1.00 in./mi.
0.100 mi.	0.00 in.	0.00 in./mi.
0.142 mi.	0.45 in.	3.17 in./mi.
0.442 mi.	0.65 in.	1.47 in./mi.

How many feet _____is the last segment; 0.142 miles?

0.142mi. X 5280 feet/mile= 750 feet

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Problem 2

Length	Roughness	Profile Index
0.100 mi.	2.09 in.	_____ in./mi.
0.100 mi.	2.64 in.	_____ in./mi.
0.100 mi.	1.39 in.	_____ in./mi.
0.100 mi.	1.62 in.	_____ in./mi.
0.100 mi.	1.22 in.	_____ in./mi.
0.100 mi.	1.89 in.	_____ in./mi.
0.100 mi.	2.19 in.	_____ in./mi.
0.100 mi.	1.27 in.	_____ in./mi.
0.087 mi.	2.04 in.	_____ in./mi.
_____ mi.	_____in.	_____ in./mi.

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Average Profile Index
(Average Wheel Tracks)

Average Profile Index= total inches/ total miles

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

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

Avg PI=3.42in./mi.

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Discussion

1. How is the MRI different from the P.I.?
2. Difference between “segment” and “section”?
3. For Historical 2317 what is the minimum length segment that stands alone? What about New 2317?
4. Round the Profile Index to how many decimal places past the “0”?

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1

Smoothness Specs/IMs

- IM 341— Smoothness procedure/ IM 341 Appendix A
- 2301— PCC Paving
- 2303— Flexible (HMA) Paving
- 2316— 0.2" Blanking Band
- New 2317- MRI/IRI/ALR
- Historical 2317— 0.0" Blanking Band
- 2428— 0.2" BB (bridges/approaches)
- 2511----Recreational Trails
- 2529— Patching
- 2331— Milling (really rare)
- 2532— Diamond Grinding (IRI)

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Calculation:

IM 341, I. Reporting Part 6

- English: Given;

Length to 3 decimal places, miles

Measured Roughness to 2 decimal places, inches (0.01 for computers, 0.05 for manuals)

Profile Index to 2 decimal places, PI = inches/miles

1 inch of Trace = 25 feet traveled pavement

5280 feet = 1 mile

1. 21.12 inches of trace is how many feet of traveled pavement?
2. If a segment of trace on a profilogram measures 21.12 inches, what distance of pavement would you report on the pavement test report?

39

Calculation:

IM341, I. Reporting Part 6

- English: Given;

Length to 3 decimal places, miles

Measured Roughness to 2 decimal places, inches (0.01 for computers, 0.05 for manuals)

Profile Index to 2 decimal places, PI = inches/miles

1 inch of Trace = 25 feet traveled pavement AND: 5280 feet = 1 mile

25 feet * 12 inches/foot=300 inches

1. 21.12 inches of trace is how many feet of traveled pavement?

   21.12 inches of trace x 25 feet/1 inch of trace=528 feet

2. If a segment of trace on a profilogram measures 21.12 inches, what distance o pavement would you report on the pavement test report?

   21.12 inch of trace x 25 feet/ 1 inch of trace=528 feet

   528 feet*1 mile/5280 feet=0.100 mile

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2316- Pavement Smoothness

- Spec 2301.H.4.b or Spec 2303.D.6.e. state apply 2316 when Section 2317 does not apply.
- Non-Primary projects, do not evaluate smoothness unless specified in the contract documents.
- 0.2” blanking band
- Wheel path testing on mainline traffic lanes. Quarter point on rest. For projects with less than 0.5 miles of mainline paving, the contractor may use quarter point.
- ½” defects considered satisfactory when corrected below 0.3”

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2317-Primary and Interstate Pavement Smoothness

- If specified in 2301 or 2303 Any bid item for that project is less than 5000 SY apply 2316
- New 2317 will apply on anything let after March 2023
- Historical 2317 may apply before April 2023; check for DS-15011 or DS-15079 (which became New 2317)
- Wheel path testing on mainline traffic lanes.

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ESTIMATE REFERENCE INFORMATION

Item No.	Item Code	Description
1	2102-2710070	EXCAVATION, CLASS 10, ROADWAY AND BORROW
		MATERIAL FROM WITHIN SITE TO BE REUSED AS FILL ONSITE. SHRINK FACTOR OF 1.25 ASSUMED. NO OVERHAUL ALLOWED.
2	2102-2710090	EXCAVATION, CLASS 10, WASTE
		WASTE NOT INCORPORATED INTO THE PROJECT. TO BECOME THE PROPERTY IF THE CONTRACTOR AND REMOVED FROM SITE. NO OVERHAUL ALLOWED.
3	2105-8425005	TOPSOIL, FURNISH AND SPREAD
		FOR AREAS WHERE PAVEMENT IS REMOVED AND TOPSOIL IS TO BE INSTALLED. MINIMUM DEPTH OF 6" REQUIRED.
4	2105-8425015	TOPSOIL, STRIP, SALVAGE AND SPREAD
		TOPSOIL TO BE REMOVED TO A DEPTH OF 6", STOCKPILED AT A LOCATION SECURED BY THE CONTRACTOR, AND RESPREAD AT A MINIMUM DEPTH OF 6".
5	2109-8225100	SPECIAL COMPACTION OF SUBGRADE
6	2115-0100000	MODIFIED SUBBASE
		CONSTRUCT TO 2' OUTSIDE OF CURB
7	2213-6745500	REMOVAL OF CURB
		SEE TABULATION ON SHEET "C.07", SAWCUTTING SHALL BE INCIDENTAL.
8	2214-5145150	PAVEMENT SCARIFICATION
		PAVEMENT SCARIFICATION TO BE A DEPTH OF 4" FOR BLOOMINGTON ROAD ASPHALT CONSTRUCTION LIMITS
9	2301-1653080	STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3 DURABILITY, 8 IN.
		PAVEMENT SMOOTHNESS WILL BE REQUIRED AND SECTION 2316 SHALL BE FOLLOWED IN ITS ENTIRETY. CERTIFIED PLANT INSPECTION WILL BE REQUIRED BY THE CONTRACTOR DURING PAVING OPERATIONS. GGBFS (SLAG) IS NOT PERMITTED FOR ANY WORK ON THIS PROJECT. PCC COMPRESIVE STRENGTH SHALL BE A MINIMUM OF 4,000 PSI AT 28 DAYS. ITEM SHALL INCLUDE QUANTITIES FOR CURB AND GUTTER SECTION AS INDICATED IN THE PLANS.
10	2301-6911722	PORTLAND CEMENT CONCRETE PAVEMENT SAMPLES

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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

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2316.02.B2.b. & Historical 2317.03.C.3

- 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.
- **New 2317.04A.1**.—Pavement will be evaluated in 0.1 mile segments using the inertial profiler…

45

2316 & 2317 continued "Evaluated/Tested"

- Not all surfaces are "evaluated".
- **Read**=>2316.02,D or Historical 2317.03,C.
- Some areas are "tested" for ½" bumps and dip.
- **New 2317.03 B 1& 2** spell out what is tested and what is evaluated

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2316 ABI (Average Base Index)

- Used for lanes placed next to existing pavement.
- Article 2316.02,A,6,b.

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Unit Positioning-2316, 2428 and Historical 2317

- Traditional push units
- Start with test wheel 16 feet on old paving (IM 341, figure 7).
- End with test wheel 16 feet on old paving.
- Ramps, loops-test as close to center as possible (offset 2ft to RIGHT if needed).
- Tapers-start/stop at 4ft width.

48

New 2317.03.B.1exceptions

C. **Twenty feet** on either side of bridges and approaches, manholes, EF joint…

49

Unit Positioning

Profilers

- Same as profilograph– in addition, the profiler needs a lead in and run out distance.
- Follow the manufacturer's recommendation for lead in and run out distance.

50

Unit Positioning
IM 341.F.11.a.2

Wheel track positioning for **mainline traffic lanes**:

Wheel tracks are 3 feet and 9 feet from the centerline or lane line.

341 App. A (MRI) essentially the same language

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Unit Positioning
IM 341.F.11.a.1

2316 states Quarter point positioning for lanes that are **not mainline through lanes.**

Quarter point located 6 feet from center line or lane line.

Ramps and tapers tested in the **center** of the lane.

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Transition Area

- IM 341
- Adding or subtracting lanes
- Start and stop trace wheel when pavement width is 4 feet. See IM 341.F.11.g
- Test in center of lane even under 0.0" BB
- IM 341 Appendix A (MRI)- similar
- Ex. **D.6.b-** says to position driver sensor 3' from left edge line…

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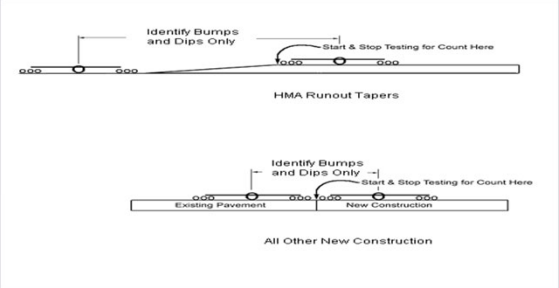
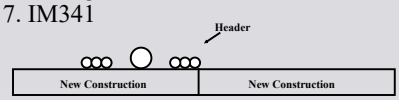
Unit Positioning-old/new headers



Check plans for HMA runout Taper length; Figure 7: Testing at Headers

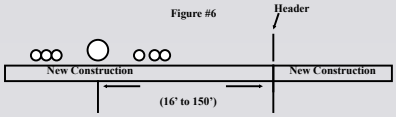
54

Unit Positioning-new headers
Figure 7. IM341



Test header to header whenever possible. Do not stop with test wheel on header-Stop with front or rear wheel on header if possible. Check entire header for 1/2" bumps or dips.

Figure #6



Add this area to the next day's paving when header to header testing is not possible. Check for 1/2" Bumps or Dips.

55

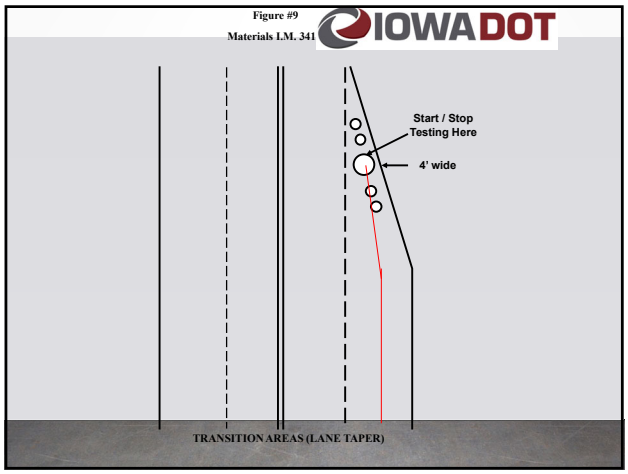
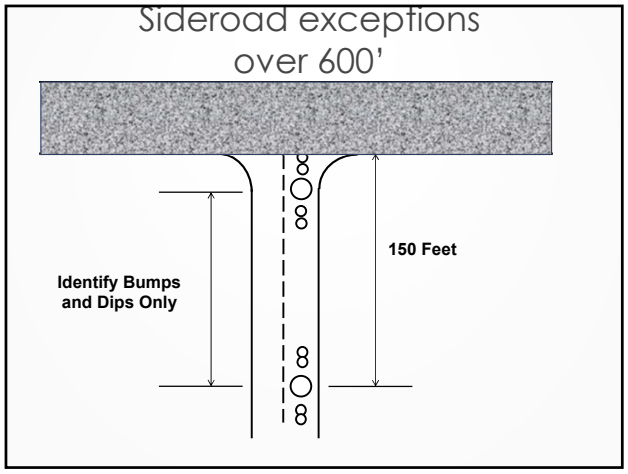
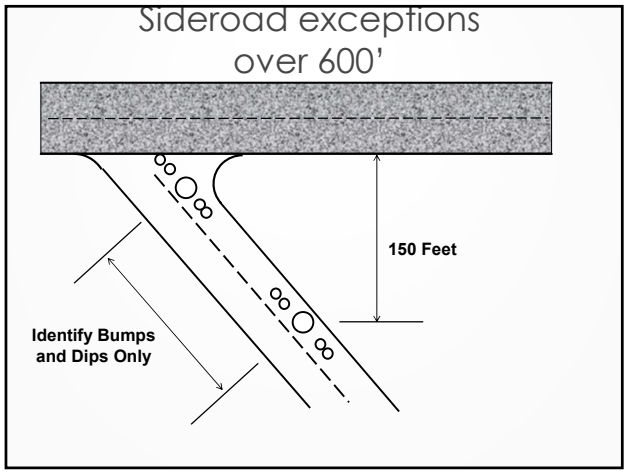


Figure #9
Materials I.M. 341
IOWADOT
Start / Stop
Testing Here
4' wide
TRANSITION AREAS (LANE TAPER)

56


Sideroad exceptions
over 600'
150 Feet
Identify Bumps
and Dips Only

57


Sideroad exceptions
over 600'
150 Feet
Identify Bumps
and Dips Only

58

Historical 2317.05-2 Pay Adjustment

- How many dollar incentive/disincentive are paid for a HMA Interstate section, speeds > 45 mph, whose segments are
- 11.40 in / mi
- 5.00 in / mi
- 12.50 in / mi
- 12.00 in / mi
- 14.00 in / mi

59

Historical 2317.05-02 Pay Adjustment

• 11.40 in / mi	+650.00
• 5.00 in / mi	+850.00
• 12.50 in / mi	+500.00
• 12.00 in / mi	+500.00
• 14.00 in/ mi	+350.00
	+$2850.00

60

Historical 2317.05-1 Pay Adjustment

- How many dollar incentive/disincentive are paid for a PCC Primary section of highway, > 45 mph, whose segments are
- 24.40 in / mi
- 20.00 in / mi
- 22.50 in / mi
- 22.60 in / mi
- 23.90 in/ mi

61

IOWA DOT

Historical 2317.05 Pay Adjustment

• 24.40 in / mi	+450.00
• 20.00 in / mi	+850.00
• 22.50 in / mi	+650.00
• 22.60 in / mi	+650.00
• 23.90 in / mi	+450.00
	$3050.00

62

Discussion

1. What things might you want to look for in the plans?
2. Should paved shoulders be tested?
3. When would you use Historical 2317? New 2317?
4. How far from the center line is the quarter point?
5. How far from the center line are the wheel tracks?

63

1

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)
- ½” defects considered satisfactory when corrected below 0.3”

64

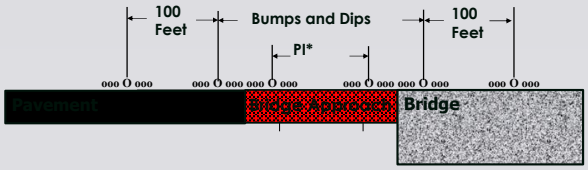
Bridge Approaches

- 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.

65

Bridge Approaches

Figure #10, IM 341



66

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" bumps or dips allowed-bumps corrected below 0.3" (with Engineer's Approval 2428.03.B)

67

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

68

2428 example
Bridge Deck Overlay 2428.05-1 or -2

Inside Wheeltrack (IWT)			Outside Wheeltrack (OWT)			
Length	Roughness	Profile Index	Length	Roughness	Profile Index	PI Average
(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? _____

69

2428 example
Bridge Deck Overlay

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

What is the incentive/disincentive pay for the bridge deck overlay mentioned above? Unit Price

70

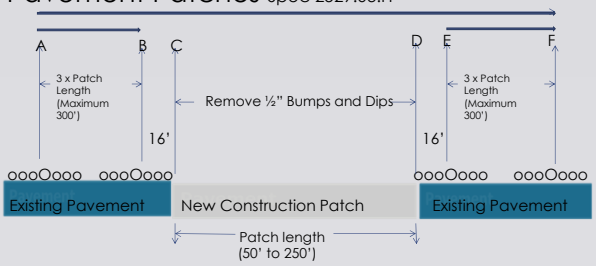
Specifications Continued

- Other less common projects:
- Patching 2529.03,H
- Milling 2531.03,C
- Diamond grinding 2532.03,C
- Recreational Trails 2511.03,B.5

71

Figure 14 IM341

Pavement Patches Spec 2529.03.H



Apply Spec 2316. Run the profilograph from "A" to "F"
Evaluate the Profile Index from "A to "F"
Evaluate the Profile Index from "A" to "B"
Evaluate the Profile Index from "E" to "F"
Compare the Profile Index of Line AF to the profile index of the Average Base Index (ABI)

$ABI = \frac{AB+EF}{2}$

72

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?

73

1

Reporting
IM 341 I.

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

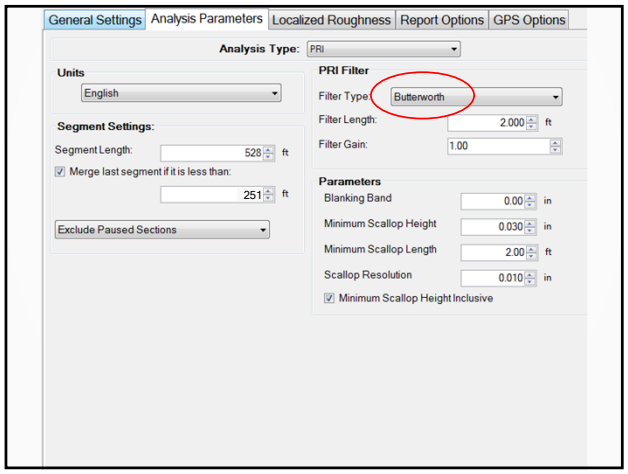
74

Reporting
Rule #1.

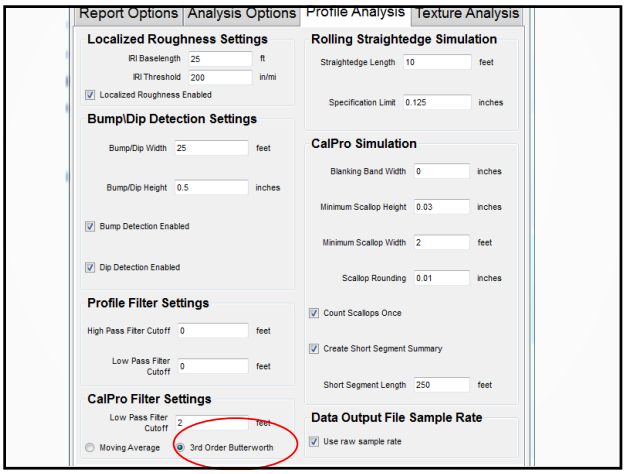
Make sure analysis settings are correct.

See IM 341

75



76



77

Computer Settings

IM 341 Example:

- **PROFILOGRAPH/ PROFILER REDUCTION SETTINGS**

Blanking Band	#1 0.20 in.	or 0.001 in.
Scallop Rounding	#2 0.01 in.	Or 0.05 in.(Manual reduction)
Minimum Scallop Height	#3 0.03 in.	
Minimum Scallop Width	#4 0.08 in.	on trace(2.0 ft. actual distance).
Filter Type	#5 Butterworth.	
Bump/Dip Height	#6 0.5 in.	
Bump/Dip Width	#7 25 ft.	

78

Reporting

Types of Reports IM341 I.

- Information Only
- Preliminary reports are to get information to inspectors ASAP. A final report must follow
- Final reports must be neat, orderly, easy to understand and have all required information
- Corrected reports indicate either an error on the original or that corrective work has been accomplished and retested

79

Reporting-

Lab numbers IM341 I.

- 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

80

Reporting
IM 341 I.

- 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.**

81

Reporting
IM341 I.

- Corrected test reports shall include all the information and data from the original test report and also show the retested profile index for each corrected segment.
- Identified bumps and dips shall be noted as corrected
- A letter should be added to the end of the original lab number.

82

Reporting-Rounding
IM341 I.

- Length (miles) to 3 decimal places (EX:0.100 mi.)
- Measured Roughness (inches) to 2 decimal places. (EX:2.23 in.) Note: nearest 0.05 (manual) hand reduction
- Profile Index (in / mi) to 2 decimal places (EX:22.30 in / mi)
- Method for rounding and determination of specification compliance shall be according to the "Rounding Method" in ASTM E29

83

IM 202 - ROUNDING

B. Rounding Procedure

- If the digit following the last digit to be used is less than 5, do not change the last digit used. Example: 1.861 would round to 1.86 for the nearest 0.01
- If the digit following the last digit to be used is more than 5, raise the last digit used one number. Example: 1.861 would round to 1.9 for the nearest 0.1
- If the digit following the last digit to be used is exactly 5, raise the last digit used one number. Example: 1.85 would round to 1.9 for the nearest 0.1

84

Reporting
IM341 I.

- Always start with a full 0.100 mi segment and align both lanes or wheel paths on the form.
- The certified test report shall have the name and certification number of the person doing the testing, the person performing the analysis, and the person completing the report.

85

Reporting

IM341 I.

- Each contractor test report must include the following Certification Statement

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

86

Reporting

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)

87

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?

88

IM 216 Solution

Bridge Profile Index (0.2" blanking band) IM 341

Verification Profile Index Test Result

Inches/mile	
6.0 or less	2.0 in./mi.
6.1 to 20.0	3.0 in./mi.
20.1 to 40.0	4.0 in./mi.
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.

89

IM 216

IRI Example
(information for future use, not tested on this today)

- 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 ?

90

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 in/mi+62.05 in/mi) /2 = 60.945 in/mi [need to round]
=60.95 in/mi x 0.08 = 4.88in./mi. [+/- tolerance from IDOT]
Is the Contractor number within tolerance with IDOT?
(54.96 in/mi to 64.72 in/mi)? [59.84 +/- 4.88]
Yes.

91

Reporting Distribution

IM341 I.

- DocExpress projects- may just upload **final** reports to DocExpress (Note difference in DS or SS)
- Certified test reports shall have the following distribution:
  - RCE, County or City Engineer
  - District Materials Engineer
  - Special Investigations Engineer
  - Contractor (For Iowa DOT personnel)
  - Subcontractor (For Iowa DOT personnel)

92

DocExpress reporting

Personally, I place my reports in the "Pay Items" Drawer as "District Materials Input" and call it DOT smoothness. We do not have a standard yet, but I ask that Contractors do the same and attach "smoothness" or Profile" to each of your reports so when I am searching for them all I have to do it type "smooth" or "prof" and I get a hit.

93

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."

94

Discussion

1. How many places past the decimal point should the PI be reported to?
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. Who gets a copy of the report?

95

1

2-Nov-2016

Profile Summary Sheet

IOWA DOT
SMARTER | SIMPLER | CUSTOMER DRIVEN

Project Number	NHSN-075-2(92)--2R-75
Date Measuered	8/31/2017
Tested By	Jim Glaspie
Direction	Southbound
Lane Description	Mainline: Lane 2

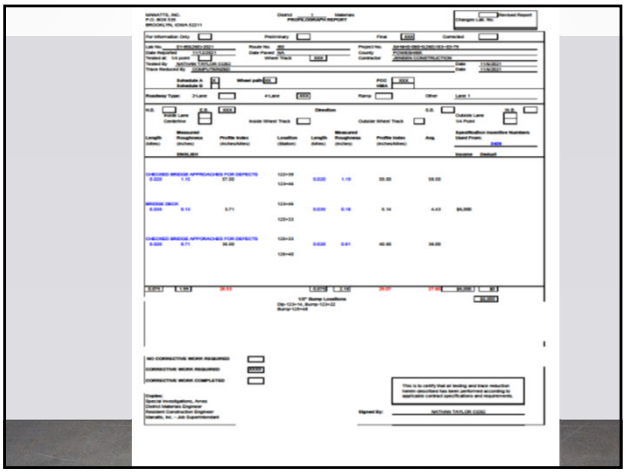
Report Number	1-ISL
Smoothness Equation	PCC
Posted Vehicle Speed	> 45 mph

Stationing	Section 1	Section 2	Section 3
Beginning	763+04		
Ending	722+07		

Area of Localized Roughness (ALR)	
200.0 ≤ ALR < 250.0 (ft.)	0.00
ALR ≥ 250.0 (ft.)	0.00

	Grind	Beginnimg Sta.	Ending Sta.	Segment Length (ft)	Final Smoothness (in/mi)	Segment Pay Adjustment
S1	☐	763+04	757+76	528	58.86	$776.25
	☐	757+76	752+48	528	44.85	$1,500.00
	☐	752+48	747+20	528	42.71	$1,500.00
	☐	747+20	741+92	528	39.35	$1,500.00
	☐	741+92	736+64	528	38.99	$1,500.00
	☐	736+64	731+36	528	45.37	$1,500.00
	☐	731+36	726+08	528	41.53	$1,500.00
	☐	726+08	722+07	401	44.67	$1,139.20
	☐					
	☐					
	☐					
	☐					

96



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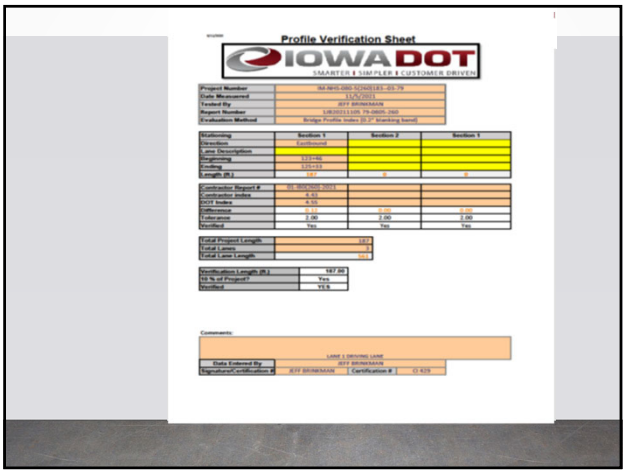

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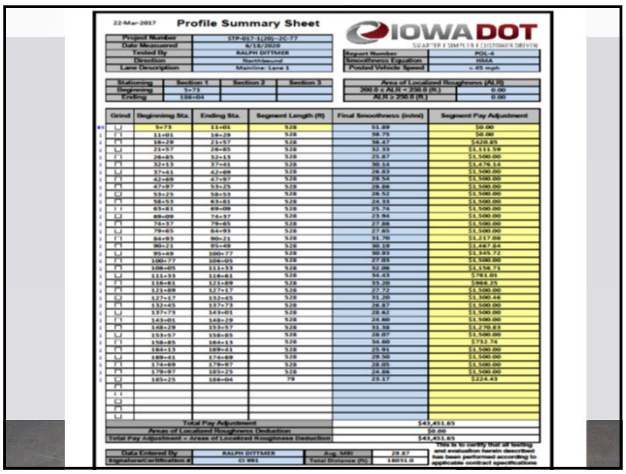


22-Mar-2017 **Profile Summary Sheet** IOWA DOT

Project Number	STP-017-1(28)--2C-77
Date Measured	5/18/2020
Tested By	RALPH DITTMER
Direction	Northbound
Lane Description	Mainline Lane 1

Report Number	POL-4
Smoothness Equation	HMA
Posted Vehicle Speed	> 45 mph

Stationing	Section 1	Section 2	Section 3
Beginning	5+73		
Ending	186+04		

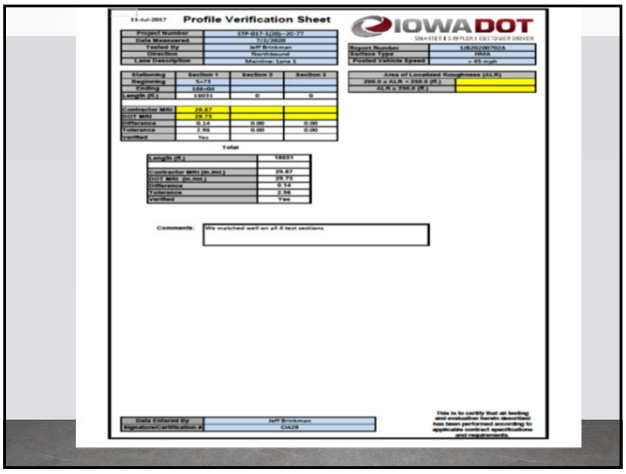
Area of Localized Roughness (ALR)	
200.0 ≤ ALR < 250.0 (ft.)	0.00
ALR ≥ 250.0 (ft.)	0.00

Grind	Beginning Sta.	Ending Sta.	Segment Length (ft)	Final Smoothness (inim)	Segment Pay Adjustment
LJ	5+73	11+01	528	51.89	$0.00
FL	11+01	16+29	528	98.75	$0.00
FL	16+29	21+57	528	98.47	$420.85
LJ	21+57	26+85	528	52.33	$1,111.59
FL	26+85	32+13	528	25.87	$1,500.00
FL	32+13	37+41	528	30.14	$1,476.14
LJ	37+41	42+69	528	26.83	$1,500.00
FL	42+69	47+97	528	29.54	$1,500.00
LJ	47+97	53+25	528	26.88	$1,500.00
FL	53+25	58+53	528	26.12	$1,500.00
FL	58+53	63+81	528	24.33	$1,500.00
LJ	63+81	69+09	528	25.74	$1,500.00
LJ	69+09	74+37	528	23.94	$1,500.00
FL	74+37	79+65	528	27.88	$1,500.00
LJ	79+65	84+93	528	27.65	$1,500.00
FL	84+93	90+21	528	31.76	$1,217.00
FL	90+21	95+49	528	30.19	$1,487.84
LJ	95+49	100+77	528	30.93	$1,345.72
FL	100+77	106+05	528	27.88	$1,500.00
FL	106+05	111+33	528	32.06	$1,136.73
LJ	111+33	116+61	528	34.43	$761.01
FL	116+61	121+89	528	33.20	$968.25
FL	121+89	127+17	528	27.72	$1,500.00
FL	127+17	132+45	528	31.20	$1,300.46
FL	132+45	137+73	528	26.87	$1,500.00
LJ	137+73	143+01	528	28.42	$1,500.00
FL	143+01	148+29	528	24.80	$1,500.00
FL	148+29	153+57	528	31.58	$1,270.83
LJ	153+57	158+85	528	26.07	$1,500.00
FL	158+85	164+13	528	34.00	$793.74
FL	164+13	169+41	528	25.91	$1,500.00
LJ	169+41	174+69	528	29.50	$1,500.00
FL	174+69	179+97	528	26.05	$1,500.00
FL	179+97	185+25	528	24.86	$1,500.00
LJ	185+25	186+04	79	23.17	$224.43
FL					
FL					
LJ					
FL					
LJ					

Total Pay Adjustment	$47,451.65
Areas of Localized Roughness Deduction	$0.00
Total Pay Adjustment - Areas of Localized Roughness Deduction	$47,451.65

Data Entered By	RALPH DITTMER	Avg. MRI	29.87	This is to certify that all testing and evaluation herein described has been performed according to applicable contract specifications
Signature/Certification #	CI 991	Total Distance (ft)	18051.0	

99



13-Jul-2017 **Profile Verification Sheet** IOWA DOT

Project Number	STP-017-1(28)--2C-77
Date Measured	7/7/2020
Tested By	Jeff Brinkman
Direction	Northbound
Lane Description	Mainline Lane 1

Report Number	18-0-0027-01A
Surface Type	HMA
Posted Vehicle Speed	> 45 mph

Stationing	Section 1	Section 2	Section 3
Beginning	5+73		
Ending	186+04		
Length (ft.)	18031	0	0
Contractor MRI	29.87		
DOT MRI	29.73		
Difference	0.14	0.00	0.00
Tolerance	2.98	0.00	0.00
Verified	Yes		

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

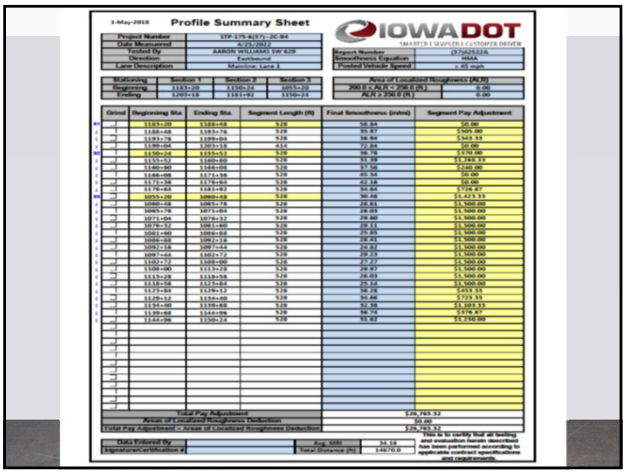
Total

Length (ft.)	18031
Contractor MRI (in./mi.)	29.87
DOT MRI (in./mi.)	29.73
Difference	0.14
Tolerance	2.98
Verified	Yes

Comments: We matched well on all 4 test sections

Data Entered By	Jeff Brinkman	This is to certify that all testing and evaluation herein described has been performed according to applicable contract specifications and requirements.
Signature/Certification #	CI429	

100



1-May-2018 **Profile Summary Sheet** IOWA DOT

Project Number	STP-175-4(37)--2C-84
Date Measured	4/25/2022
Tested By	AARON WILLIAMS SW 629
Direction	Eastbound
Lane Description	Mainline Lane 1

Report Number	2T4G522A
Smoothness Equation	HMA
Posted Vehicle Speed	> 45 mph

Stationing	Section 1	Section 2	Section 3
Beginning	1183+20	1150+24	1055+20
Ending	1203+18	1181+82	1150+24

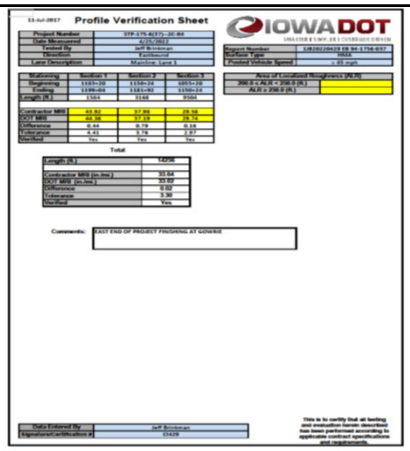
Area of Localized Roughness (ALR)	
200.0 ≤ ALR < 250.0 (ft.)	0.00
ALR ≥ 250.0 (ft.)	0.00

Grind	Beginning Sta.	Ending Sta.	Segment Length (ft)	Final Smoothness (inim)	Segment Pay Adjustment
LJ	1183+20	1188+48	528	58.84	$0.00
FL	1188+48	1193+76	528	35.97	$509.00
FL	1193+76	1199+04	528	36.94	$543.33
FL	1199+04	1203+18	414	72.84	$0.00
FL	1150+24	1155+52	528	36.78	$570.00
FL	1155+52	1160+80	528	35.39	$1,263.33
FL	1160+80	1166+08	528	37.56	$240.00
FL	1166+08	1171+36	528	45.34	$0.00
FL	1171+36	1176+64	528	42.16	$0.00
FL	1176+64	1181+92	528	54.84	$728.67
FL	1055+20	1060+48	528	30.46	$1,423.33
FL	1060+48	1065+76	528	28.81	$1,500.00
FL	1065+76	1071+04	528	28.05	$1,500.00
FL	1071+04	1076+32	528	28.80	$1,500.00
FL	1076+32	1081+60	528	28.11	$1,500.00
FL	1081+60	1086+88	528	25.85	$1,500.00
FL	1086+88	1092+16	528	28.41	$1,500.00
FL	1092+16	1097+44	528	24.82	$1,500.00
FL	1097+44	1102+72	528	29.23	$1,500.00
FL	1102+72	1108+00	528	27.27	$1,500.00
FL	1108+00	1113+28	528	28.97	$1,500.00
FL	1113+28	1118+56	528	26.03	$1,500.00
FL	1118+56	1123+84	528	25.14	$1,500.00
FL	1123+84	1129+12	528	56.18	$453.33
FL	1129+12	1134+40	528	34.46	$723.33
FL	1134+40	1139+68	528	52.58	$1,103.33
FL	1139+68	1144+96	528	56.74	$576.67
FL	1144+96	1150+24	528	91.82	$1,750.00

Total Pay Adjustment	$26,765.32
Areas of Localized Roughness Deduction	$0.00
Total Pay Adjustment - Areas of Localized Roughness Deduction	$26,765.32

Data Entered By		Avg. MRI	36.18	This is to certify that all testing and evaluation herein described has been performed according to applicable contract specifications and requirements.
Signature/Certification #		Total Distance (ft)	14470.0	

101



Profile Verification Sheet

IOWA DOT

Project Number	STP-175-6(77)--2C-84
Date Measured	6/21/2017
Tested By	Jeff Bickman
Direction	Eastbound
Lane Description	Mainline Lane 1

Report Number	LR2022062E 28 84 1756-037
Surface Type	HMA
Posted Vehicle Speed	< 45 mph

Stationing	Section 1	Section 2	Section 3
Beginning	1149+20	1159+24	1057+10
Ending	1159+04	1161+92	1159+24
Length (ft.)	1384	1168	9584

Area of Localized Roughness (ALR)

250.0 < ALR < 250.0 (ft.) | No

ALR = 250.0 (ft.)

Contractor MRI	41.92	27.90	29.38
DOT MRI	41.36	27.28	28.76
Difference	0.44	0.78	0.16
Tolerance	4.41	5.76	2.87
Verified	Yes	Yes	Yes

Total

Length (ft.)	10296
Contractor MRI (in./mi.)	31.04
DOT MRI (in./mi.)	30.69
Difference	0.02
Tolerance	1.30
Verified	Yes

Comments: EAST END OF PROJECT FINISHING AT GOWRIE

Data Entered By: Jeff Bickman

Engineer Verification #: 11429

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

102

IOWA DOT

Eastbound - Incentive
Lane 1

	Station		Length	Pregrind IRI Avg	Target/ 35% Imp.	Final IRI	Incentive
Poweshiek	744+00.0	749+28.0	528	119.14	77.44	46.90	$62.00
	749+28.0	754+56.0	528	88.44	65.00	31.49	$370.20
	754+56.0	759+84.0	528	96.95	65.00	31.13	$377.40
	759+84.0	765+12.0	528	91.84	65.00	31.31	$373.80
	765+12.0	770+40.0	528	100.54	65.35	36.89	$262.20
	770+40.0	775+68.0	528	86.18	65.00	35.17	$296.60
	775+68.0	780+96.0	528	93.77	65.00	39.27	$214.60
	780+96.0	786+24.0	528	78.55	65.00	30.67	$386.60
	786+24.0	791+52.0	528	76.89	65.00	29.40	$400.00
	791+52.0	796+80.0	528	105.49	68.57	40.92	$181.60
	796+80.0	802+08.0	528	87.27	65.00	40.80	$184.00
	802+08.0	807+36.0	528	115.95	75.37	47.92	$41.60
	807+36.0	812+64.0	528	103.51	67.28	27.53	$400.00
	812+64.0	817+92.0	528	106.45	69.19	29.62	$400.00
	817+92.0	823+20.0	528	119.49	77.67	50.04	$0.00
	823+20.0	828+48.0	528	94.61	65.00	34.45	$311.00
	828+48.0	833+76.0	528	69.75	65.00	26.64	$400.00
	833+76.0	839+04.0	528	57.22	65.00	21.51	$400.00
	839+04.0	844+32.0	528	78.7	65.00	29.42	$400.00

103

IOWA DOT

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

104

IM 207 Appx. A

April 21, 2015 — Matls. IM 207

Supersedes October 21, 2014 — 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 209/216	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

105

~~Smoothness DS-15079 or SS-15011 Objectives:~~

Now it's the **New 2317**, but the objectives are the same!

- 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.

106

These next slides are a rehash of some points we brought up earlier but are specific to the **NEW 2317**

107

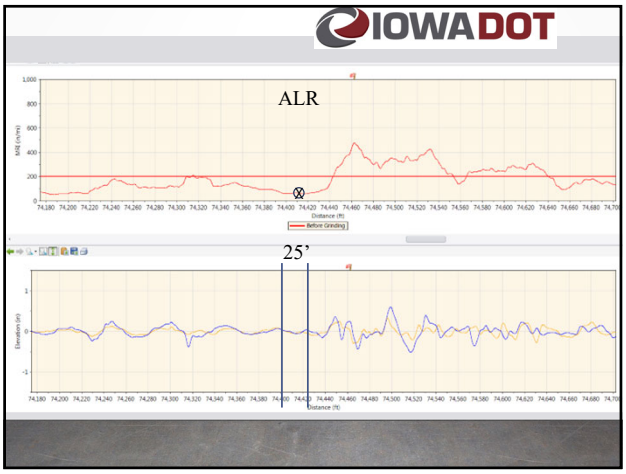
Recognize MRI and ALR terms

- 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.

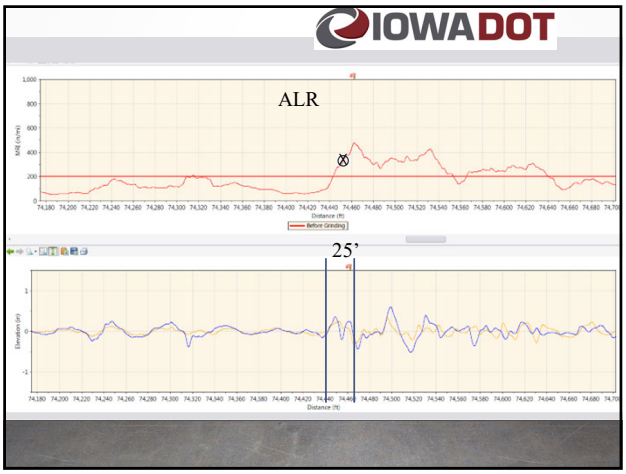
108

Explain Moving Average.

109



110



111

Pavement Segment:

- A Pavement Segment is defined as a continuous area of finished pavement 0.100 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).

112

Pavement 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

113

DS-15079 or SS-15011which became NEW 2317
Test Unit positioning IM 341 App A.D, 6a-e

- a. Perform testing with sensors in wheel paths, 3 feet and 9 feet from centerline or lane line, for lanes 11 feet to 12 feet wide unless noted otherwise in contract documents.
- b. For testing wider lanes such as ramps or loops, position driver side sensor 3 feet from left edge line. If passenger side sensors are within 1 foot of a longitudinal joint, adjust travel path to the right so sensor is 2 feet from the joint line.
- c. For testing tapers to and from a full lane, begin or end section testing when pavement is either 12 feet or at full lane width whichever is less.

114

DS-15079 or SS-15011-New 2317
Test Unit positioning IM 341D, 6a-e

- d. Begin collecting profile data for ALR 50 feet before beginning header from old to new surface and 50 feet beyond header from new to old surface. Figure 1.
- e. Analyze ALR at obstructions defined in 2317.03,B,2,b…20 feet on either side of bridges, bridge approaches, manholes, or water valve boxes in the lane that the obstruction is located.

115

Exclusions & Exceptions:

- 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

116

B. Areas of Localized Roughness.
Payment for areas of localized roughness will be adjusted as shown in Table 2317.05-1.

Table 2317.05-1: Schedule for Adjustment Payment for Areas of Localized Roughness

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*
Greater than 250.0	Grind*

*Correct these areas to below 200.0 inches per mile

117

C. PCC Pavement.
Payment for mean International Roughness Index for PCC pavement will be adjusted as shown in Table 2317.05-2.

Table 2317.05-2: Schedule for Adjustment Payment for PCC Pavements

Mean International Roughness Index (MRI) Inches per mile	Dollars per 0.1 mile segment per lane
Less than 55.0	1500.00
55.0 to 63.0	11812.5 - 187.5 X MRI
63.0 to 75.0	0.00
75.0 to 90.0	7500 – 100 X MRI or grind*
Greater than 90.0	Grind*

*Correct these areas to below 75.0 inches per mile

118

C. PCC Pavement.
Payment for mean International Roughness Index for PCC pavement will be adjusted as shown in Table 2317.05-2.

Table 2317.05-2: Schedule for Adjustment Payment for PCC Pavements

Mean International Roughness Index (MRI) Inches per mile	Dollars per 0.1 mile segment per lane
Less than 55.0	1500.00
55.0 to 63.0	11812.5 - 187.5 X MRI
63.0 to 75.0	0.00
75.0 to 90.0	7500 – 100 X MRI or grind*
Greater than 90.0	Grind*

*Correct these areas to below 75.0 inches per mile

Question:

A PCC pavement segment has an MRI of 57.0 inches per mile. According to SS-15011 what is the adjustment to payment for this segment?

Adjustment=11815.5-187.5x57.0=$1125.00

119

IOWA DOT

D. HMA Pavement.
The payment for mean International Roughness Index for HMA pavement will be adjusted as shown in Table 2317.05-3.

Table 2317.05-3: Schedule for Adjustment Payment for HMA Pavements

Mean International Roughness Index (MRI) Inches per mile	Dollars per 0.1 mile segment per lane
Less than 30.0	1500.00
30.0 to 39.0	6500 - 166.6667 X MRI
39.0 to 75.0	0.00
75.0 to 90.0	7500 – 100 X MRI or grind*
Greater than 90.0	Grind*

*Correct these areas to below 75.0 inches per mile

120

IOWA DOT

D. HMA Pavement.
The payment for mean International Roughness Index for HMA pavement will be adjusted as shown in Table 2317.05-3.

Table 2317.05-3: Schedule for Adjustment Payment for HMA Pavements

Mean International Roughness Index (MRI) Inches per mile	Dollars per 0.1 mile segment per lane
Less than 30.0	1500.00
30.0 to 39.0	6500 - 166.6667 X MRI
39.0 to 75.0	0.00
75.0 to 90.0	7500 – 100 X MRI or grind*
Greater than 90.0	Grind*

*Correct these areas to below 75.0 inches per mile

Question:

An HMA pavement segment has an MRI of 85.0 inches per mile. According to New 2317 what is the adjustment to payment for this segment?

121

IOWA DOT

D. HMA Pavement.
The payment for mean International Roughness Index for HMA pavement will be adjusted as shown in Table 2317.05-3.

Table 2317.05-3: Schedule for Adjustment Payment for HMA Pavements

Mean International Roughness Index (MRI) Inches per mile	Dollars per 0.1 mile segment per lane
Less than 30.0	1500.00
30.0 to 39.0	6500 - 166.6667 X MRI
39.0 to 75.0	0.00
75.0 to 90.0	7500 – 100 X MRI or grind*
Greater than 90.0	Grind*

*Correct these areas to below 75.0 inches per mile

Question:

An HMA pavement segment has an MRI of 85.0 inches per mile. According to New 2317 what is the adjustment to payment for this segment?

Adjustment=7500-100x85.00=-$1000.00

122

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.

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48 HOUR NOTIFICATION!!!!!

IM 341, Paragraph F, #1, page 4

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.

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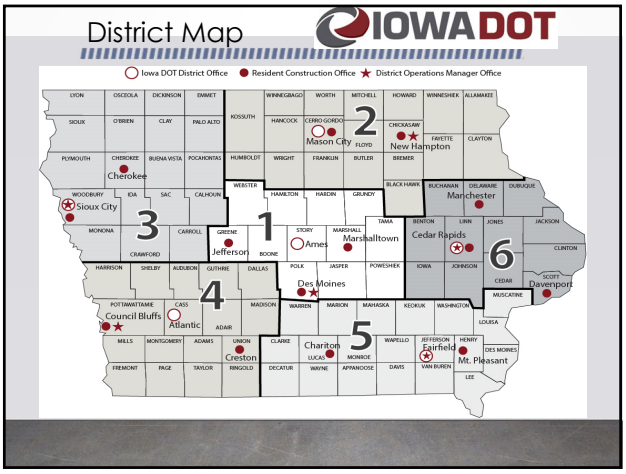
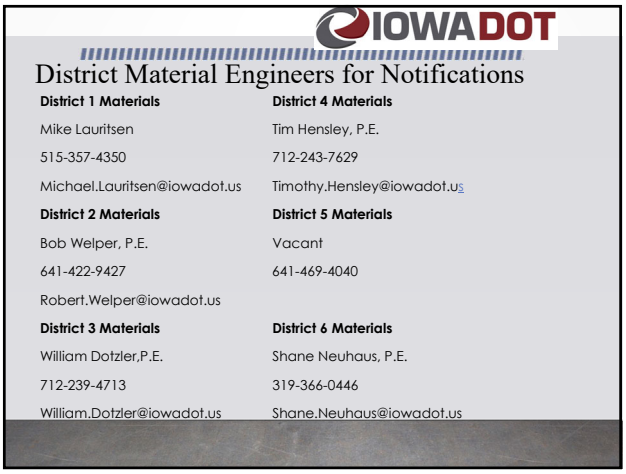
126



127



IOWA DOT

District Material Engineers for Notifications

District 1 Materials	**District 4 Materials**
Mike Lauritsen	Tim Hensley, P.E.
515-357-4350	712-243-7629
Michael.Lauritsen@iowadot.us	Timothy.Hensley@iowadot.us
District 2 Materials	**District 5 Materials**
Bob Welper, P.E.	Vacant
641-422-9427	641-469-4040
Robert.Welper@iowadot.us	
District 3 Materials	**District 6 Materials**
William Dotzler,P.E.	Shane Neuhaus, P.E.
712-239-4713	319-366-0446
William.Dotzler@iowadot.us	Shane.Neuhaus@iowadot.us

128

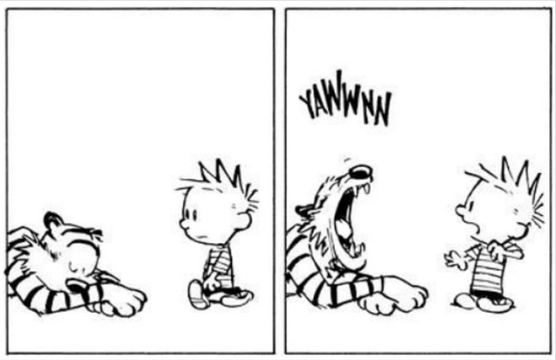
District IAP Contacts for Notifications

District 1 Materials	**District 4 Materials**
Jeff Brinkman	Todd Blum
515-290-1375	712-243-7629
Jeff.Brinkman@iowadot.us	Todd Blum@iowadot.us
District 2 Materials	**5 Materials**
Scott Boyle	Jon Mason
641-422-9427	641-919-5666
Scott.Boyle@iowadot.us	Jon.Mason@iowadot.us
District 3 Materials	**District 6 Materials**
Tony Willman	Maziar Kazemian
712-539-1315	319-366-0446
Anthony.Willman@iowadot.us	Maziar.Kazemian@iowadot.us

129

Submit all preliminary profile summary sheets 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.

130



131

District 1 Materials
1020 South 4th Street
Ames, Iowa 50010

Iowa Department of Transportation

☐ Revised Report
Changes Lab. No.

PAVEMENT TEST REPORT
25-FOOT CALIFORNIA PROFILOGRAPH

☐ For Information Only ☐ Preliminary ☐ Intermediate ☑ Final

Lab No. 1JB11-036 Route No. Hwy 30 WB Project# NHSX-030-4(75)--3H-08
Date Reported 6/3/11 Date Paved 5/4/11&5/5/11 County STORY
Contractor Manatt's Inc.
Tested By Jeff Brinkman/Dan Miner Date 6/1/11
Trace Reduced By computer Date 6/3/11

Primary 2317 Tested at: Wheel Track
PCC Slip Form Blanking Band: 0.0-Inch

Roadway Type: ☐ 2-Lane ☑ 4-Lane ☐ Ramp ☐ Other

Direction (4-Lane Only): Westbound

☐ Inside Lane				☑ Outside Lane			
Length (Miles)	Wheel Track Measured Roughness (Inches)	Inside Profile Index (Inches/Mile)	Location (Station)	Length (Miles)	Wheel Track Measured Roughness (Inches)	Outside Profile Index (Inches/Mile)	Index Average (In./Mi.)
0.100	2.62	26.20	1102+50	0.100	2.67	26.70	26.45
0.100	1.74	17.40		0.100	2.36	23.60	20.50
0.100	2.20	22.00		0.100	2.56	25.60	23.80
0.100	2.31	23.10		0.100	2.74	27.40	25.25
0.100	2.36	23.60		0.100	4.48	44.80	34.20
0.100	2.18	21.80		0.100	3.07	30.70	26.25
0.100	1.73	17.30		0.100	2.25	22.50	19.90
0.100	2.80	28.00		0.100	2.27	22.70	25.35
0.100	2.21	22.10		0.100	1.87	18.70	20.40
0.049	2.38	48.57	1152+60	0.049	2.32	47.35	47.96
0.949	22.53			0.949	26.59		
AVG =	23.74			AVG =	28.02	TOTAL AVG=	25.88

Incentive Levels

Station	1/2" Bump Locations	Station
		Bump

Contractor lab	Contractor Results	DOT Results	Difference	IM 216 Tolerance
06&10 HWY 30*	24.81 in/mi	25.88 in/mi	1.07 in/mi	+/- 4 in/mi

* Combined 2 Contractor reports (06-HWY30-BOONE-2011 and 10-HWY30-BOONE-2011)
RESULTS COMPLY WITH IM 216. Will need to check more smoothness on rest of the project to achieve 10%

Copies: Special Investigations, Ames
District 1 Materials Engineer
DSM RCE
Manatt's Inc.-job superintendent

Jeff Brinkman--cert number CI 429
District 1 Materials Tech 3

CONCRETE TECHNOLOGIES, INC.
3809 NW 109ST SUITE D
URBANDALE, IOWA 50322
P: 515-252-1650 F: 515-252-1642

PAVEMENT TEST REPORT

25-FOOT AMES PROFILOGRAPH

District 1 Materials

Revised Report:

Changes Lab. No. _____

[ ] For Information Only [ ] Preliminary [ ] Intermediate [X] Final

Lab No:	15014-9F	Route No:	I-80		IMX-80-5(329)143--02-77
Date Reported:	8/21/2015	Date Paved:	8/20/15	County:	Polk/Jasper
				Contractor:	Concrete Technologies
Tested By:	Scott Palmer			Date:	8/21/2015
Trace Reduced By:	Computer			Date:	8/21/2015
Testing Specification:	2316			Tested at:	
Paving Type:	PCC Slipform			Blanking Band:	0.2 Inch

Roadway Type: [ ] 2-LANE [ ] 4-LANE [ ] RAMP [X] OTHER

WESTBOUND ABI #9	Direction (4-Lane Only)	WESTBOUND NEW 9

Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Mile)	Location (Station)			Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Mile)	Target Av (In./Mi.)	Incent./ Deduct
0.100	1.33	13.30	Header		Header	0.100	0.48	4.80	10.15	$0.00
0.100	0.96	9.60	1661+84		1661+84	0.100	0.00	0.00	8.30	$0.00
0.100	2.68	26.80				0.100	0.47	4.70	16.90	$0.00
0.100	1.31	13.10	Header		Header	0.100	0.16	1.60	10.05	$0.00
0.100	3.58	35.80	1629+32		1629+32	0.100	0.09	0.90	21.40	$0.00
0.116	2.00	17.25	Notes:			0.116	0.65	5.61	12.13	$0.00
			0-ABI = $0.00							
			ABI+0.1 - ABI+4.0 = -$300							
			ABI+4.1 - ABI+8.0 = -$500							
			ABI+8.1 - ABI+12.0 = -$800							
			< ABI + 12.0 = Grind							
0.616	*11.86*					*0.616*	*1.85*			*$0.00*

Avg: *19.26* Avg: *3.00*

Station	1/2" Bump/Dip Locations	Station
1649+28 -B		NONE
1640+24 -D		
1637+50 - B		
1637+36 - D		
ABI BUMPS/DIPS		*NEW BUMPS/DIPS*

Copies: Special Investigations, Marshaltown
District Materials Engineer
CTI File

Andrew Denker #CI862

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

Cedar Valley Corp.

P.O. Box 1740, Waterloo, IA 50704

DISTRICT TEST REPORT
MATERIALS DISTRICT # 3

☐ REVISION TO (Grinding Done)
☐ CORRECTION TO _____

☑ ENGLISH ☐ METRIC

☐ NEW BRIDGE DECK ☐ BRIDGE DECK OVERLAY

☐ INFORMATIONAL ☐ PRELIMINARY ☐ INTERMEDIATE ☑ FINAL

LAB NO	15012-10 NBL	ROUTE NO	Hwy 71	PROJECT #	NHSX-071-8(59)--3H-21
PAVE DATE	06/25/15 & 06/26/15	REPORT DATE	6/29/2015	COUNTY	Clay
TESTED AT:	Wheel Track	BAND	0.0	PRIME	CVC
TESTED BY:	J Glaspie NE246			SUB	
REDUCED BY:	J Glaspie NE246			DESIGN #:	

SCHEDULE A ☐ MULTI-LANE ☐ PRIMARY ☐ NON PRIMARY

SCHEDULE B ☐ NEW ☐ RESURFACED

PLACEMENT TYPE: PCC SLIP FORM

☐ SECONDARY

SPEED: Greater than 45 MPH

☐ MUNICIPAL ☐ BUMPS / DIPS

ROADWAY TYPE: 2 LANE

☑ N.B. ☐ E.B. <---------- DIRECTION ----------> ☐ S.B. ☐ W.B.

☑ OSWT ☐ OUTSIDE LANE ☐ CENTER LANE ☐ INSIDE LANE ☑ ISWT

Length	Measured Roughness	Profile Index		LOCATION	Length	Measured Roughness	Profile Index	Average Profile Index	Incentive
0.100	2.03	20.30			0.100	1.94	19.40	19.85	850
0.100	1.78	17.80		474+00.0	0.100	1.62	16.20	17.00	850
0.100	2.39	23.90		TO	0.100	2.03	20.30	22.10	650
0.100	1.60	16.00		397+00.0	0.100	1.92	19.20	17.60	850
0.100	1.75	17.50			0.100	1.77	17.70	17.60	850
0.100	1.70	17.00			0.100	2.03	20.30	18.65	850
0.100	1.93	19.30			0.100	2.58	25.80	22.55	650
0.100	1.80	18.00			0.100	1.63	16.30	17.15	850
0.100	1.71	17.10			0.100	1.20	12.00	14.55	850
0.100	1.78	17.80			0.100	1.98	19.80	18.80	850
0.100	1.92	19.20			0.100	1.50	15.00	17.10	850
0.100	1.47	14.70			0.100	1.69	16.90	15.80	850
0.100	2.37	23.70		TO	0.100	2.22	22.20	22.95	650
0.100	2.30	23.00			0.100	1.59	15.90	19.45	850
0.058	0.96	16.55			0.058	0.97	16.72	16.64	850
1.458	**27.49**	**18.85**	**0**	**TOTALS**	**1.458**	**26.67**	**18.29**	**18.6**	**12150**

Total Incentive this Report
$12,150.00

NO CORRECTIVE WORK REQUIRED 100% PAY

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

Name: J Glaspie NE246

BUMPS	DIPS		BUMPS	DIPS
EXCLUDED BUMPS	EXCLUDED DIPS		EXCLUDED BUMPS	EXCLUDED DIPS

R = Rerun A = Grinding was done

rev 06/05/13

REMARKS:

HENNINGSEN CONST. INC.

PAVEMENT TEST REPORT

For Information Only [ ] Preliminary [ ] Intermediate [ ] Final [X]

Lab No. WB073014
Date Reported 8/1/2014

Route No. HWY 3
Date Paved 7/30/2014

Project No. NHSX-003-2(62)--3H-18
County CHEROKEE
Contractor HENNINGSEN

Traced By A.WILLIAMS
Reduced By COMPUTER

Tested At: 1/4 pt. [ ] Wheel Track [X]

Blanking Band 0

Primary Schedule A [X]
Primary Schedule B [ ]
2316 SCHEDULE B [ ]

ACC Paving [ ]
ACC Resurfacing [X]
PCC Patching [ ]

2-Lane [X]
4-Lane [ ]
Ramp [ ]

NB [ ]
SB [ ]
EB [ ]
WB [X]

IN LANE [ ]
OUT LANE [ ]

1/2" Bump Locations

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract secifications and requirments.
Aaron Williams SW 629

Segment Number	Length (miles)	Track 1 Measured Roughness (inches)	Track 1 Profile Index (in/mi)	Track 2 Measured Roughness (inches)	Track 2 Profile Index (in/mi)	Start Station	End Station	Average Profile Index (in/mi)
A	0.1	1.82	18.20	1.44	14.40	451+52		16.30
1	0.1	0.99	9.90	1.16	11.60			10.75
2	0.1	1.21	12.10	0.89	8.90			10.50
3	0.1	1.29	12.90	1.17	11.70			12.30
4	0.1	1.07	10.70	0.76	7.60			9.15
5	0.1	1.17	11.70	1.19	11.90			11.80
6	0.1	1.17	11.70	1.05	10.50			11.10
7	0.1	1.35	13.50	0.86	8.60			11.05
8	0.085	1.18	13.85	0.80	9.39		404+78	11.62

NO CORRECTIVE WORK REQUIRED

AVERAGE FOR THE DAY 11.62

Norris Asphalt Paving Company
ENGLISH

Revised Report		Changes:	
Information only		Intermediate	
Preliminary		Final	<<====

Project No.	STPN-002-7(38)--2J-04	Report I.D.	2
County	Appanoose	Date Reported	06/23/15
Route No.	Highway 2	Date Paved	06/22/15

Traced By:	Chad Meyer	Date	06/22/15
Reduced By:	Computer	Date	06/22/15

Primary Schedule A:	<<====	ACC Paving	
Primary Schedule B:		ACC Resrfcing	<<====
Secondary:		ACC Patches	
Municipal:			
Other:			

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

Roadway Type:	2-Lane	<<====	Ramp	
	4-Lane		Other	

NORTH BOUND		<-- DIRECTION -->	SOUTH BOUND	
EAST BOUND		<-- DIRECTION -->	WEST BOUND	<<====

INSIDE LANE		<-(4-LANE ONLY) ->	OUTSIDE LANE	
CENTERLINE		<-(PATCHES ONLY)->	1/4 POINT	

LENGTH (MILES)	MEASURED ROUGHNESS (L.WHEEL)	MEASURED ROUGHNESS (R. WHEEL)	AVERAGE PROFILE INDEX	LOCATION (STATIONS)	INCENTIVE/ DEDUCT	NOTES	
0.1	1.09	1.25	11.70	565.92	INCENTIVE		$350
0.1	1.00	0.99	9.95		INCENTIVE		$750
0.1	0.83	0.89	8.60		INCENTIVE		$750
0.1	0.91	0.75	8.30		INCENTIVE		$750
0.1	0.70	0.66	6.80		INCENTIVE		$750
0.1	0.93	0.75	8.40		INCENTIVE		$750
0.1	1.15	0.85	10.00		INCENTIVE		$750
0.1	1.08	1.15	11.15		INCENTIVE		$500
0.1	0.95	0.70	8.25		INCENTIVE		$750
0.1	0.87	0.54	7.05		INCENTIVE		$750
0.1	0.96	0.68	8.20		INCENTIVE		$750
0.1	1.34	0.86	11.00		INCENTIVE		$500
0.1	1.06	0.92	9.90		INCENTIVE		$750
0.1	1.49	0.92	12.05		INCENTIVE		$350
0.1	1.51	1.02	12.65		INCENTIVE		$350
0.1	1.72	1.13	14.25		INCENTIVE		$200
0.1	1.11	1.06	10.85		INCENTIVE		$500
0.1	1.45	1.02	12.35		INCENTIVE		$350
0.1	1.15	0.72	9.35		INCENTIVE		$750
0.1	1.08	0.97	10.25		INCENTIVE		$500
0.1	1.10	0.73	9.15		INCENTIVE		$750
0.1	1.09	0.63	8.60		INCENTIVE		$750
0.1	1.02	0.75	8.85		INCENTIVE		$750
0.1	1.39	1.01	12.00		INCENTIVE		$350
0.1	1.10	0.93	10.15		INCENTIVE		$500
0.1	0.95	0.75	8.50		INCENTIVE		$750
0.1	1.03	0.90	9.65		INCENTIVE		$750
0.1	1.19	1.01	11.00		INCENTIVE		$500
0.1	0.82	0.56	8.90		INCENTIVE		$750
0.1	1.37	0.83	11.00		INCENTIVE		$500
0.1	1.24	0.78	10.10		INCENTIVE		$500
0.1	1.12	0.93	10.25		INCENTIVE		$500
0.10208	1.98	1.15	15.33		INCENTIVE		$200
				391.57			
3.3021	37.78	28.79					
		AVG =	10.08				$19,400

KH

BUMPS AND DIPS:

25 FOOT CALIFORNIA PROFILOMETER [ ] Revised Report
Changes Lab No. _____

New Bridge Deck [X] Bridge Deck Overlay [ ]

For InformationOnly [ ] Preliminary [X] Intermediate [ ] Final [X]

Lab No. 615-6 Route No. IA 316 Project No. BRFN-316-3(14)--39-77
Date Reported _____ Date Poured _____ County POLK
Tested at: Wheeltracks Contractor CRAMER & ASSOCIATES
Tested by SALLY BENSON Date 6/5/2015
Trace Reduced by COMPUTER Date 6/5/2015

Road Type: 2-Lane [ ] 4-Lane [ ] Ramp [ ] Other _____

N.B [X] E.B. [ ] S.B [ ] W.B. [ ]
Outside Lane [ ] Inside lane [ ]

INSIDE WHEELTRACK					OUTSIDE WHEELTRACK		
Length (Miles)	Measured Roughness (Inches)	Profile Index (IN/MI)	Location	AVG	Length (miles)	Measured Roughness (Inches)	Profile Index (IN/MI)
0.117	3.32	28.32	86+58 to 92+77	27.48	0.117	3.11	26.53

Station 86+89	<------ 1/2" Bump Location-------->	**Station**	86+89
87+76	* *Could not grind because of steel channel		87+83
91+23	* incentive		91+20

Copies
Dan Zeimen, P.E.
Scott Dockstader, P.E.
Special Investigations Eng.
Cramer & Associates, Inc.

SALLY BENSON

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

Diamond Surface Inc.
21025 Commerce Blvd.
Suite 900
Roger, MN 55374

Profile Report
Materials District # 6

☐ Revised Report
☐ Correction to

☐ Information Only ☐ Preliminary ☐ Intermediate ☒ Final

Lab No. WB-1 Route No. Co Rd Y61 Project No. STPN-062-1(20)--2J-49
Report Date 9/3/2015 Date Paved 6/29/2015 County Jaskson
Tested At: ☐ 1/4 Point ☒ Wheel Track Contractor Diamond Surface Inc.

Tested By Dan Stoltenberg Date 6/29/2015
Reduced By Computer Date 6/29/2015

☐ Primary Schedule A
☐ Primary Schedule B
☒ Secondary
☐ Municipal
☐ Other

☐ PCC Slip Form
☐ PCC Fixed Form
☐ PCC bonded Overlay
☐ PCC Unbonded Overlay
☐ PCC Patches

☐ ACC Paving
☐ ACC Resurfacing
☐ ACC Patches
☒ PCC Grinding

Roadway Type: ☒ 2-Lane ☐ 4-Lane ☐ Ramp ☐ Other

☐ Northbound ☐ Eastbound ☐ Inside ← Direction 4-Lane Only → ☐ Southbound ☐ Outside ☒ Westbound

Inside Wheel Track				Outside Wheel Track				
Length Miles (km)	Before IRI	After IRI	Location	Length Miles (km)	Before IRI	After IRI	Average IRI	Incentive
0.047	268.18	80.27	1977+28-1974+78	0.047	226.02	100.66	90.47	$0.00
0.100	229.78	56.63	1973+11	0.100	215.51	58.74	57.68	$0.00
0.100	270.29	78.22		0.100	202.44	83.50	80.86	$0.00
0.100	256.13	89.22		0.100	211.34	86.26	87.74	$0.00
0.100	286.31	65.16		0.100	260.05	63.90	64.53	$0.00
0.100	326.63	66.45	TO	0.100	334.25	62.22	64.33	$0.00
0.100	316.15	66.13		0.100	323.95	64.21	65.17	$0.00
0.100	295.73	69.95		0.100	313.99	79.60	74.77	$0.00
0.100	246.52	82.43		0.100	256.72	90.51	86.47	$0.00
0.100	226.25	63.94		0.100	233.51	79.11	71.52	$0.00
0.100	222.73	61.27		0.100	225.79	63.26	62.26	$0.00
0.069	300.14	93.95	1916+64	0.069	306.21	112.91	103.42	$0.00

Station 1/2" Bumps Locations Station
NONE

Copys:

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

Name:
Dan Stoltenberg Cert. Tech. NE716

CMT
1717 NE 58th Ave
Des Moines, Iowa 50313
Phone: 515-263-0794 Fax: 515-263-0851

25 FOOT CALIFORNIA PROFILOMETER

District [2] Materials

[X] Revised Report
Changes Lab. No. HAR-1

[ ] For Information Only [X] Preliminary [ ] Intermediate [ ] Final

Lab No. HAR-1C
Route No. US 65
Project No. STP-65-6(47)--2C-42
Date Reported
Date Paved 6/12/06
County HARDIN
Tested At 1/4 Point [ ] Wheel Track [X] [ ] 0.2" Blanking Band 0.0" [X]
Contractor HEARTLAND ASPHALT
Tested By RALPH DITTMER, MIKE LEEPER
Date 6/12/2006
Traced Reduced By COMPUTER
Date 6/12/2006

[X] Primary Schedule A
[ ] Primary Schedule B
[ ] Other:

[ ] PCC Slip Form
[ ] PCC Fixed Form
[ ] PCC Patches

[ ] ACC Paving
[X] ACC Resurfacing
[ ] ACC Patches

Roadway Type: [X] 2-Lane [ ] 4-Lane [ ] Ramp [ ] Other

[ ] Northbound [ ] Eastbound ← Direction → [X] Southbound [ ] Westbound
[ ] Inside Lane [ ] Inside Wheel Track ← (4-Lane Only) → [ ] Outside Lane [ ] Outside Wheel Track

Length (Miles)		Measured Roughness (Inches)	Profile Index (In/Mi)	Location (Station)	Average Profile Index (Inches/miles)	Length (Miles)		Measured Roughness (Inches)	Profile Index (In/Mi)
INSIDE WHEEL TRACK						OUTSIDE WHEEL TRACK			
0.1		2.89	28.90		30.85	0.1		3.28	32.80
0.1		2.41	24.10	(BEGIN FULL DEPTH)	28.10	0.1		3.21	32.10
0.1		2.41	24.10	1588+94	22.00	0.1		1.99	19.90
0.1		2.32	23.20		24.70	0.1		2.62	26.20
0.1		1.92	19.20	TO	18.60	0.1		1.80	18.00
0.1		1.59	15.90	1417+16	17.35	0.1		1.88	18.80
0.1		1.95	19.50	(END FULL DEPTH)	19.50	0.1		1.95	19.50
0.1		1.79	17.90		19.40	0.1		2.09	20.90
0.1		1.89	18.90		19.70	0.1		2.05	20.50
0.1		1.67	16.70		18.05	0.1		1.94	19.40
0.1		1.59	15.90		17.45	0.1		1.90	19.00
0.1		2.20	22.00		22.10	0.1		2.22	22.20
0.1		1.67	16.70		17.05	0.1		1.74	17.40
0.1		2.04	20.40		20.40	0.1		2.04	20.40
0.1		1.39	13.90		14.35	0.1	D	1.48	14.80
0.1		1.94	19.40		20.20	0.1		2.10	21.00
0.1		1.67	16.70		16.20	0.1		1.57	15.70
0.1		1.78	17.80		17.70	0.1		1.76	17.60
0.1		1.67	16.70		15.05	0.1	D	1.34	13.40
0.1		1.54	15.40		15.65	0.1		1.59	15.90

Note: A = $750.00 Incentive Pay
B = $500.00 Incentive Pay
C = $350.00 Incentive Pay
D = $200.00 Incentive Pay

***Note:** 1/2" bump in outside wheel track at Station 1466+94 corrected by contractor.

PAGE 1 OF 2

Station NONE

(1/2") Bump Locations
or
(1/2") Dip Locations

Station NONE

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

Form 821301
3-63

District ____ Materials
25 FOOT CALIFORNIA PROFILOMETER

☐ Revised Report
Changes Lab. No. _____

For Information Only ☐ Preliminary ☐ Intermediate ☐ Final ☐

Lab. No. _____ Route No. [redacted] Project No. [redacted]
Date Reported _____ Date Paved [redacted] County [redacted]
Tested at: ¼ [redacted] Wheel Track ☐ Contractor [redacted]
Tested By [redacted] Date [redacted]
Trace Reduced By [redacted] Date [redacted]

Primary Schedule A ☒ PCC Slip Form ☐ ACC Paving ☐
Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing ☒
Secondary ☐ PCC Bonded Overlay ☐ ACC Patches ☐
Municipal ☐ PCC Unbonded Overlay ☐
Other ☐ PCC Patches ☐

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

N.B. ☐ E.B. ☒ ← Direction → S.B. ☐ W.B. ☐
Inside Lane ☐ ← (4-Lane Only) → Outside Lane ☒
Centerline ☐ ← (Patches Only) → ¼ Point ☐

Measured

Bad Example

BEGINNING STATION	ENDING STATION	DISTANCE MEASURED (FEET)	DISTANCE TRAVELED (FEET)	PROFILE INDEX (IN/MI)
651+86	657+14	528	528	2.8
657+14	662+42	528	528	3
662+42	667+70	528	528	0.8
667+70	672+98	528	528	1.7
672+98	678+26	528	528	2.3
678+26	683+54	528	528	3.5
683+54	688+07	146	453	2.1
688+07	690+50	0	243	Bridge
690+50	695+78	235	528	1.5
695+78	701+06	528	528	2.5
701+06	706+34	528	528	2.4
706+34	711+62	528	528	0.7
711+62	716+90	528	528	1.9
716+90	722+18	528	528	0.7
722+18	727+46	528	528	4.6
727+46	732+74	528	528	2.6
732+74	738+02	528	528	3.2
738+02	743+30	528	528	7.3
743+30	748+58	528	528	2.5
748+58	753+86	528	528	4.6
753+86	759+14	528	528	6.2
759+14	764+42	528	528	4.6
764+42	769+70	528	528	0.6
Bumps or Dips	None			

25 – FOOT CALIFORNIA PROFILOGRAPH

☒ For Information Only ☐ Preliminary ☐ Intermediate ☐ Final

Lab No. [redacted] Route No [redacted] Project No. [redacted]

Date Reported [redacted] Date Paved [redacted] Cou[redacted]

Tested At: ☒ ¼ Point ☐ Wheel Track Contractor [redacted]

Tested By [redacted] Date [redacted]

Trace Reduced By [redacted] Date [redacted]

☒ Primary Schedule A ☒ PCC Slip Form ☐ ACC Paving

☐ Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing

☐ Secondary ☐ PCC Bonded Overlay ☐ ACC Patches

☐ Municipal ☐ PCC Unbonded Overlay

☐ Other ☐ PCC Patches

Bad Example

Roadway Type: ☒ 2-Lane ☐ 4-Lane ☐ Ramp ☐ Other ____

☒ Northbound ☐ Eastbound ≥ Direction ☐ Southbound ☐ Westboun

☒ Inside Lane ≥ (4-Lane Only) ☒ Outside Lane

Length Miles (km)	Measured Roughness Inches (mm)	Profile Index Inches/Miles (mm/km)	Location (Station)	Length Miles (km)	Measured Roughness Inches (mm)	Profile Index Inches/Miles (mm/km
0.069	0.80	11.59	132+17	0.161	10.00	62.11
0.161	21.00	130.43	to	0.161	17.70	109.94
0.161	8.60	53.42	139+31	0.161	21.70	134.78
0.161	5.20	32.30		0.161	2.60	16.15
0.161	2.90	18.01		0.068	0.00	0.00
Total	Total	Total		Total	Total	Total
52.00	73.	54.00 mm/km		0.712	52.00	73.03 mm/km

[redacted]

Station ≥ ½" (12.7 mm) **Bump Locations** or ½" (12.7 mm) **Dip Locations** **Station**

Bump 136+26 to 136+27

Copies [redacted]

[redacted]

IM 207
INDEPENDENT ASSURANCE

INDEPENDENT ASSURANCE PROGRAM FOR CONSTRUCTION OVERVIEW & DESCRIPTION

The Independent Assurance Program (IAP) is a part of the Iowa DOT Quality Assurance Program for Construction. Appendix A contains the details of who is covered and what sampling and testing is covered in the program.

- Purpose of IAP— IAP is an unbiased and independent assessment of all sampling, testing, and testing equipment. This assessment includes evaluation of procedures and equipment used for the acceptance of highway materials and construction. 23 CFR Part 637 requires each state to have an IA Program.
- IAP is distinct from and not intended as an acceptance process or for use in verification of contractor sampling and testing results. IAP is distinct from and not intended for production quality control (QC) purposes. If IAP results indicate a potential problem with quality, the results may be used to initiate additional testing.
- IAP sampling shall be done in such a manner as to minimize variability. In order to eliminate material and process variability, split samples should be used. IAP samples may be taken independently of Agency verification or Contractor/Producer QC samples, or may be a split of a verification or an QC sample.
- Deficiencies in verification or QC processes that are identified through the IAP program must be investigated and resolved.
- IAP is an essential tool that helps to ensure integrity within the quality assurance (QA) program.

The IAP includes both system- and project-based approaches defined as follows:

- Project Approach. The frequency of IAP activities is based primarily on quantities of materials being tested and requires minimums (as per IM 204) on every project. For projects with small quantities, project IAP will not be required:
  HMA quantities less than 5000 tons
  PCC paving quantities less than 5000 sq. yds.
  PCC for structural and miscellaneous less than 50 cu. yds.
  Non-Proportioned aggregate less than 5000 tons.
  Earthwork quantities less than 50,000 Yd^3.
- System Approach. The frequency of IAP activities is based on time intervals, regardless of the number of tests, quantities of materials, or numbers of projects being tested by the individual and equipment being evaluated. Each active technician should be checked at least 1 time per year. For HMA, the Districts Laboratories perform proficiency testing monthly during the construction season and field HMA laboratories perform proficiency testing at least 1 time per construction season. If a significant deficiency is observed for a technician, a later second check should be made.

Record keeping is required for all IAP observations and tests. The record should include who and what was checked, when, where, and the outcome of the check. An annual report is required by the FHWA detailing the system approach program- how many people for each test were checked, what was found, and how it was resolved. Also any systematic issues should be detailed (i.e. problems with equipment or calibrations, need for additional training, improvements in test procedure instructions.).

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

IAP Responsibilities

PCC Paving				
Procedure to Check	**To Whom**	**By Whom**	**How**	**Approach(1)**
Core Sampling	RCE	Training	Training	System
Core Testing	RCE	DME	Test same cores- IM 216	Project
Air Sampling	RCE	DME	Observe	Both
Air Testing	RCE	DME	Side-by-side tests- IM 216	Both
Aggregate Grad. Sampling	RCE, CONTR(3)	Training or DME	Training or Observe	Both
Aggregate Grad. Testing	RCE, CONTR(3), DME(2)	DME	Split Test- IM 216	Both
Aggregate Quality Sampling	DME	Training/Demo.	Training	System
Aggregate Quality Testing	None	None		
Cementitious Materials Sampling	DME	Training/Demo.	Training	System
Cementitious Materials Testing	None	None		
Admixtures Sampling	DME	Training/Demo.	Training	System
Admixtures Testing	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.
Note 3- QMC projects only.
RCE-Resident Construction Engineer/Project Engineer
DME-District Materials Engineer
CTRL-Central Materials Office
CONTR-Contractor

IAP Responsibilities

PCC Structures				
Procedure to Check	**To Whom**	**By Whom**	**How**	**Approach(1)**
Slump Sampling	RCE	DME	Observe	Both
Slump Testing	RCE	DME	Observe or side-by-side tests- IM 216	Both
Air Sampling	RCE	DME	Observe	Both
Air Testing	RCE	DME	Side-by-side tests- IM 216	Both
Aggregate Grad. Sampling	CONTR, RCE	DME	Observe	Both
Aggregate Grad. Testing	RCE	DME	Split tests- IM 216	Both
Aggregate Quality Sampling	DME	Training/Demo.	Training	System
Aggregate Quality Testing	None	None		
Cementitious Materials Sampling	DME	Training/Demo.	Training	System
Cementitious Materials Testing	None	None		
Admixtures Sampling	DME	Training/Demo.	Training	System
Admixtures Testing	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.
RCE-Resident Construction Engineer/Project Engineer
DME-District Materials Engineer
CTRL-Central Materials Office
CONTR-Contractor

IAP Responsibilities

Non-Proportioned Aggregates (Including Recycled)				
Procedure to Check	**To Whom**	**By Whom**	**How**	**Approach(1)**
Aggregate Grad. Sampling	CONTR, DME	Training or DME	Training or Observe	Both
Aggregate Grad. Testing	CONTR, DME	DME	Proficiency or Split test IM 208/216	Both
Aggregate Quality Sampling	DME	Training/Demo.	Training	System
Aggregate Quality Testing	None	None		

Note 1- The DME may use different approaches for DOT, local agency, and contractor personnel.
RCE-Resident Construction Engineer/Project Engineer
DME-District Materials Engineer
CTRL-Central Materials Office
CONTR-Contractor or Producer

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 applicable schooling 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 shall be valid for five years.

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 December 31st of the fifth year. A 90-day grace period will be allowed. If the individual has not renewed their certification within the 90-day grace period, they are automatically decertified. The individual may obtain certification by taking the examination for the level of certification they are requesting. If the individual does not take the examination within one year after their certification(s) expire, i.e., 12/31/expiration year, they must retake all applicable schooling and pass the examinations. 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.

All certified technicians will be required to pass an examination in each level of certification they hold before recertification will be issued. Failure of any level shall require the applicant to retake the applicable schooling and pass the test.

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 permanent file with the District Materials Office in which the technician resides. The notice will also be placed on the statewide computer file. 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 & RESPONSIBILITES

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
	CONTRACT ADMINISTRATION	
Level II Contract Admin.	Level II Contract Admin. Tech	Level I Contract Admin.
Level III Contract Admin.	Level III Contract Admin. Tech	Level II Contract Admin., Level I HMA, Level II PCC
	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 will be placed in your permanent file with the District Materials Office in which you reside. It will also be placed on the statewide computer file.

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

Unsatisfactory Performance:

_____

_____

_____

_____

_____

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_____

_____
District Materials Engineer

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

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."

CERTIFIED TECHNICIANS QUALIFICATIONS

Tests and Procedures the Certified Technician is qualified to perform for each level of certification.

AGGREGATE SAMPLER

- IM 204 - Inspection of Construction Project Sampling & Testing (when material is incorporated)
- IM 209, App. C - Aggregate Specification Limits & Sampling & Testing Guide (when material is produced)
- IM 301 - Aggregate Sampling Methods
- IM 336 – Methods of Reducing Aggregate Field Samples to Test Samples

AGGREGATE TECHNICIAN

- IM 204 - Inspection of Construction Project Sampling & Testing (when material is incorporated)
- IM 209, App. C - Aggregate Specification Limits & Sampling & Testing Guide (when material is produced)
- IM 210 – Production of Certified Aggregate From Reclaimed Roadways
- IM 216 - Guidelines for Verifying Certified Testing Results
- IM 301 - Aggregate Sampling Methods
- IM 302 - Sieve Analysis of Aggregates
- IM 306 - Determining the Amount of Material Finer Than #200 (75µm) Sieve in Aggregate
- IM 307 - Determining Specific Gravity of Aggregate
- IM 308 - Determining Free Moisture & Absorption of Aggregate
- IM 336 - Methods of Reducing Aggregate Field Samples to Test Samples
- IM 344 - Determining the Amount of Shale in Fine Aggregate
- IM 345 - Determining the Amount of Shale in Coarse Aggregate
- IM 368 – Determining the Amount of Clay Lumps & Friable Particles in Coarse Aggregate
- IM 409 – Source Approvals for Aggregate

LEVEL II CONTRACT ADMINISTRATION

- N/A

LEVEL III CONTRACT ADMINISTRATION

- IM 101 – Review of Materials Used in Construction & Maintenance Projects
- IM 103 – Inspection Services Provided to Counties, Cities, and Other State Agencies
- IM 204 – Inspection of Construction Project Sampling & Testing

HMA BASIC TESTER (This is for Provisional Certification Only)

- IM 321 - Method of Test for Compacted Density of Hot Mix Asphalt (HMA) (Displacement Method)
- IM 322 - Method of Sampling Uncompacted Hot Mix Asphalt
- IM 323 - Method of Sampling Asphaltic Materials
- IM 325G - Method of Test for Determining the Density of Hot Mix Asphalt (HMA) Using the Superpave Gyratory Compactor (SGC)
- IM 350 - Maximum Specific Gravity of Hot Mix Asphalt (HMA) Mixtures

- IM 357 - Preparation of Hot Mix Asphalt (HMA) Mix Samples for Test Specimens
- All forms must be signed by an HMA I or HMA II certified technician

HMA SAMPLER

- IM 320 – Method of Sampling Compacted Asphalt Mixtures
- IM 321 – Method of Test for Compacted Density of Hot Mix Asphalt (HMA) (Displacement Method)
- IM 322 - Method of Sampling Uncompacted Hot Mix Asphalt
- IM 323 - Method of Sampling Asphaltic Materials

LEVEL I HMA

- IM 204 - Inspection of Construction Project Sampling & Testing
- IM 208 - Materials Laboratory Qualification Program
- IM 216 - Guidelines for Verifying Certified Testing Results
- IM 320 - Method of Sampling Compacted Asphalt Mixtures
- IM 321 - Method of Test for Compacted Density of Hot Mix Asphalt (HMA) (Displacement Method)
- IM 322 - Method of Sampling Uncompacted Hot Mix Asphalt
- IM 323 - Method of Sampling Asphaltic Materials
- IM 325G - Method of Test for Determining the Density of Hot Mix Asphalt (HMA) Using the Superpave Gyratory Compactor (SGC)
- IM 337 - Determining Thickness of Completed Courses of Base, Subbase, & Hot Mix Asphalt
- IM 350 - Maximum Specific Gravity of Hot Mix Asphalt (HMA) Mixtures
- IM 357 - Preparation of Hot Mix Asphalt (HMA) Mix Samples for Test Specimens
- IM 501 - Asphaltic Terminology, Equations & Example Calculations
- IM 508 - Hot Mix Asphalt (HMA) Plant Inspection
- IM 509 - Tank Measurement & Asphalt Cement Content Determination
- IM 511 - Control of Hot Mix Asphalt (HMA) Mixtures

LEVEL II HMA

- IM 380 - Vacuum-Saturated Specific Gravity & Absorption of Combined or Individual Aggregate Sources
- IM 510 - Method of Design of Hot Mix Asphalt (HMA) Mixes
- AASHTO T176 - Plastic Fines in Graded Aggregate & Soils by use of Sand Equivalent Test
- AASHTO T304 - Uncompacted Void Content of Fine Aggregate
- ASTM D 4791 - Flat Particles, Elongated Particles, or Flat & Elongated Particles in Coarse Aggregate
- AASHTO T283 Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage

LEVEL I PCC

- IM 204 - Inspection of Construction Project Sampling & Testing
- IM 208 - Materials Laboratory Qualification Program
- IM 216 - Guidelines for Verifying Certified Testing Results
- IM 315 - Method of Protecting, Curing, Making & Testing Concrete Cylinders
- IM 316 - Flexural Strength of Concrete

- IM 317 - Slump of Hydraulic Cement Concrete
- IM 318 - Air Content of Freshly-Mixed Concrete by Pressure
- IM 327 - Sampling Freshly-Mixed Concrete
- IM 328 - Making, Protecting, and Curing Concrete Flexural Specimens
- IM 340 - Weight Per Cubic Foot, Yield, & Air Content (Gravimetric) of Concrete
- IM 347 – Measuring Length of Drilled Concrete Cores
- IM 383 - Testing the Strength of PCC Using the Maturity Method
- IM 385 - Temperature of Freshly-Mixed Concrete
- IM 525 - Designing Flowable Mortar
- AASHTO T97 - Third Point Loading

LEVEL II PCC

- IM 527 - Paving Plant Inspection
- IM 528 - Structural Concrete Plant Inspection
- IM 529 - PC Concrete Proportions

LEVEL III PCC

- IM 530 - Quality Management & Acceptance of PC Concrete Pavement
- IM 531 - Test Method for Combining Aggregate Gradations
- IM 532 - Aggregate Proportioning Guide for Portland Cement Concrete Pavement

PRESTRESS

- IM 570 - Precast & Prestressed Concrete Bridge Units

RIDE QUALITY

- IM 341 - Determining Pavement & Bridge Ride Quality

SOILS

- IM 309 – Determining Standard Proctor Moisture Density Relationship of Soils
- IM 312 – Sampling of Soils for Construction Project
- IM 335 – Determining Moisture Content of Soils
- ASTM D-2937 – Field density by drive-cylinder method

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. Indentify 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.

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

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

In-Place Wet Density, Soils & Bases	IM 334, 326, other approved	2.0 lb./ft³
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)	IM 341	
Verification Profile Index Test Result		
Inches/mile		
6.0 or less		1.0 in./mi.
6.1 to 20.0		2.0 in./mi.
20.1 to 40.0		3.0 in./mi.
More than 40.0		5.0 in./mi.
Pavement Profile Index (0.0” blanking band)	IM 341	
Verification Profile Index Test Result		
Inches/mile		
25.0 or less		3.0 in./mi.
25.1 to 40.0		4.0 in./mi.
More than 40.0		5.0 in./mi.
Bridge Profile Index (0.2” blanking band)	IM 341	
Verification Profile Index Test Result		
Inches/mile		
6.0 or less		2.0 in./mi.
6.1 to 20.0		3.0 in./mi.
20.1 to 40.0		4.0 in./mi.
More than 40.0		6.0 in./mi.
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

TOLERANCES FOR AGGREGATE GRADATIONS

Determining the precision of an aggregate sieve analysis presents a special problem because the result obtained with a sieve is affected by the quantity of material retained on the sieve and by results obtained on sieves coarser than the sieve in question. Tolerances are, therefore, given for different ranges of percentage of aggregate passing one sieve and retained on the next finer sieve used.

Comparisons of test results are made on each fraction of the sample, expressed in percent that occurs between consecutive sieves.

NOTE: Unless otherwise noted, tolerances for aggregate gradations are only valid if the two tests were made on a split sample. Experience has shown that improper sample reduction, as well as differences in test procedures can contribute to results being out of tolerance. When a comparison exceeds the tolerance limits, a review of the test procedures and equipment will be performed. Where practical, additional comparisons will be done with similar equipment and methods.

Table 1 Tolerances for All Aggregates Except HMA-Combined Aggregate

	Size Fraction Between Consecutive Sieves, %*			Tolerance, %
Coarse Portion:	0.0	to	3.0	2
#4 Sieve and larger	3.1	to	10.0	3
	10.1	to	20.0	5
	20.1	to	30.0	6
	30.1	to	40.0	7
	40.1	to	50.0	9
Fine portion:	0.0	to	3.0	1
#8 Sieve and smaller	3.1	to	10.0	2
	10.1	to	20.0	3
	20.1	to	30.0	4
	30.1	to	40.0	4

Table 2 Tolerances for All HMA-Combined Aggregate

Size Fraction Between Consecutive Sieves, %*				Tolerances(1)
0.0	to	3.0		2
3.1	to	10.0		3
10.1	to	20.0		5
20.1	to	30.0		6
30.1	to	40.0		7
40.1	to	50.0		9

(1) Minimum tolerance of 5% is applied to all size fractions coarser than the #4 sieve when comparing cold feed to ignition oven as shown on page 3 of Appendix A.
*The verification test analysis fraction is used to find the proper tolerance.

COMPARISON OF AGGREGATE GRADATIONS

Use of these tolerances is explained in the following examples. Computer spreadsheets to perform the analysis are available on the Iowa DOT Materials Office website. Use of the spreadsheets is preferred when possible. Appendix A contains a copy of the printouts from the spreadsheets.

Example 1 - PC Concrete Coarse Aggregate

Sieve Size	DOT Coarse Aggr Percent Passing	Prod./CPI Coarse Aggr Percent Passing	DOT Coarse Aggr Percent Retained	Prod./CPI Coarse Aggr Percent Retained	Fraction Difference	Applicable Tolerance	Complies
1.5"	100.0	100.0	0.0	0.0	0.0	2	Yes
1"	97.1	99.1	2.9	0.9	2.0	2	Yes
3/4"	72.2	65.1	24.9	34.0	9.1	6	No
1/2"	38.1	34.9	34.1	30.2	3.9	7	Yes
3/8"	12.0	8.8	26.1	26.1	0.0	6	Yes
#4	0.6	0.2	11.4	8.6	2.8	5	Yes
#8	0.5	0.2	0.1	0.0	0.1	1	Yes
Minus #200	0.3	0.2	0.3	0.2	0.1	1	Yes

The size fraction between consecutive sieves is found by calculating the difference between the percent passing reported for the two sieves. For example, the fraction between the 1.5 in. and 1 in. sieves for the above verification test is 100.0 - 97.1 = 2.9%. Between the 1/2 in. and 3/8 in. sieves it is 38.1 – 12.0 = 26.1%. Since nothing passes the pan, the size fraction between the #200 sieve and the pan is equal to the percent passing the #200.

The example shows the fraction between each pair of consecutive sieve sizes for both tests and the difference between these fractions for both tests. The difference is compared with the applicable tolerance to determine a disposition. In this example, a suspect result is found in the fraction between the 1 in. and 3/4 in. sieves. Since the suspect difference is due primarily to the percent passing results on the 3/4 in. sieves, it is these results that should at least be investigated first. Only further investigation can determine which 3/4 in. sieve, if any is faulty.

NOTE: The applicable tolerance changes between #4 and #8 size fractions.

Example 2 - PC Concrete Fine Aggregate

Sieve Size	DOT Fine Aggregate Percent Passing	Prod./CPI Fine Aggregate Percent Passing	DOT Fine Aggregate Percent Retained	Prod./CPI Fine Aggregate Percent Retained	Fraction Difference	Applicable Tolerance	Complies
3/8"	100.0	100.0	0.0	0.0	0.0	2	Yes
#4	95.0	95.0	5.0	5.0	0.0	3	Yes
#8	87.8	86.3	7.2	8.7	1.5	2	Yes
#16	72.0	71.5	15.8	14.8	1.0	3	Yes
#30	44.0	43.8	28.0	27.7	0.3	4	Yes
#50	12.2	13.0	31.8	30.8	1.0	4	Yes
#100	1.5	1.3	10.7	11.7	1.0	3	Yes
Minus #200	0.4	0.4	0.4	0.4	0.0	1	Yes

Example 3 - HMA Combined Aggregate

		Sieve Sizes										
		1"	3/4"	1/2"	3/8"	4	8	16	30	50	100	200
	Specs.											
	D.O.T.		100	99.1	87.3	68.8	54.2	41.4	28.2	15.5	9.1	6.9
	Prod./C.P.I.		100	98.8	86.1	74.9	56.1	41.9	28.7	15.1	10.9	8.6

D.O.T. % Retained	Prod./C.P.I. % Retained	Diff.	Tol. %	Comply (Y/N)
NA	NA	0.0	2	Y
0.9	1.2	0.3	2	Y
11.8	12.7	0.9	5	Y
18.5	11.2	7.3	5	N
14.6	18.8	4.2	5	Y
12.8	14.2	1.4	5	Y
13.2	13.2	0.0	5	Y
12.7	13.6	0.9	5	Y
6.4	4.2	2.2	3	Y
2.2	2.3	0.1	2	Y
6.9	8.6	1.7	3	Y

D.O.T. FBR: _____

Sieve Fraction Between Consecutive Sieves, %			Tolerance, %
0.0	To	3.0	2
3.1	To	10.0	3
10.1	To	20.0	5
20.1	To	30.0	6
30.1	To	40.0	7
40.1	To	50.0	9

NOTE: The applicable tolerance for this combined aggregate sample is from Table 2. In this example, the suspect fractions would indicate a possible problem for two pairs of consecutive sieve sizes involving the #4 sieves. This evidence and the difference in the test values found for the #4 sieves, strongly point to an error in one of the #4 sieve results.

When RAP mixes are used, the comparison data is of the composite gradation results and not of the cold feed.

Example 4 HMA Cold-Feed to Ignition Oven Comparison

			Sieve Sizes - Percent Passing											
			1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
		Specs.	**100**	100	100	90-100	76-90	50-64	30-40		20-28			3.0-7.0
Sample ID		Ign. Oven	100.0	100.0	100.0	92.0	82.0	62.0	40.0	30.0	20.0	15.0	9.0	5.0
Sample ID		Cold-Feed	100.0	100.0	100.0	90.0	80.0	60.0	35.0	27.0	22.0	13.0	7.0	3.0
	Correction Factor		0.0	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.3	-0.3	-0.2	-0.3	-0.3

Sieves	Ign. Oven % Retained	Cold-Feed % Retained	Diff.	Tol. %	Comply (Y/N)
1 1/2 - 1	0.0	0.0	0.0	2	Y
1 - 3/4	0.0	0.0	0.0	2	Y
3/4 - 1/2	8.0	10.0	2.0	3	Y
1/2 - 3/8	10.3	10.0	0.3	5	Y
3/8 - 4	20.2	20.0	0.2	6	Y
4 - 8	22.0	25.0	3.0	6	Y
8 - 16	9.8	8.0	1.8	3	Y
16 - 30	10.0	5.0	5.0	3	N
30 - 50	4.9	9.0	4.1	3	N
50 - 100	6.1	6.0	0.1	3	Y
100 - 200	4.0	4.0	0.0	3	Y
200	4.7	3.0	1.7	3	Y

Corrected Ign. Oven SA:	5.6	Film Thickness:	7.3
Cold-Feed Surface Area:	4.7	Film Thickness:	8.7
Correction Factor:	-0.1		

Sieve Fraction Between Consecutive Sieves, %			Tolerance, %
0.0	To	3.0	2
3.1	To	10.0	3
10.1	To	20.0	5
20.1	To	30.0	6
30.1	To	40.0	7
40.1	To	50.0	9
+#4 sieves minimum tolerance =			5

When comparing an ignition oven extracted gradation to a cold-feed gradation a correction factor must be applied to the ignition oven extracted gradation before comparing it to the cold-feed gradation. The correction factor is determined by calculating the difference between a cold-feed gradation and an ignition oven gradation on the first day of HMA production according to IM 501. The correction factor is then applied to all subsequent comparisons. In the example above, the correction factor was determined on a previous sample. The District Materials Engineer may establish new or average correction factors when needed.

IM 341
DETERMINING QUALITY

DETERMINING PAVEMENT & BRIDGE RIDE QUALITY

SCOPE

This IM describes procedures used to perform smoothness testing on new pavements and bridge deck surfaces. A certified person is required to perform the testing and the reduction and reporting.

PROCEDURE

A. Apparatus

1. Automated procedure
   a. An inertial profiler meeting requirements of AASHTO M 328. See Figure 4

   b. Reporting Form #821301 or a modified form with the same format.

2. Manual procedure
   a. California or Ames Engineering type, 25-foot profilograph. See Figure 1, 2, and 3

   b. Plain recording chart paper for the manual units.

   c. Blanking band, a plastic scale 1.70 in. wide and 21.12 in. long. The center of the scale has an opaque band 0.2 in. wide extending the entire length and scribed lines 0.1 in. apart, parallel to the opaque band. This blanking band is used for reducing bridge deck traces and non-primary road traces. See Figure 5.

   d. Bump template, a plastic template with a line 1 inch long scribed on one face with a small hole or scribed mark at both ends, and a parallel slot (or edge) 0.5 inches away. See Figure 5.

   e. Scale graduated in tenths of an inch.

   f. Medium-point ballpoint pen in red ink or other contrasting color to the profile trace.

   g. Calculator.

   h. Reporting Form #821301 or a modified form with the same format.

B. Profiler Approval

All profilers must first be evaluated by the Iowa DOT Materials Laboratory to be considered for use under Articles 2316, 2317, 2428 and 2529.03, H of the Standard Specifications. The manufacturer or contractor shall arrange for testing on an HMA pavement and a longitudinally tined PCC pavement with a profile index of less than 3.0 inches per mile and shall contact the Special Investigations Engineer to arrange for side-by-side testing with the Iowa DOT test equipment. The units shall be within 0.5 inches per mile on the 0.2-inch blanking band and within 10% on the 0.0-inch blanking band. Re-evaluation may be required if the unit fails to correlate

with the Iowa DOT monitor testing.

C. Traffic Control

1. Follow Traffic Control Layouts in the Iowa DOT Standard Road Plan sheets TC-231 and TC-431 when performing smoothness testing on pavements or bridges under traffic. The link is www.iowadot.gov/erl/current/RS/Navigation/tc.htm.

2. Remember that these are minimum traffic control layouts and that additional signing or more elaborate traffic control layouts (such as a complete lane closure) may be required. Two-way radios may also be required.

3. Safety first! No test result is worth a crash, personal injury or fatality.

D. Calibration

A vertical and a horizontal calibration are required for the profilograph or profiler to work properly. Prior to use, the Iowa DOT shall calibrate profilographs and profilers. The calibration is good for a maximum of one year. The entire profilograph must be assembled for inspection of condition. Contractor-owned ProScan units must also be calibrated annually in the Central Materials Laboratory.

1. The horizontal calibration is done on a 528-ft. test section. The profilograph trace (profilogram) shall be identical to the reference trace when viewed on a light box. A rotating calibration wheel may also be used. The scale is 1:300. The unit shall be adjusted according to the manufacturer's instructions to within a tolerance of 0.25% (0.05 inches on the profilogram, 1.3 feet on the test section).

2. The vertical calibration or verification is done with the unit stopped. Calibration blocks (machined to within 0.01 inches.) are slid under the recording wheel or sensor. For manual units, measure the vertical trace line from the base line to the peak and return. (**NOTE:** The trace line must return to the base line.) For computerized units follow the manufacturer's procedure. The tolerance shall be ± 0.01 inch.

   A rotating calibration wheel shall also be used with the same vertical calibration test tolerance as above. The Profile Index computed by the profilograph shall be within 10% of the established 0.0-inch blanking band index for the calibration wheel. Those profilographs not meeting the tolerance and those profilographs and profilers not calibrated on the wheel may be required to demonstrate compliance on a pavement section. Compliance would be determined comparing the computed index to a calibrated profilograph or profiler run at the same time. The units shall be within 0.5 inches per mile on the 0.2-inch blanking band and within 10% on the 0.0-inch blanking band.

E. Computer Settings

Below are the settings that shall be used for testing in Iowa.

PROFILOGRAPH/ PROFILER CALIBRATION FACTORS

			FILTER SETTINGS	TIRE PRESSURE	
MANUFACTURER	**MANUAL**	**COMPUTER**	**LOW PASS/ DATA**	**170kPa (25 PSI)**	**OTHER**
AMES	X	---	---	---	As Calibrated
AMES	---	X	2.0	X	---
AMES LISA (1)	---	X	2.0	---	10 PSI
COX	X	---	---	X	---
MCCRACKEN	X	---	---	X	---
MCCRACKEN	---	X	2.0	X	---
MACBETH	X	---	---	---	As Calibrated
LAB-BUILT	X	---	---	X	---
SSI	---	X	2.0	X	---
SSI HIGH SPEED (2)	---	X	2.0	---	As Calibrated

(1) The Gocator laser, RoLine laser, and TriODS triple laser are approved for both HMA and tined PCC. The single laser is approved for HMA only.
(2) The Gocator laser and RoLine laser are approved for both HMA and tined PCC. The single laser is approved for HMA only.

PROFILOGRAPH/ PROFILER REDUCTION SETTINGS

Blanking Band*	0.20 inches or 0.001 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

* A zero inch blanking band is used for primary pavement segments.
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 should be set to “0” (off) for the majority of profilograph testing. The filter setting is displayed with the other information at the end of the profilogram. It is intended to be used only on short radius horizontal curves to compensate for the effect of the superelevation. The result of using the filter is a reduction in the longer wavelength features of the profilogram and a possible reduction in the profile index.

F. Test Procedure

1. The contractor (or sub-contractor) responsible for smoothness testing shall give the Project Engineer and the District Materials Engineer 48 hours notice prior to testing so the District Materials Office may provide a certified technician for verification testing.

2. Dirt and debris may affect profilograph index readings. 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. This will produce fewer spikes and a better profile trace to accurately reduce.

3. Since the profilograph is symmetrical, testing may be performed in either direction of traffic. It is desirable to test in the direction of traffic and reduce traces in the direction of traffic wherever possible. While this is easy to do with manual profilograph machines and reduction methods, it is recognized that some computer profilographs may have problems meeting these criteria. It is not the intention to penalize for the use of computer profilographs.

4. Pointer bar use is mandatory except on bridge decks.

5. More than one person may be required to hold the back end of the profilograph exactly at 1/4 point or wheel track on superelevated or sharp horizontal curves.

6. The profilograph is pushed at walking speed. Do not push or pull with a truck or car.

7. For manual units, lift the test wheel and rotate it to take slackness out of the chain, and lower it to the pavement surface at the starting point prior to testing. Lifting the test wheel at the beginning and end of each trace clearly define termini. This may also be accomplished by pulling the recording cable.

8. Note stationing on the profilogram at least every 1000 ft. and preferably every 500 ft. Closer station references are highly desirable where possible. This station referencing on the trace is used to accurately locate 1/2 in. bumps (or dips). Use landmarks, roadway signs, maintenance markers, or mileposts on Hot Mix Asphalt (HMA) resurfacing projects. Spray paint can be used on the pavement for computer profilographs to mark the location of 1/2 in. bumps (or dips).

9. Completely label both ends of the profilograph roll and note the stationing and roll number at each end of the roll. Add the test report laboratory number to each end after reduction.

10. When a segment is corrected by grinding to improve the profile index, the entire segment must be retested and a new profile index calculated to determined specification compliance. The profilograph roll from the corrected area shall be labeled at both ends with the information from the original profilograph roll and a note indicating that the area was corrected by grinding.

11. Test unit positioning

    a. Testing is normally done in wheel path unless noted differently elsewhere in the specifications or this I.M. The specifications identify two locations for testing, the ¼ point and the wheel paths.
        1) For ¼ point testing, the center wheel shall be 6 feet from the centerline or lane line.
        2) For wheel path testing, the center wheel shall be 3 feet and 9 feet from the centerline or lane line. See Figure 6.

    b. Where possible, the profilograph should start with the front wheel at beginning of the new

construction for which the contractor is responsible. See Figure 7.

c. Test to header whenever possible stopping the front wheel at the header, and starting at that same location for the next section. The header must be included in the count and checked for 1/2 in. bumps or dips and count.

d. The 16 ft. to 150 ft. odd length at the end of a day's run due to barrier fences, machinery, paving not placed yet, etc., should be included in the next day's run. When a profiler is used, this distance may be extended to provide for a safe starting and stopping distance.

e. The first 150 ft. on side roads which are 600 feet or longer will be omitted from the profile index. This 150 ft. distance will be measured perpendicular to mainline paving and from edge of pavement to edge of pavement. This area will be checked for bumps and dips only. See Figure 8.

f. Acceleration and deceleration tapers to ramps and loops are tested in the ¼ point. The end of the entrance and exit ramp tapers is located at the point where the ramp is full lane width.

g. Testing starts on transitions and tapers to lanes and ramps when the pavement reaches a width of 4 feet. See Figure 9.

h. Test the wider pavement width on ramps to represent ramp smoothness if the ramp width is placed in more than one pass (such as on HMA resurfacing projects). Testing should be performed as closely to the center of the ramp driving lane as possible. If the pavement joint falls exactly at the center of the driving lane of the ramp, then offset 2 ft. to the right with traffic to test with the profilograph.

i. When testing bridge approaches, push the profilograph 100 ft. on the pavement and 100 ft. on the bridge to get enough trace to correctly position the blanking band through the bridge approach area. Only the actual bridge approach length is analyzed as shown in Figure 10. The header at the bridge and at the approach and adjacent pavement are checked for bumps and dips.

j. When testing over 4 in. expansion joints, fill the space with wood, cover the space with metal (or some other material) so that the small profilograph wheels can roll over the joint.

G. Manual Trace Reduction & Bump Locating Procedure

1. A red (or other contrasting color) outlining procedure is mandatory on all manually reduced profilograms from PCC pavement sections involving price adjustments or incentive payments. No outlining shall be done on HMA or bridge decks. On bridge decks, the deck should be swept and the profilograph should be pushed slowly enough so that no or little spiking occurs.

   a. Outlining is not intended to correct or compensate for an incorrectly run profilogram. Continuous spiking and chatter indicates that the profilograph was operated too fast or the pavement was not cleaned prior to testing. Profilograms with continuous spiking or chatter are not acceptable and should be rerun.

   b. The outlining procedure removes spikes and minor deviations caused by rocks, texturing,

or dirt. See Figure 11. To outline a trace, care should be taken to average only normal spiking. Scallops must **not** be smoothed or averaged during the outlining.

c. Start at one end of the trace. Carefully draw a line along the trace profile. Draw along scallops, even those less than 0.08 inches wide.

2. Use a 1/2 in. bump template to locate bumps or dips for removal. At each prominent bump or dip on the profile trace, place the template so that the small holes or scribe marks at each end of the scribed line intersect the profile trace to form a chord across the base of the dip or indicated bump. The line on the template need not be horizontal. With a sharp pencil draw a line using the narrow slot in the template (or edge) as a guide. Any portion of the trace extending above or below this line will indicate the approximate length and height of the bump or dip in excess of the specification.

3. There may be instances where the distance between easily recognizable low points is less than 1 in. (25 ft.). In such cases a shorter chord length shall be used in making the scribed line on the template tangent to the trace at the low points. It is the intent, however, of this requirement that the baseline for measuring the height of bumps or dips will be as nearly 25 feet (1 inch) as possible, but in no case to exceed this value. When the distance between prominent low points is greater than 25 feet (1 inch) make the ends of the scribed line intersect the profile trace when the template is in a nearly horizontal position. A few examples of the procedure are shown in Figure 12.

4. Place the blanking band over the profile to remove or "blank out" as much of the profile as possible. When this is done, scallops above and below the blanking band usually will be approximately balanced. The blanking band must not move when counting scallops in a segment. See Figure 13.

   The profile trace may move from a generally horizontal position when going over the transition to small radius superelevated curves. When such conditions occur, contact the District Materials Engineer. The District Materials Engineer may allow the profile at that segment to be broken into short sections and the blanking band repositioned on each section while counting scallops.

5. Measure and total the height of all the scallops appearing both above and below the blanking band, measuring each scallop to the nearest 0.05 in.. Round down as well as up. Do not count a scallop as 0.05 in. just because you see the profile line or there is space under the line.

   Short sections of the profile line may be visible outside the blanking band, but unless they project 0.03 in. or more and extend longitudinally for 2.0 feet (0.08 in. on the profilogram) or more, they are not included in the count. See Figure 11 for illustration of these special conditions. Spikes are not counted. Double-peaked scallops are only counted once as the highest peak.

   Write the total count in inches on the profilogram above the profile line (toward the center of the segment) and circle it. Outline the position of the blanking band when reducing the trace for later repositioning to check trace reduction procedure. Do not rotate the blanking band about the last end position when moving forward with trace reduction. Blank out as much of the profile as possible for each segment.

   When a scallop occurs at the end of the blanking band, count the scallop only once. Place the scallop in the 0.1-mile segment where the peak is highest.

Always use the measured trace length in computations. This length will not agree exactly with distance by subtracting stationing. Always use ± after the ending station on the report.

6. The last segment counted is generally not an even 0.1-mile. If not, its length should be scaled to determine its length in miles. For the example shown below, the odd length segment measures 7.60 in. in length.

$$\frac{7.60 \text{ in. x } 25 \text{ ft./in.}}{5{,}280 \text{ ft./mi.}} = 0.036 \text{ mi.}$$

If the odd length segment is 0.047 miles (250 feet) or less, it is added to and included in the evaluation of the adjacent segment in that section. If the odd length segment is more than 0.047 miles it is evaluated on its own.

The profile index is determined as inches per mile in excess of the blanking band. For 0.1-mile segments, the profile index can be determined from the inches of roughness by moving the decimal place one position to the right. For odd length segments and metric, the profile index is determined by dividing the inches by the segment length in miles. The weighted average for a day's run is determined by dividing the total inches of roughness for the day's run by the total length in miles of the day's run.

H. Testing of Patches

1. Testing of pavement patches is covered in Article 2529.03,H of the Standard Specifications. Patches between 50 feet and 250 feet are evaluated using the Average Base Index (ABI).

2. Figure 14 shows the areas to be tested and analyzed.

I. Reporting

1. The test report is required for project acceptance. Contractors should put their company name at the top of Iowa DOT Form #821301 and produce a new form. Remove "District Materials Engineer" at bottom of form. Contractors may develop their own form but it shall follow the same layout and style as Form #821301.

2. There are several types of reports:
   a. **Information Only**. Used by the DOT inspector when the test report is not for validation.
   b. **Preliminary.** Used by the contractor to submit the report in the time period required in the specifications. A final report must follow.
   c. **Final.** Used to indicate that the report is being submitted for acceptance.
   d. **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.

3. 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). Put the Laboratory Number on the trace roll.

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

f. **Corrective Work Required.**
g. **Corrective Work Completed.**

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

6. Rounding for reporting shall be as follows:

   Length to 3 decimal places, miles
   Roughness to 2 decimal places, inches (0.01 for computers, 0.05 for manual)
   Profile index to 2 decimal places, Inches/mile

   The method for rounding for reporting and determination of specification compliance shall be according to the "Rounding Method" in ~~ASTM E29~~ IM 202.

7. An example of a completed report form is shown in Figure 15. Always start with a full 0.10-mile segment and align both directions or lanes on the form.

8. The reverse side of Form #821301 is for bridge decks. An example of a completed bridge deck monitor report is shown in Figure 16.

9. The certified profilograph test report shall have the name and certification number of the person doing the testing, the person performing the analysis, and the person completing the test report.

   Each certified profilograph test report must also include the following certification statement:

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

10. Certified profilograph reports shall have the following distribution:

    RCE, County or City Engineer
    District Materials Engineer
    Special Investigations Engineer (will make Ames distribution)
    Contractor (For Iowa DOT Personnel)
    Subcontractor (For Iowa DOT Personnel)

11. The report and profilogram submittal may be in an electronic form compatible with the Agency's computer system (Adobe Acrobat PDF format for the profilogram). The Engineer may require a paper submittal of reports and profilograms if there are errors in the reports or validation is not achieved.

J. Certification

1. A trained, certified person shall do the testing, evaluation, and complete the test report.

2. Basis of certification is in Materials IM 213. Applications should be sent to the Technical Training & Certification Program Coordinator.

VALIDATION OF CONTRACTOR TEST RESULTS

In order to use the Contractor test results in the acceptance decision, the results must be validated. Normally the District Materials Office will perform verification testing within 1 month from receiving finals test reports and notification from the Contractor that the bridge or pavement is available for testing. The validation tolerances are in IM 216. When wheel path testing is specified, both wheel paths will be averaged for validation comparison (unless safety concerns or other conditions don't permit).

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 or an evaluation performed by the Iowa DOT Central Materials Laboratory. Resolution decisions by the Iowa DOT Central Materials Laboratory will be final.

The District Materials Engineer will select some or all of the following steps for the dispute resolution:

1. Check all numbers and calculations.
2. Review testing procedures.
3. Compare profilograms and dates of testing.
4. Check equipment operation, calibrations and tolerances.
5. Perform side-by side tests.
6. Involve the Central Materials Laboratory.

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.

Figure 1. 25-Foot California Type Profilograph

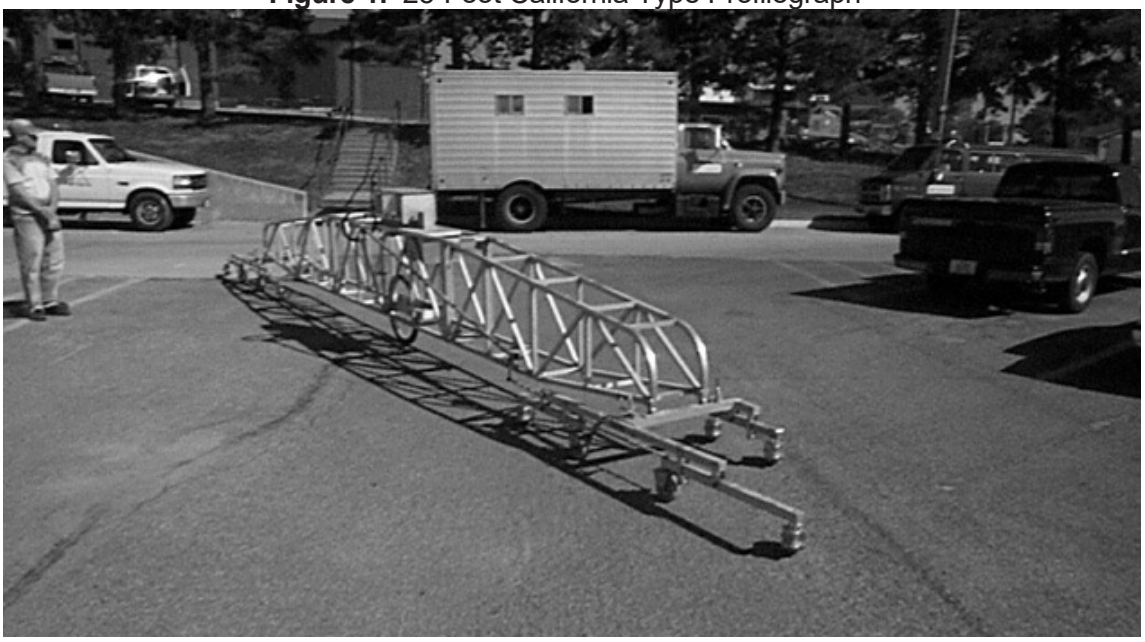


Figure 2. Manual Profilograph Recording Unit

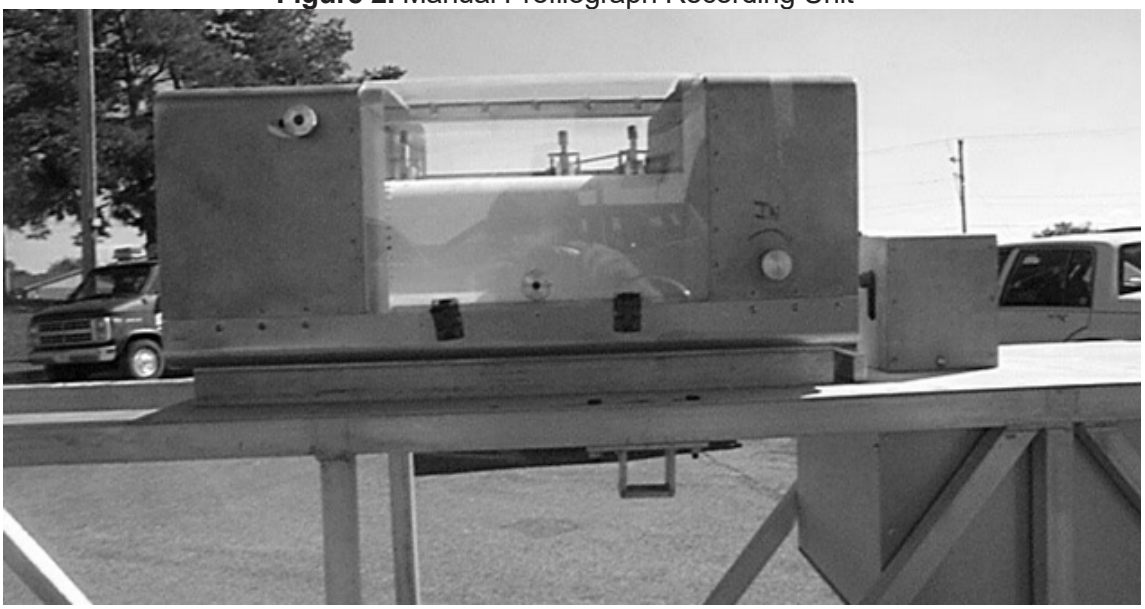


Figure 3. Computerized Profilograph

Figure 4. Light Weight Inertial Profiler

Figure 5. Blanking Band and Bump Template

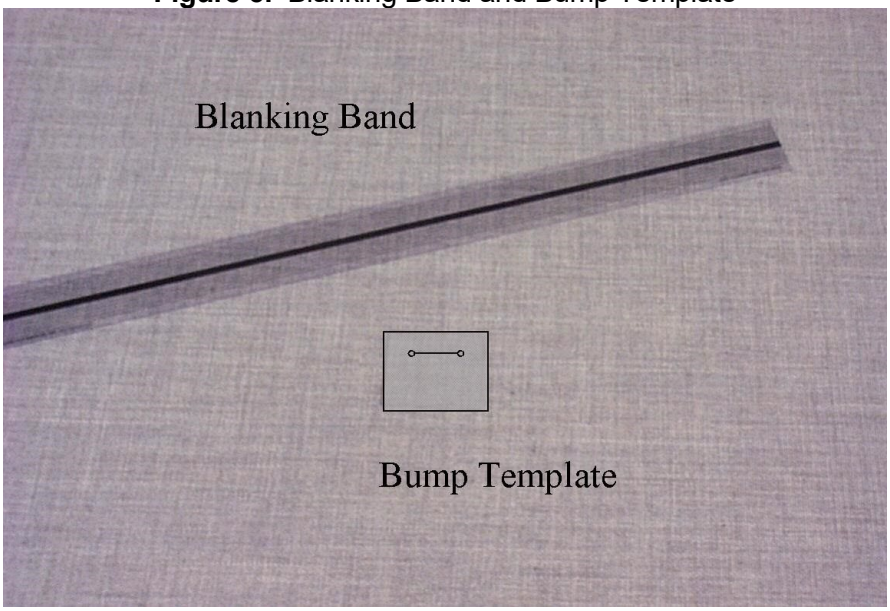


Figure 6. Location for Testing Bridge Decks

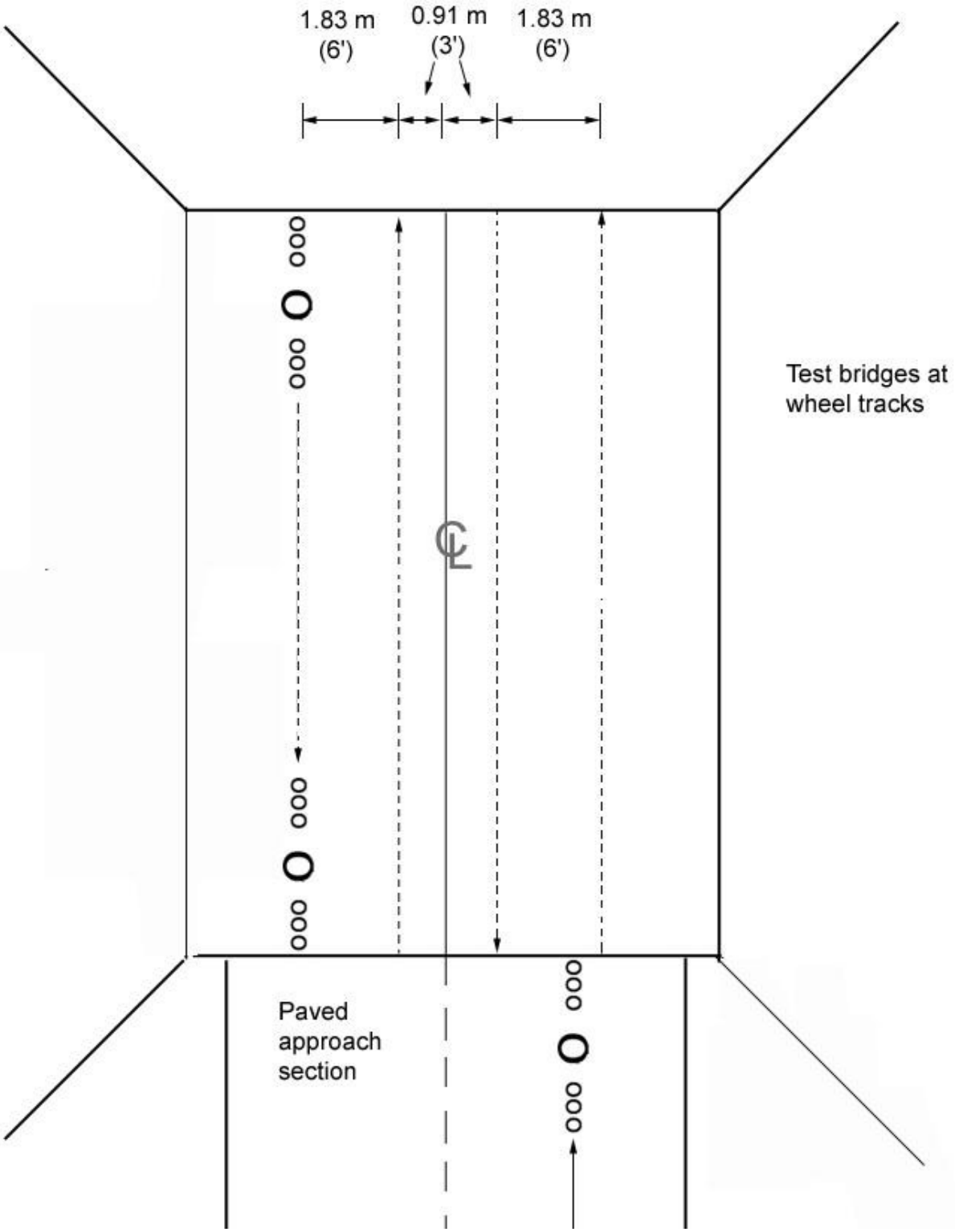
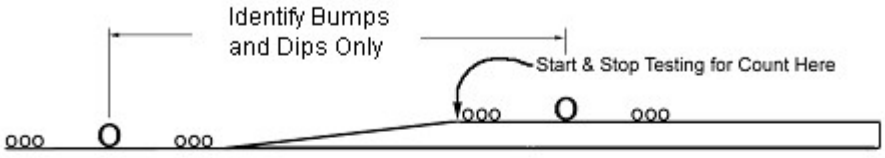
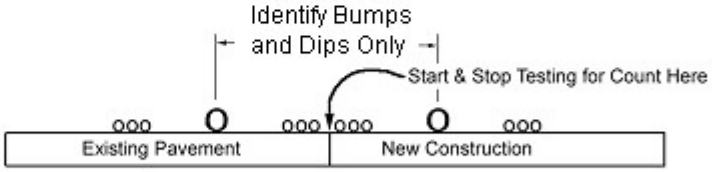


Figure 7. Testing at Headers



HMA Runout Tapers



All Other New Construction

Figure 8. Excluded Area from Profile Index for Side Roads over 600 Feet

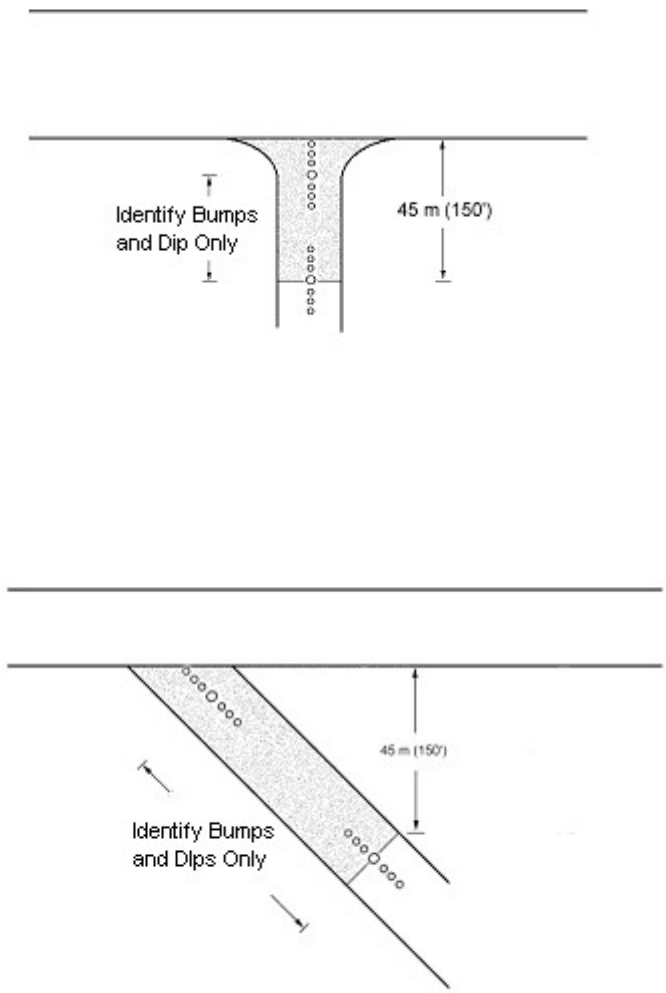


Figure 9. Starting and Stopping Location for Tapers

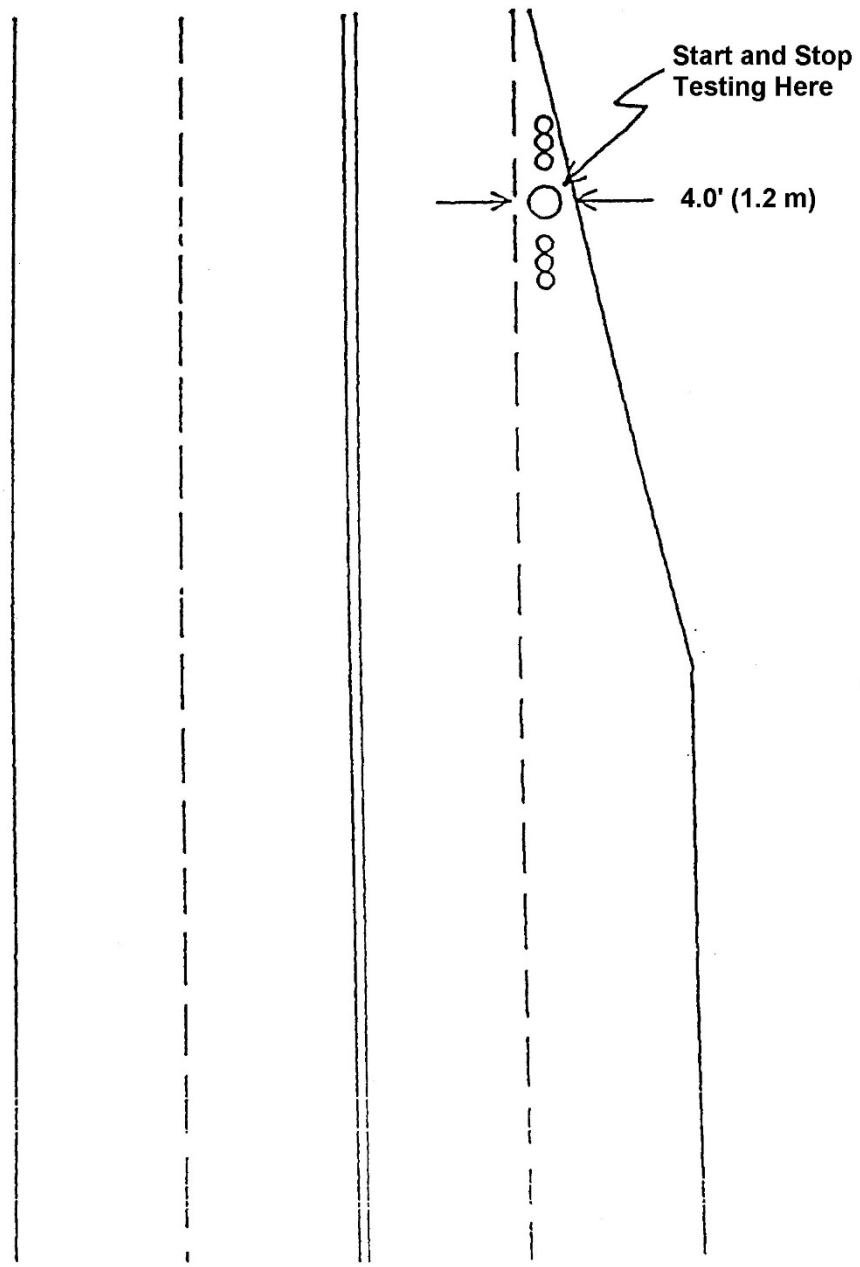


Figure 10. Testing of Bridge Approach Sections

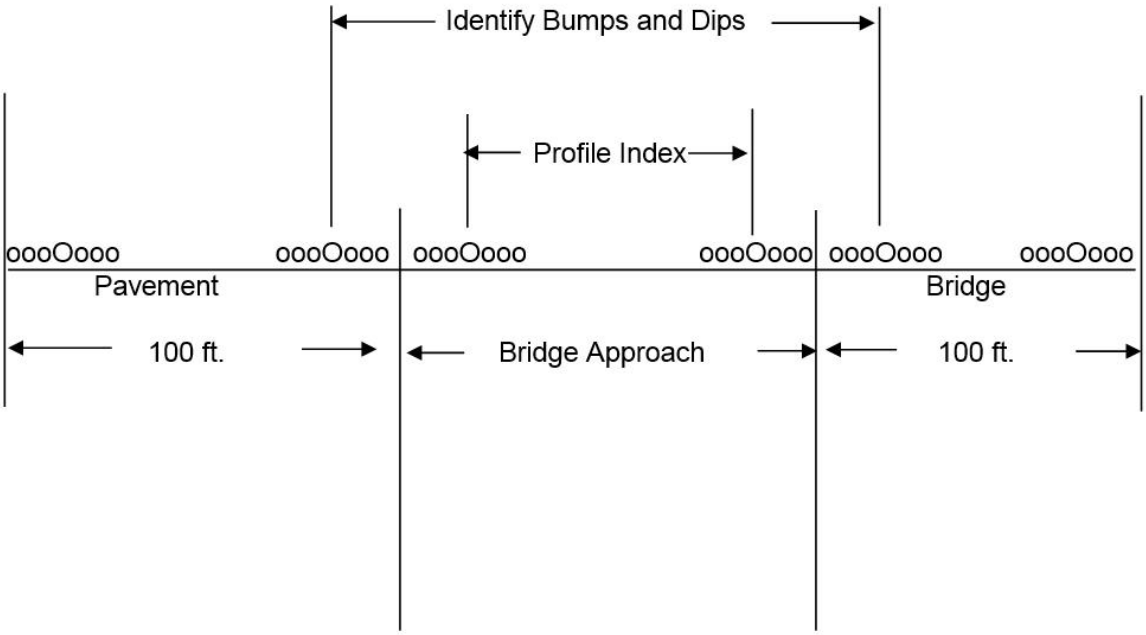


Figure 11. Manual Trace Reduction Conditions

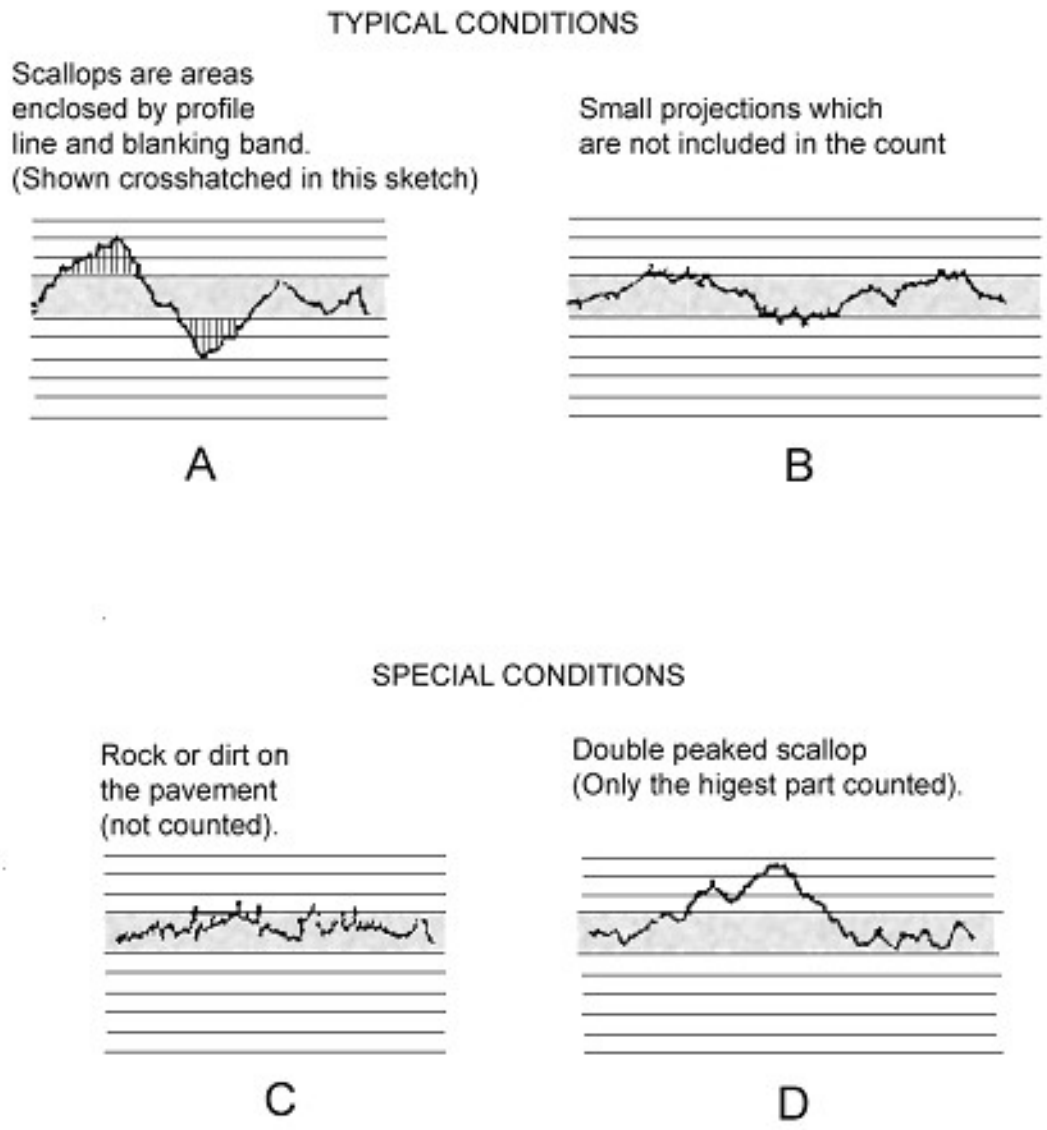


Figure 12. Examples Using the Bump Template

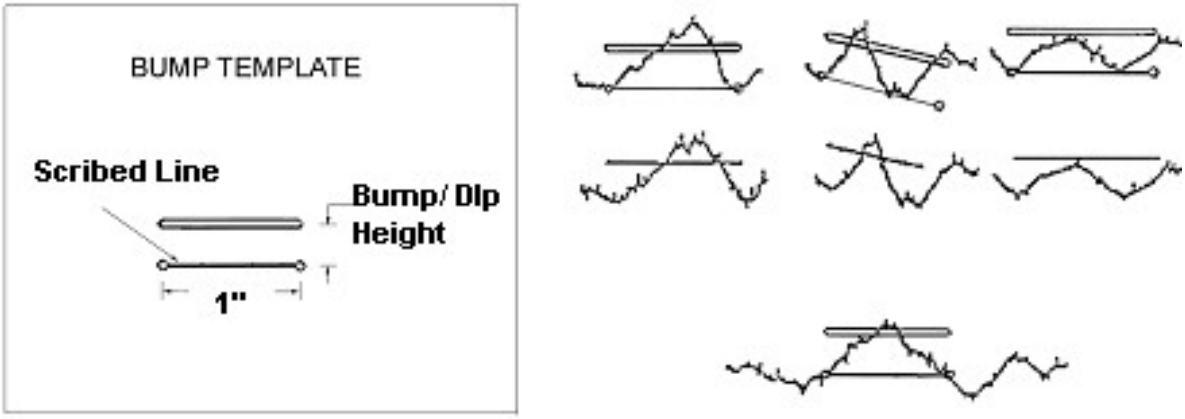


Figure 13. Example of Blanking Band Placement

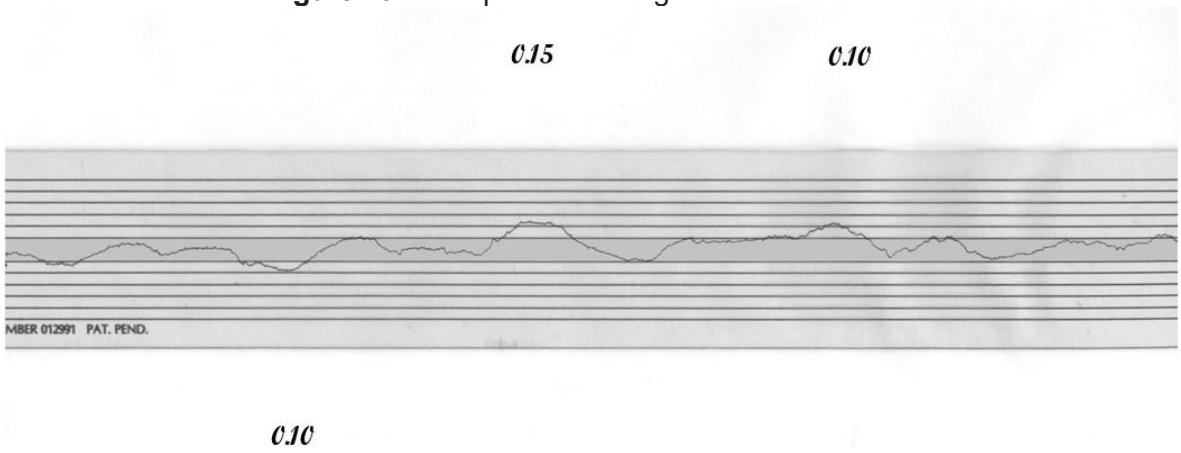
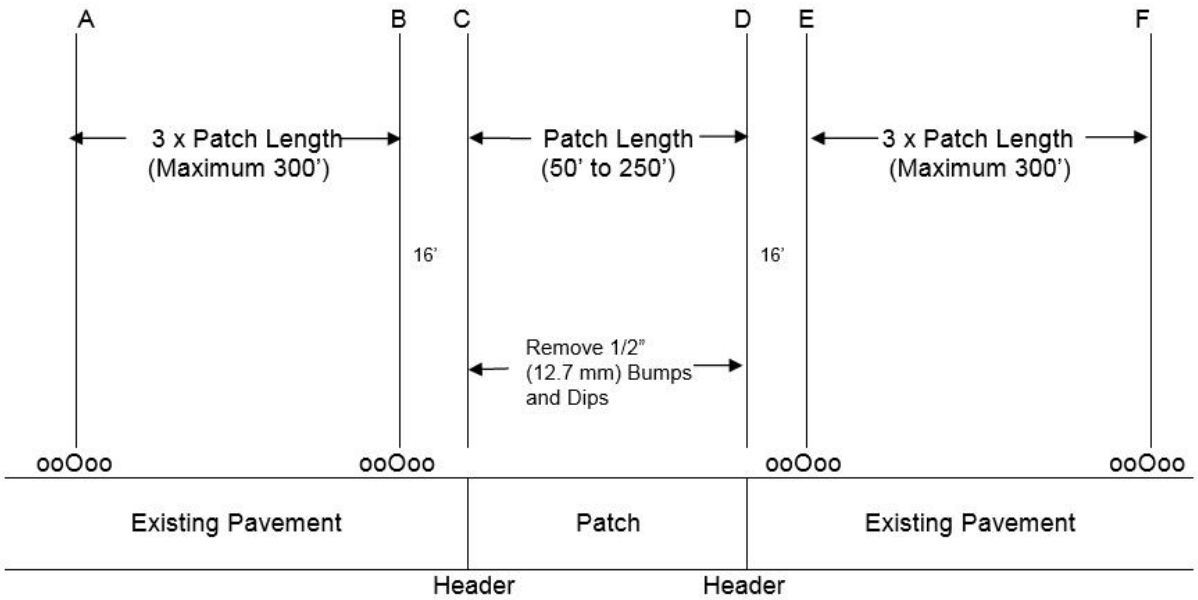


Figure 14. Area to be Tested for Pavement Patches



Patch Testing Procedure Specification 2529.03, H

Run the profilograph from "A" to "F"
Analyze for P.I. from "A" to "F"
Analyze for P.I. from "A" to "B"
Analyze for P.I. from "E" to "F"

Compare the profile index of Line AF to the index of the ABI

$$ABI = \frac{AB + EF}{2}$$

Figure 15. Sample Pavement Test Report

Iowa Department of Transportation

Report: Standard

PAVEMENT TEST REPORT
25-FOOT CALIFORNIA PROFILOGRAPH

Results: Final

Lab No. JS04-18-12 | Route No. US 18 | Project No. NHSX-18-7(49)--2R-19
Date Reported 9/9/2004 | Date Paved 9/8/2004 | County Chickasaw
Contractor ABC Construction
Tested By John Smith | Date 09/08/04
Trace Reduced By Computer | Date 09/08/04

Primary Schedule A | Tested at: 1/4 Point | Design: English

HMA Resurfacing | Blanking Band: 0.2-Inch

Roadway Type: 2-Lane | **Lane:**

Eastbound			Direction (4-Lane Only)	Westbound				
Length (Miles)	**1/4 Point Measured Roughness** (Inches)	**Profile Index** (Inches/Mile)	**Location** (Station)	**Length** (Miles)	**1/4 Point Measured Roughness** (Inches)	**Profile Index** (Inches/Mile)	**Index Avg.** (in./mi.)	**Incent./ Deduct**
0.100	0.20	2.00	75+57					
0.100	0.00	0.00						
0.100	0.11	1.10						
0.100	0.00	0.00						
0.100	0.00	0.00						
0.100	0.06	0.60						
0.100	0.13	1.30						
0.100	0.15	1.50						
0.100	0.18	1.80						
0.100	0.03	0.30						
0.100	0.00	0.00						
0.100	0.03	0.30						
0.100	0.15	1.50						
0.100	0.00	0.00						
0.100	0.00	0.00						
0.100	0.04	0.40						
0.100	0.00	0.00						
0.100	0.00	0.00						
0.100	0.00	0.00						
0.100	0.00	0.00						
0.100	0.00	0.00						
0.100	0.15	1.50						
0.100	0.12	1.20						
0.086	0.21	2.44	202+29 +/-					
2.386	1.56							
	AVG = 0.65				AVG =			

Incentive Levels: 0-1.0, $200; 1.1-2.0, $150; 2.1-3.0, $100; within limits and no grinding, increase $25/segment

From Station	1/2" Bump Locations	To Station

NO CORRECTIVE WORK REQUIRED

Copies: Special Investigations, Ames
District Materials Engineer
Resident Construction Engineer

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

Figure 16. Sample Bridge Test Report

Report: Standard

PAVEMENT TEST REPORT
25-FOOT CALIFORNIA PROFILOGRAPH

New Bridge

Results: Final

Lab No. JS04-18-1
Date Reported 9/9/2004
Route No. US 18
Date Paved 8/8/2004
Project No. NHSX-18-7(49)--2R-19
County Chickasaw
Contractor ABC Construction

Tested By John Smith — Date 09/08/04
Trace Reduced By John Smith — Date 09/08/04

Other
Tested at: Wheel Track
Design: English

New Bridge
Blanking Band: 0.2-Inch

Roadway Type: 2-Lane
Lane:

Eastbound — **Direction (4-Lane Only)**

Length (Miles)	Wheel Track Measured Roughness (Inches)	Inside Profile Index (Inches/Mile)	Location (Station)	Length (Miles)	Wheel Track Measured Roughness (Inches)	Outside Profile Index (Inches/Mile)	Index Avg. (in./mi.)	Incent./ Deduct
0.057	0.20	3.51	77+12	0.057	0.30	5.26	4.39	
			80+12 +/-					
0.057	0.20			0.057	0.30			
	AVG =	3.51			AVG =	5.26		

Incentive Levels: Other

From Station	1/2" Bump Locations	To Station

NO CORRECTIVE WORK REQUIRED

Copies:
Special Investigations, Ames
District Materials Engineer
Resident Construction Engineer

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

IOWADOT
Form 821301wd (12-14)

☐ Revised Report
Changes Lab. No. _____

25 – FOOT CALIFORNIA PROFILOGRAPH

☐ For Information Only ☐ Preliminary ☐ Intermediate ☐ Final

Lab No. _____ Route No. _____ Project No. _____

Date Reported _____ Date Paved _____ County _____

Tested At: ☐ ¼ Point ☐ Wheel Track Contractor _____

Tested By _____ Date _____

Trace Reduced By _____ Date _____

☐ Primary Schedule A ☐ PCC Slip Form ☐ ACC Paving
☐ Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing
☐ Secondary ☐ PCC Bonded Overlay ☐ ACC Patches
☐ Municipal ☐ PCC Unbonded Overlay
☐ Other ☐ PCC Patches

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

☐ Northbound ☐ Eastbound ≥ Direction ⎫ ☐ Southbound ☐ Westbound
☐ Inside Lane ≥ (4-Lane Only) ⎭ ☐ Outside Lane

Length Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)	**Location** (Station)	**Length** Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)

Station ≥ ½" (12.7 mm) **Bump Locations** ⎫ **Station**
or
½" (12.7 mm) **Dip Locations**

Copies

District Materials Engineer

IOWADOT

☐ Revised Report
Changes Lab. No. _____

25 – FOOT CALIFORNIA PROFILOGRAPH

☐ New Bridge Deck ☐ Bridge Deck Overlay

☐ For Information Only ☐ Preliminary ☐ Intermediate ☐ Final

Lab No. _____ Route No. _____ Project No. _____ Design No. _____

Date Reported _____ Date Poured _____ County _____

Tested At: ☐ Wheel Tracks Contractor _____

Tested By _____ Date _____

Trace Reduced By _____ Date _____

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

INSIDE WHEEL TRACK				OUTSIDE WHEEL TRACK		
Length Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)	**Location** (Station)	**Length** Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)

Station ≥ ½" (12.7 mm) **Bump Locations** **Station**
or
½" (12.7 mm) **Dip Locations**

Copies

_____
District Materials Engineer

2301 & 2303
PAVING SPECS

Article 2301.03, H, 4 For PCC Pavement

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.

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 if any individual PCC Pavement bid item for that project is 5000 square yards or greater. Apply Section 2316 to all other Primary projects or when specifically required for other projects.

Article 2303.03, D, 6 For HMA Pavement

e. Smoothness.

Construct pavement to have a smooth riding surface according to the following:

1) Apply Section 2317 to HMA surface mixture bid items of a Primary project if any individual HMA mixture bid item is 1000 tons or greater or 5000 square yards or greater. Apply Section 2316 to all other Primary projects with a surface course and when specifically required for other projects.

2) When neither Section 2316 nor Section 2317 is applied to a project, the Engineer may check the riding surface for defects using one of the following criteria:

- The surface shall not deviate from a straight line by more than 1/8 inch in 10 feet when measured longitudinally with a 10 foot straightedge.
- The surface shall not contain any bump or dip exceeding 1/2 inch over a 25 foot length when measured with a method in Materials I.M. 341.

The Engineer may either require the defects be corrected according to Article 2316.03, B, 2, or apply a price adjustment.

2316
PAVEMENT SMOOTHNESS

Section 2316. Pavement Smoothness

2316.01 DESCRIPTION.

A. Apply this specification when Section 2317 does not apply.

B. Test and evaluate pavement smoothness. Perform surface correction if required.

2316.02 TESTING AND EVALUATION.

A. General.

1. Evaluate pavement smoothness for all main line pavement surfaces, except when specifically excluded or modified by the contract documents. Main line pavement is defined as all permanent pavement for traffic lanes, including:
- Tapers to parallel lanes or through lanes at intersections,
- Tapers to climbing lanes, and
- Tapers to ramps and loops.

2. Evaluate pavement smoothness for all interchange ramps and loops.

3. For non-Primary projects, do not evaluate pavement smoothness unless specified in the contract documents.

4. 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.

5. Bridge approach sections which are a part of the paving contract will be tested according to Section 2428.

6. Smoothness Requirements:
- **a.** Apply Table 2316.02-1 to all projects when specified. Smoothness requirements in inches per mile are listed in Schedules A and B.
- **b.** For through traffic lanes wider than 8.5 feet which require matching the surface of the new pavement to the surface of an existing old pavement, the price reduction tables for Schedule A and B will be replaced by Schedule C. When the Profile Index is greater than 7.0 inches for schedule A segments or 22.0 inches per mile for Schedule B segments, calculate an Average Base Index (ABI) for each segment as shown in Table 2316.02-1.

Table 2316.02-1: Schedule for Identification of Pavements

Pavement	Schedule by Posted Speed (mph) (Existing or Proposed)	
	45 or less	over 45
Mainline, curbed (one or both sides of roadway	B	A
Mainline, not curbed	A	A
Ramps and Collector Distributor Roads	A[c]	A[c]
Loops	B	B
Side Roads	B	A
Grade Separations[a]	B	A
Pavement adjacent to existing pavement (added lane)	C[b]	C[b]

(a) Including municipal or Secondary Roads therein.

(b) $ABI = \frac{PI + X}{2}$

where:
PI = the profile index of the edge line of the abutting lane. If the computed ABI is less than X, use an ABI equal to X

X = 7 inches/mile if Schedule A, or 22 inches/mile if Schedule B.

(c) When a ramp or collector distributor road terminates at an intersection with a traffic signal or stop sign, the 700 feet nearest the intersection will be evaluated under Schedule B.

7. Exclusions:
Paved shoulders will be excluded from smoothness testing unless used as a temporary driving surface. When used as a temporary driving surface, evaluate paved shoulders for bumps and dips only. Evaluate and correct as provided in Article 2316.03, C.

B. Measurement.

1. General.

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

b. When a pavement for which smoothness is to be tested is adjacent to an existing old pavement, smoothness must also be tested on the old pavement 3 feet from the adjacent edge for ABI calculation. Should the surface of the old pavement be specified for correction, perform smoothness testing for ABI calculation after correction.

c. Remove all objects and foreign material on the pavement surface, including protective covers if used, prior to testing. If appropriate, properly replace protective covers after testing.

d. Produce a profilogram for each segment of 50 feet or more. Include the 16 feet beyond the ends of the section in the profilogram.

2. Pavements.

a. The pavement surface will be divided into sections that represent continuous placement.

b. A section will terminate at a day's work joint (header), a bridge, similar interruption, or when continuous placement crosses to a section with a different smoothness designation.

c. Sections longer than 778 feet or 0.147 miles placed without interruption will be separated into segments of 0.1 mile. The terminating segment may be shorter than 0.1 mile and greater than 250 feet and still be considered a segment. A segment is to be in only one traffic lane. Each traffic lane will be tested and evaluated separately. Gaps for temporary crossings or similar construction sequencing which are placed in otherwise continuous sections will be tested, when placed, and included in the adjacent section evaluation. Determine pavement profiles for each lane according to procedures for one lane, as shown in Materials I.M. 341 except for main line traffic lanes which will be tested in the wheel paths. Round trace scallops to nearest 0.01 inch. Wheel paths are defined as 3 feet and 9 feet from center line or lane line. Average the two wheel path profile indexes for each

segment. For projects with less than 0.5 miles of mainline paving, Contractor may elect to determine pavement profile in the quarter point unless another location is specified in the contract documents.

C. Profilograph Testing.

Perform testing and provide the Engineer with the profilogram results. Ensure testing and evaluation are done by a trained and certified person. Ensure the evaluation is certified according to Materials I.M. 341.

1. Test each segment within 48 hours following placement. Provide the Engineer the index for each segment of paving by the end of the next day worked following the placement until there has been 3 consecutive days of paving where the index for all segments would result in 100% payment or better.

2. Should any following day be evaluated to receive less than 100% payment, immediately notify the Engineer, and take corrective action to modify paving methods and equipment to achieve 100% payment or better.

3. Submit all final profilograph test reports and profile traces to the Engineer within 14 calendar days following completion of paving on the project. Selected reports and traces may be requested by the Engineer in advance of paving completion for purposes of validating the Contractor's test results. Incentive payments for qualifying segments will be made following receipt of appropriate documentation of certified smoothness results.

4. 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. The Engineer may test the entire project length if it is determined that the Contractor certified test results are inaccurate, and the Contractor will be charged for this work at a rate of $400.00 per mile, per profile track, with a minimum charge of $800.00. Furnishing inaccurate tests may result in decertification of the Contractor's certified operator.

D. Profile Index.

1. Calculate a profile index for each segment from the profilogram, according to Materials I.M. 341, except for:

- **a.** Side road connections less than 600 feet in length.
- **b.** Single lift pavement overlays 2 inches or less in thickness unless the existing surface has been corrected by milling or scarification.
- **c.** Storage lanes and turn lanes.
- **d.** Pavement less than 8.5 feet in width.
- **e.** The 16 feet at the ends of the section when the Contractor is not responsible for the adjoining surface.
- **f.** Runout tapers on HMA overlays at existing pavement, bridges, or bridge approach sections when the thickness is less than the design thickness.
- **g.** Detour Pavement**.**
- **h.** Crossovers**.**
- **i.** Sections less than 50 feet long

Evaluate pavement segments excluded from profile index calculation for bumps and dips. Evaluate and correct per Article 2316.03, C.

2. If there is a segment 250 feet or 0.047 mile long or less at the end of a section, include the profilograph measurements for that segment in the evaluation of the adjacent segment in that section.

3. Identify bumps and dips separately on all profilograms. These appear as high or low points on the profilogram and correspond to high points (bumps) or low points (dips) on the pavement surface. They are identified by locating vertical deviations exceeding 0.5 inches for a 25 foot span for both bumps and dips as indicated on the profilogram.

2316.03 SURFACE CORRECTION.

A. General.

1. Surface correction for pavement smoothness may be required, which includes bumps or dips. Complete the correction before the determination of pavement thickness.

2. Perform bump, dip, and smoothness correction work for the full lane width of the paved surface.

3. Obtain the Engineer's approval for all correction work. After all required correction work is completed, determine the final profile index.

B. Pavements.

1. Portland Cement Concrete Pavement.

a. Accomplish PCC pavement surface correction by grinding the pavement with a diamond grinder, by PCC resurfacing, or by replacement.

b. Use grinding and texturing equipment that meets the requirements of Section 2532. Use a cutting head that is a minimum of 36 inches wide, unless a 24 inch cutting head is necessary due to space limitations.

c. Perform surface correction parallel to lane lines or edge lines as directed by the Engineer. Make each pass parallel to the previous passes. Ensure the ground surface is of a uniform texture.

d. Do not allow adjacent passes to overlap 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.

e. Begin and end smoothness correction at lines normal to the pavement lane lines or edge lines within any one corrected area. Proceed from the center line or lane line toward the pavement edge to maintain pavement cross slope.

2. Hot Mix Asphalt Pavements.

a. Accomplish asphalt pavement surface correction by:

- Diamond grinding,
- Overlaying the area,
- Replacing the area, or
- Inlaying the area.

b. For diamond grinding, perform the same work and use the same equipment specified for PCC pavement. Cover the surface that has been ground with a seal coat according to Section 2307 with the following modifications:

- The binder bitumen may be the same material used for tack coat, applied at a rate of 0.10 gallon per square yard. Hand methods may be used for spraying.
- Apply a cover aggregate consisting of sand at a rate of 10 pounds per square yard. Hand methods may be used for spreading. Apply the sand slightly damp, but with no free moisture, as determined by visual inspection. Embed with at least one complete pneumatic roller coverage.
- This seal coat is intended to be placed immediately after the diamond grinding is completed in the travel lane. Complete this work when the road surface temperature is above 60ºF.
- Labor, equipment, and materials used for this seal coat will not be paid for separately, but are incidental to the items for which correction is required.

c. 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. Ensure the profile of the surface is smooth with no bumps or dips at the beginning or end of correction. Overlay correction must be for the entire pavement width. Maintain pavement cross slope through the corrected areas.

C. Bumps and Dips.

Evaluate bumps and dips, including those at headers, on all pavements for which pavement smoothness is designated.

1. Bumps.

a. For all pavements evaluated, if the Engineer does not assess a price adjustment, correct all bumps exceeding 0.5 inch within a 25 foot span, as indicated on the profilogram, except as stated in Article 2316.03, C, 3.

b. Corrected bumps will be considered satisfactory when measurement by the profilograph shows that the bumps are 0.3 inch or less in a 25 foot span.

c. When a through traffic lane over 8.5 feet wide is constructed adjacent to an existing old pavement, bump correction or price adjustment to the Contractor for a bump will not apply if a bump exists at that location in the adjacent existing old pavement.

2. Dips.

a. On all pavements, if the Engineer does not asses a price adjustment, correct dips of 0.5 inch to 1.0 inch in a 25 foot span, as indicated on the profilogram, except as stated in Article 2316.03, C, 3. Replace the pavement in areas with dips over 1.0 inch. Corrected dips will be considered satisfactory when the profilogram shows the dips are less than 0.3 inch in a 25 foot span.

b. When a lane over 8.5 feet wide is constructed adjacent to an existing old pavement, correction of a dip or price adjustment to the Contractor for a dip will not be required if a dip exists at that location in the adjacent existing old pavement.

3. 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 all 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.

2316.04 SMOOTHNESS.
Pavement smoothness will be compensated by adding to (incentive) or subtracting from (price reduction) the price bid for pavement a determined amount for each segment. These amounts are identified in the appropriate schedule of Article 2316.05.

A. Pavement Where Schedule A Smoothness is Required.

1. For the appropriate categories of highway, as shown in Schedule A, incentives for pavement smoothness will be paid for each segment of pavement with an initial index per mile per segment of 3.0 inches or less.

2. For segments with an initial index of 7.1 to 10.0 inches per mile, the Contractor will be assessed a price reduction.

3. For segments with an index of 10.1 inches per mile and greater, grind the surface to a final index of 7.0 inches per mile or less.

B. Pavement Where Schedule B Smoothness is Required.

1. For all highways, incentives for pavement smoothness will be paid for each segment of pavement with an initial index of 12 inches per mile per segment or less.

2. For all segments with an initial index of 22.1 to 30.0 inches per mile, the Contractor will be assessed a price reduction.

3. For segments with an index of 30.1 inches per mile and greater, grind the surface to a final index of 22.0 inches per mile or less.

C. Pavement Adjacent to Existing Pavement.

1. Smoothness will be evaluated by the ABI as defined in Article 2316.02, A, 6 or 7, for each segment of new pavement 8.5 feet wide or more, and over 600 feet in length, which is to be matched to the surface of an existing pavement.

2. Surface correction is required for smoothness exceeding ABI + 12 when Schedule A is required and exceeding ABI + 30 when Schedule B is required. Payment will be based on results after correction according to Schedule C.

3. Longitudinally check areas not included in the profilograph test with a 10 foot straight edge. Ensure the surface does not deviate from a straight line by more than 1/8 inch in 10 feet. Meet requirements of Article 2316.03 for all corrections needed.

D. Bridge Approach Sections.
Smoothness of bridge approach sections will not be used in the calculations for incentive or price reduction of pavement segments, sections, or the project.

2316.05 SCHEDULE OF PAYMENT.

A. For each traffic lane of main line pavement and each traffic lane of interchange ramps and loops evaluated for smoothness, as defined in Article 2316.02, A, the Engineer will determine the length of each segment in miles.

B. For roadways, the Contractor may receive an incentive payment or be assessed a price reduction based on the number of qualifying segments and the initial profile index.

C. Pavement segments excluding repair work that are subject to profilograph testing, as defined in Article 2316.02, D, will be considered for additional payment as a smoothness incentive or price reduction. For a segment to be qualified for incentive, there must be no grinding within that segment.

D. Surface correction (grinding) of bridge approach sections, and as stated in Article 2316.03, C, 3, will not count as surface correction on adjacent pavement segments and will not detract from possible incentive payments on those segments.

E. Single lift pavement resurfacing 2 inches thick or more that has milling or scarification of the original pavement will be rated using the multi-lift schedules.

F. A $1600 price adjustment will be assessed for each dip not corrected in each pavement lane under Schedule A and B, except as stated in Article 2316.03, C, 3. In addition, a $1600 price adjustment will be assessed for each bump not corrected under Schedule A and B, except as stated in Article 2316.03, C, 3. Bumps and dips not corrected will also be included in the evaluation for the segment smoothness.

G. The cost of certified smoothness and associated traffic control is incidental to the cost of the pavement.

H. These payments or assessments will be based on the following schedules:

1. Schedule A Smoothness Requirements.
Pavement segments which are designated for Schedule A smoothness will be evaluated for incentive or price reduction assessments as follows:

Table 2316.05-1: Incentives for Pavement Smoothness

Initial Profile Index	Single Lift Pavements		Multi-Lift Pavements	
Inches Per Mile Per Segment [(a)]	Primary	Non-Primary	Primary	Non-Primary
	Dollars Per Segment	Dollars Per Segment	Dollars Per Segment	Dollars Per Segment
0-1.0	700	300	250	125
1.1-2.0	600	250	200	100
2.1-3.0	450	200	150	50
3.1-7.0	Unit Price	Unit Price	Unit Price	Unit Price

[(a)] For each segment of pavement that has an initial index, within the limits listed, with no grinding, the Contractor will receive an incentive payment as shown in the tabulation for the appropriate category.

Table 2316.05-2: Price Reduction for Pavement Smoothness

Initial Profile Index	Single Lift Pavements		Multi-Lift Pavements	
Inches Per Mile Per Segment [(a)]	Primary	Non-Primary	Primary	Non-Primary
	Dollars Per Segment	Dollars Per Segment	Dollars Per Segment	Dollars Per Segment
3.1-7.0	Unit Price	Unit Price	Unit Price	Unit Price
7.1-10.0	200	100	100	50
10.1 & Over[(a)]	Grind Only	Grind Only	Grind Only	Grind Only

[(a)] For segments with an initial index of 10.1 and over, grind the surface to a final index of 7.0 or better. In lieu of grinding the surface to a final index of 7.0 or better, the Contractor may elect to replace part or all of the segment.

2. **Schedule B Smoothness Requirements.**
   a. Pavement segments designated for Schedule B smoothness and indexed in segments greater than 50 feet will be evaluated for incentive or price reduction as shown in Tables 2316.05-3 and 2316.05-4.
   b. No price reduction assessment will be made for individual segments shorter than 50 feet properly corrected if required.

Table 2316.05-3: Incentives for Pavement Smoothness

Initial Profile Index	New Pavements	Resurfaced Pavements
Inches Per Mile Per Segment [(a)]	Dollars Per Segment	Dollars Per Segment
0-4.0 4.1-8.0 8.1-12.0 12.1-22	600 500 400 Unit Price	300 250 200 Unit Price
(a) For each segment of pavement that has an initial index, within the limits listed, with no grinding, the Contractor will receive an incentive payment as shown in the tabulation for the appropriate category.		

Table 2316.05-4: Price Reduction for Pavement Smoothness

Initial Profile Index	New Pavements	Resurfaced Pavements
Inches Per Mile Per Segment[(a)]	Dollars Per Segment	Dollars Per Segment
12.1-22.0 22.1-30.0 30.1 & Over [(a)]	Unit Price 500 Grind Only	Unit Price 250 Grind Only
(a) For segments with an initial index of 30.1 and over, grind the surface to a finish index of 22.0 or better. In lieu of grinding the surface to a final index of 22.0 or better the Contractor may elect to replace part or all of the segment.		

3. **Schedule C Smoothness Requirements (Pavement Adjacent to Existing Pavement).**
   For new pavement which has been matched to an existing old pavement for which an Average Base Index (ABI) was calculated, the pavement will be evaluated for a price reduction for each segment based on Schedule A or Schedule B payment.

Table 2316.05-5: Initial Profile Index or Profile Index after Correction

Schedule A Inches Per Mile Per Segment	Schedule B Inches Per Mile Per Segment	Dollars Per Segment
0 to ABI	0 to ABI	0
ABI + 0.1 to ABI +4 incl.	ABI + 0.1 to ABI + 10 incl.	300
ABI + 4.1 to ABI +8.0 incl.	ABI + 10.1 to ABI + 20 incl.	500
ABI + 8.1 to ABI +12 incl.	ABI + 20.1 to ABI + 30 incl.	800
Greater than ABI + 12	Greater than ABI + 30	Grind Only

4. **Bridge Approach Sections.**
   Correct bridge approach sections for smoothness as specified in Section 2428.

Legacy
2317
PRIMARY & INTERSTATE
(Prior to April 2023)
(PI)
(0.0” Blanking Band)

Section 2317. Primary and Interstate 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. Main line pavement is defined as all permanent pavement for through lanes.

2317.02 EQUIPMENT.

A. Provide and operate an Ames type or California type profilograph or an inertial profiler to produce a profilogram (profile trace) of the surface tested according to Materials I.M. 341. Ensure the operator is trained and certified to operate the profilograph as required by the Contracting Authority.

B. If the profilograph has a mechanical recorder, provide automated trace reduction equipment according to Materials I.M. 341. If it has a computerized recorder, the trace produced will be evaluated without further reduction.

C. For corrective work by diamond grinding, use grinding and texturing equipment meeting the requirements of Section 2532.

2317.03 SURFACE TOLERANCES, TESTING, AND EVALUATION.

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 cessation of the daily paving operations, and so forth). If the partial segment is 250 feet or less in length, include its length and roughness with the previous adjacent segment. If the partial segment length is greater than 250 feet, evaluate it as a single segment. Gaps for temporary crossings or similar construction sequencing which are placed in otherwise continuous sections will be tested, when placed, and included in one of the adjacent sections for evaluation following the procedure for partial segments above.

A. Tolerances.

Produce pavement with an average profile index per 0.1 mile segment as shown in Table 2317.03-1.

Table 2317.03-1: Tolerance for Average Profile Index per 0.1 Mile (0 inch blanking band)

Surface Type	Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps
	Inches per mile	Inches per mile
PCC Pavement	40.0 or less	65.0 or less
HMA Pavement	35.0 or less	45.0 or less

B. Testing.

1. Determine the pavement profiles for each lane according to the procedures for one lane, as shown in Materials I.M. 341 except for main line traffic lanes which will be tested in the wheel paths. Round the trace scallops to the nearest 0.01 inch. The wheel paths are defined as the 3 feet and 9 feet from the center line or lane line. Average the two wheel path profile indexes for each segment. Additional profiles may be taken only to define the limits of an out-of-tolerance surface variation.

2. The Engineer may use a 10 foot straightedge (or other means) to detect irregularities outside the required trace paths. The Engineer may also use the straightedge to delineate the areas that require corrective action.

3. Test bridge approaches according to Section 2428.

4. Paved shoulders will be excluded from smoothness testing. When used as a temporary driving surface, evaluate paved shoulders for bumps and dips. Evaluate for high points and low points with deviations in excess of 0.5 inches in a length of 25 feet or less. Take corrective action.

C. Evaluation.

1. Determine a profile index based on the 0 inch blanking band following the same procedures shown in Materials I.M. 341 for each segment of finished pavement surface except for:
   - **a.** Primary side road connections less than 600 feet in length.
   - **b.** Non-primary side road connections, which are to be evaluated according to Section 2316.
   - **c.** Bridge approaches (evaluated according to Section 2428).
   - **d.** Storage lanes, turn lanes, and other auxiliary lanes less than 600 feet.
   - **e.** Pavement less than 8.5 feet in width.
   - **f.** The 16 feet before and the 16 feet beyond the ends of the section when the Contractor is not responsible for the adjoining surface.
   - **g.** Single lift pavement overlays 2 inches thick or less, unless the existing surface has been corrected by milling or scarification.
   - **h.** Runout tapers on HMA overlays at existing pavement, bridges, or bridge approach sections where the thickness is less than the design thickness.
   - **i.** Detour pavement.
   - **j.** Crossovers.
   - **k.** Individual sections of pavement less than 50 feet in length.

   Evaluate pavement segments excluded from profile index evaluation for high points and low points with deviations in excess of 0.5 inches in a length of 25 feet or less. Take corrective action.

2. For the following situations, the profile index will be evaluated. If the average profile index exceeds the tolerances listed in Article 2317.03, A, the Contractor may elect to eliminate that area from the profile index for the day's paving operation.

   Evaluate pavement segments eliminated from profile index evaluation for high points and low points with deviations in excess of 0.5 inches in a length of 25 feet or less. Take corrective action**.**
   - **a.** Horizontal curves with a centerline radius of less than 1000 feet and the pavement within the superelevation transition of such curves.
   - **b.** Crest and sag vertical curves with an L/A < 100 where L is the length of curve in feet and A is the grade change in percent (L/A < 30.5 where L is the length in meters and A is the grade change in percent).

3. Determine a daily average profile index for each day's paving operation. A day's paving operation is defined as a minimum of 0.1 mile segment of pavement placed in a day. If less than 0.1 mile segment is paved, the day's production will be grouped with the next day's production. If the production of the last day of project paving is less than 0.1 mile segment, it will be grouped with the previous day's production.

4. Test each segment within 48 hours following placement. Furnish the profile index for each segment of paving to the Engineer by the end of the next day worked following the placement until there has been 3 consecutive days of paving where the index for all segments would result in 100% payment or better. Should any following day be evaluated to receive less than 100% payment, immediately notify the Engineer and take corrective action to modify paving methods and equipment to achieve 100% payment or better.

5. If the day's average profile index exceeds the values in Table 2317.03-1, notify the Engineer and suspend the paving operation until corrective action is taken. When the paving is resumed, the paving operations will be evaluated with the start-up testing procedures in the preceding paragraph.

6. Submit all final profilograph test reports and profile traces to the Engineer within 14 calendar days following completion of paving on the project. The Engineer may request selected reports and traces in advance of paving completion for purposes of validating the Contractor's test results. Incentive payments for qualifying segments will be made following receipt of appropriate documentation of certified smoothness results.

2317.04 CORRECTIVE ACTIONS.

A. General.

1. The pavement will be evaluated in 0.1 mile segments using the profilograph, to determine pavement segments where corrective work or pay adjustments will be necessary. Each individual profilograph trace will be evaluated (not the average of multiple traces) to determine the areas where corrective action on 0.5 inch bumps and dips is needed.

2. Within each 0.1 mile segment, correct all areas representing high points (bumps) or low points (dips) with deviations in excess of 0.5 inches in a length of 25 feet or less regardless of the profile index value. Take corrective action.

3. Separately identify bumps and dips equal to or exceeding 0.5 inches in a length of 25 feet or less.

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, an Average Base Index (ABI) will be determined according to Section 2316.

B. Roadways with a posted speed greater than 45 mph.

Correct all 0.1 mile segments, including bumps, having an initial average profile index of greater than those tolerances shown in Article 2317.05. Correct these segments to reduce the average profile index to those shown in Table 2317.04-1 below. The Contractor has the option to replace these segments. On segments where corrections are made, test the pavement to verify that corrections have met the average profile index as shown in Table 2317.04-1 below.

C. Roadways with a posted speed of 45 mph, or less, and ramps.

Correct all 0.1 mile segments, including bumps, having an initial average profile index of greater than those tolerances shown in Article 2317.05. Correct these segments to reduce the average profile index to those shown in Table 2317.04-1 below. The Contractor has the option to replace these segments. On segments where corrections are made, test the pavement to verify that corrections have met the average profile index as shown in Table 2317.04-1 below.

Table 2317.04-1: Average Profile Index per 0.1 Mile after Corrections (0 inch blanking band)

Surface Type	Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps
	Inches per mile	Inches per mile
PCC Pavement	40.0 or less	65.0 or less
HMA Pavement	40.0 or less	50.0 or less

D. Bridge Approach Sections.

Correct bridge approach sections according to Section 2428.

E. Corrective Work.

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. 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. The Engineer may approve this construction when road surface temperatures are below 60ºF.

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.

F. 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 $400.00 per mile, per profile track, with a minimum charge of $800.00.

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 average profile index determined for the segments prior to performing any corrective work. Areas excluded from the profilograph 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 average profile 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. PCC Pavement.
The payment will be adjusted as shown in Table 2317.05-1 according to the posted or proposed speed.

Table 2317.05-1: Schedule for Adjustment Payment for PCC Pavements (0 inch blanking band)

Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps	Dollars per 0.1 mile segment per lane	
Inches per mile	Inches per mile	Interstate & Multi-Lane Divided Segments	Other Primary Segments
22.0 or less	25.0 or less	+950.00	+850.00
22.1 to 23.5		+800.00	+650.00
23.6 to 26.0	25.1 to 30.0	+600.00	+450.00
26.1 to 40.0	30.1 to 65.0	0.00	0.00
40.1 to 45.0	65.1 to 70.0	-600.00 or grind*	-450.00 or grind*
45.1 or more	70.1 or more	0.00*	0.00*
* These segments shall be corrected to the levels shown in Table 2317.04-1.			

C. HMA Pavement.

The payment will be adjusted as shown in Table 2317.05-2 according to the posted or proposed speed.

Table 2317.05-2: Schedule for Adjustment Payment for HMA Pavements (0 inch blanking band)

Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps	Dollars per 0.1 mile (161 m) segment per lane	
Inches per mile	Inches per mile	Interstate & Multi-Lane Divided Segments	Other Primary Segments
10.0 or less		+850.00	+750.00
10.1 to 11.5	15.0 or less	+650.00	+500.00
11.6 to 13.5		+500.00	+350.00
13.6 to 15.5	15.1 to 20.0	+350.00	+200.00
15.6 to 35.0	20.1 to 45.0	0.00	0.00
35.1 to 40.0	45.1 to 50.0	-350.00 or grind*	-200.00 or grind*
40.1 or more	50.1 or more	0.00*	0.00*
* These segments shall be corrected to the levels shown in Table 2317.04-1.			

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 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 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.

2511
SIDEWALKS & REC TRAILS

Article 2511.03, B, 5 Removal and Construction of Sidewalks and Recreational Trails

5. **Smoothness.**
   - **a.** Ensure sidewalk and recreational trail smoothness comply with Article 2301.03, H, 4, except for the requirements for pavement and bridge approach sections for Primary projects.
   - **b.** Areas may be checked by the Engineer with a surface checker and are not to exceed 1/4 inch in 10 feet. For each bump exceeding these requirements, the Contractor will be assessed $50 or the bump corrected as agreed upon by the Engineer and Contractor.

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. Do not use grinding and texturing equipment that causes excessive ravels, aggregate fractures, spalls, or disturbance of the transverse and/or longitudinal joints.

3. Use grinding equipment with a minimum effective head width of 36 inches.

4. 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 1 inch.

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.

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 2532.03-1on 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 milling.

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 or into gutters or other drainage facilities. This residue may be spread on the foreslope or removed according to Article 1104.08.

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) ~~Installation of r~~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.

2317 NEW
PRIMARY & INTERSTATE
April 2023 and After
(MRI)

Section 2317. Primary and Interstate 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 of the Standard Specifications.

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 of the Standard Specifications.

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 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 of the Standard Specificatons).
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

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 of the Standard Specifications).
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 231705-2. 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 of the Standard Specifications.

F. Corrective Work.
When the Contractor is not responsible for the adjoining surface, ALR in the 20 feet at the end of a section will be reviewed by the Engineer. Correct ALR determined to be under the control of the Contractor and resulting from the Contractor's operations. Correction of ALR determined to be beyond the control of the Contractor will be paid according to Article 1109.03, B of the Standard Specifications. 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.
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 to70.0	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	

IM 341IRI
APPENDIX A

DETERMINING PAVEMENT RIDE QUALITY

SCOPE

This IM describes procedures used to perform smoothness testing on new pavements surfaces. A certified person is required to perform the testing, evaluation, and reporting.

PROCEDURE

A. Apparatus

1. 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.

2. Ten-foot straight edge or a 10-foot straight edge software simulation.

3. Distance measuring wheel or tape.

4. Latest version of ProVAL software. http://www.roadprofile.com/proval-software/current-version/

5. Latest version of the Iowa DOT Spreadsheet, Profile Summary Sheet and the current ProVAL template. https://iowadot.gov/construction_materials/Materials-forms

B. Profiler Approval

1. 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.

2. ProVAL will be used to analyze the profiler files. The criteria for approval includes:

   a) 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).
   b) Submittal of 5 good runs of the test strip as ProVAL readable files.
   c) The DMI distance shall be within 0.15% of the actual test strip distance.
   d) The equipment repeatability score with the IRI filter shall be 0.90 or greater.
   e) The equipment accuracy score with the IRI filter shall be 0.88 or greater when compared to the reference profiler.
   f) The average IRI shall be within 5% of the reference profiler IRI.

C. Calibration and Verifications

Checks, calibrations, and verification of subsystems vary by manufacturer. Follow the manufacturer's recommended procedures and frequencies to ensure proper profile collection.

D. Test Procedure

1. The contractor (or sub-contractor) responsible for smoothness testing shall give the Project Engineer and the District Materials Engineer 48 hour notice prior to testing so the District Materials Office may provide verification testing.

2. 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.

3. Perform the warmup and checks of the profiler.
   a) For most profilers, the tire pressures should be maintained at the same pressures as when the distance was last calibrated.
   b) It is advisable to do a bounce test and vertical height test on the sensors before beginning testing.

4. 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".

5. Test in the direction of traffic whenever possible.

6. Test unit positioning.

   a) 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.

   b) 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 is within 1 foot of a longitudinal joint. Adjust the travel path to the right so the sensor is 2 feet from the joint line.

   c) 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.

   d) 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. Figure 1

   e) Figure 2 and 3 show examples of how to analyze ALR at obstructions defined in 2317.03,B,2,b.

7. Ensure there is enough room before and after the section to be tested to allow for a 300 foot run-in and run-out area for the profiler before and after the test section according to the manufacturer's recommendations. The run-in allows the accelerometers, lasers, and computer to stabilize before the start of the section. 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.

8. Use the event feature to mark on the file any reference points like, 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.)

9. 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.

10. Label the file so it can be easily found and retrieved later. (Project number, lane, and beginning station in the file name is one way to label)

11. When a segment is corrected by grinding to improve the segment MRI, the entire segment must be retested and a MRI determined to verify that the corrected segment is in specification compliance.

E. Analyzing and Reporting

1. Use the profiler software export function to export an unfiltered “ERD” file or use any other unfiltered ProVAL readable file.

2. Use the latest version of ProVAL to perform the MRI and ALR analysis on the files.

3. Report results on the DOT provided Excel spreadsheet (Figure 4).The sheet can be downloaded at https://iowadot.gov/construction_materials/Materials-forms. The test report is required on this form for project acceptance.

4. 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.

5. There are three types of reports:
   a) **Preliminary.** Used by the contractor to submit the report in the time period required in the specifications. A final report must follow.
   b) **Final.** Used to indicate that the report is being submitted for acceptance.
   c) **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.

6. 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).

7. Submit all final and corrected reports to the engineer through DocExpress. If the smoothness testing is done after the paving is completed, submit the ProVAL file(s) to DocExpress also. Label the ProVAL file(s) with the project as part of the file name.

8. Keep all ProVAL files not submitted to DocExpress until validation of the contractor test results has been confirmed.

9. An example of a completed report form is shown in Figure 4.

F. Certification

Use a trained, certified person to do the testing, evaluation, and reporting. The certification information is in Materials IM 213.

VALIDATION OF CONTRACTOR TEST RESULTS

In order to use the Contractor test results in the acceptance decision, the results must be validated.
Normally the District Materials Office will perform verification testing within 1 month from receiving finals test reports and notification from the Contractor that the pavement is available for testing. The validation tolerances are in IM 216.

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.

The District Materials Engineer will select some or all of the following steps for the dispute resolution:

1. Check all numbers and calculations.
2. Review testing procedures.
3. Compare profiles and dates of testing.
4. Check equipment operation, calibrations and tolerances.
5. Perform side-by side tests.
6. Involve the Central Materials Laboratory.

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.

Figure 1. Area of Localized Roughness (ALR) Analysis at the Beginning of Project (Same at End of Project)

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

Figure 2. ALR Analysis at the Bridges/ Bridge Approaches

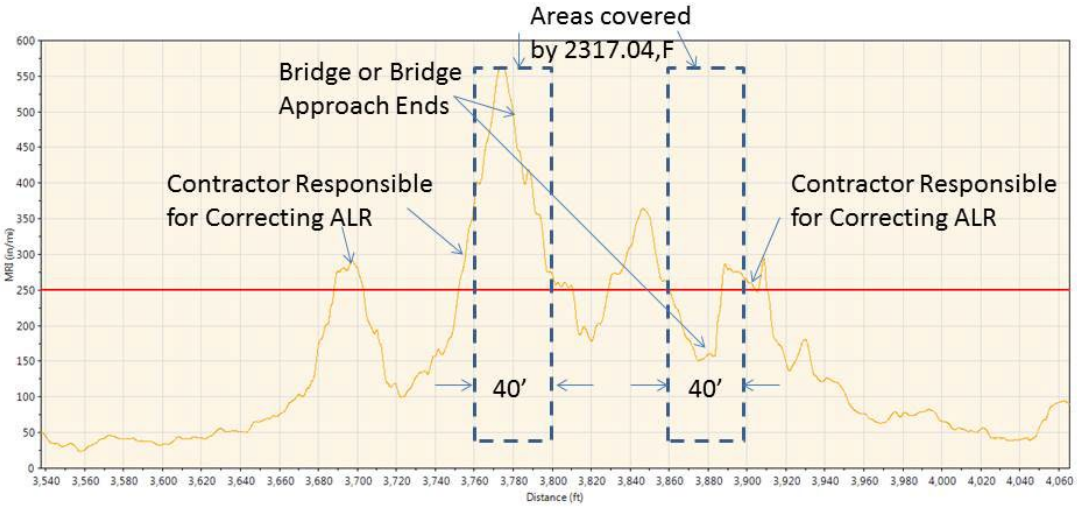


Figure 3. ALR Analysis at the Manholes and Water Valve Boxes

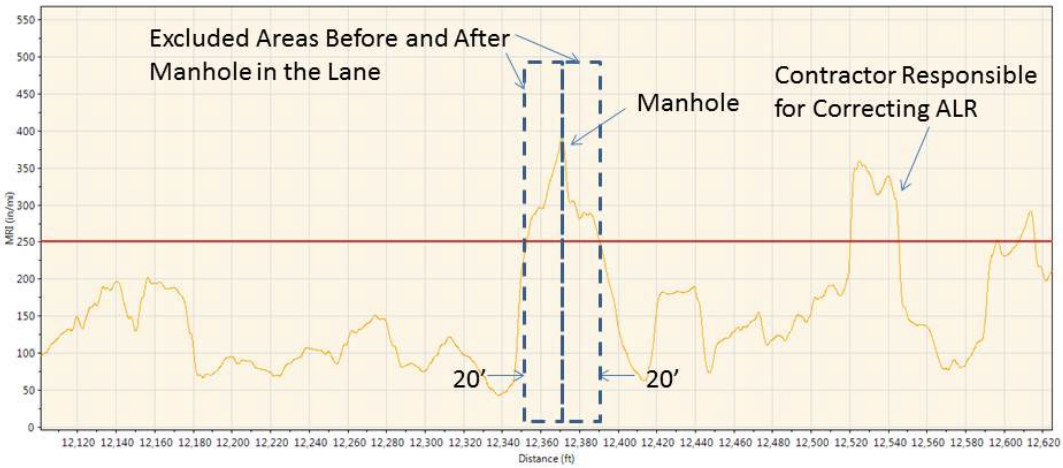
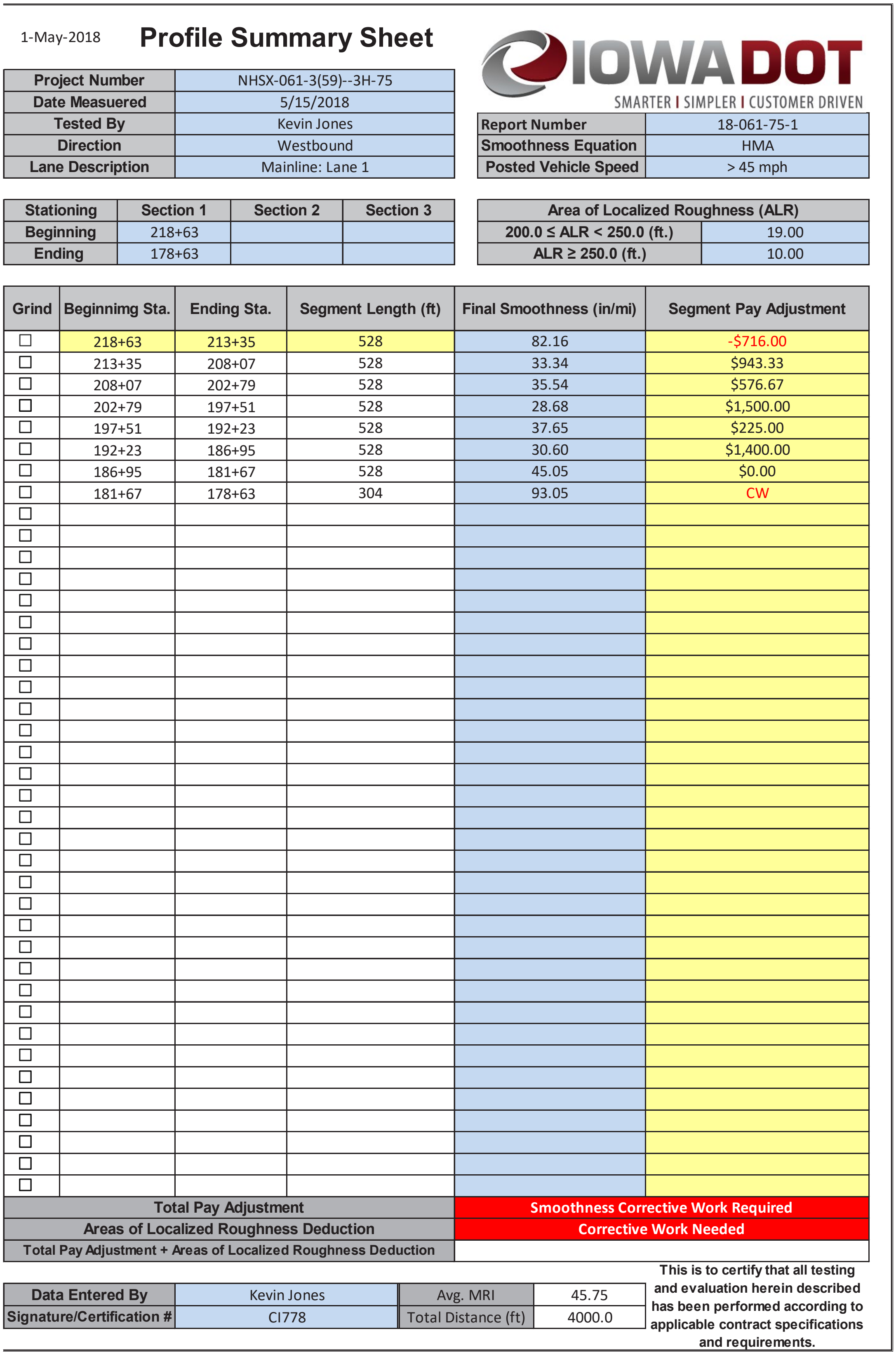


Figure 4. Standard Spreadsheet for Reporting Results



1-May-2018

Profile Summary Sheet

Project Number	NHSX-061-3(59)--3H-75
Date Measured	5/15/2018
Tested By	Kevin Jones
Direction	Westbound
Lane Description	Mainline: Lane 1

Report Number	18-061-75-1
Smoothness Equation	HMA
Posted Vehicle Speed	> 45 mph

Stationing	**Section 1**	**Section 2**	**Section 3**
Beginning	218+63		
Ending	178+63		

Area of Localized Roughness (ALR)	
200.0 ≤ ALR < 250.0 (ft.)	19.00
ALR ≥ 250.0 (ft.)	10.00

Grind	**Beginnimg Sta.**	**Ending Sta.**	**Segment Length (ft)**	**Final Smoothness (in/mi)**	**Segment Pay Adjustment**
☐	218+63	213+35	528	82.16	-$716.00
☐	213+35	208+07	528	33.34	$943.33
☐	208+07	202+79	528	35.54	$576.67
☐	202+79	197+51	528	28.68	$1,500.00
☐	197+51	192+23	528	37.65	$225.00
☐	192+23	186+95	528	30.60	$1,400.00
☐	186+95	181+67	528	45.05	$0.00
☐	181+67	178+63	304	93.05	CW
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Total Pay Adjustment	Smoothness Corrective Work Required
Areas of Localized Roughness Deduction	Corrective Work Needed
Total Pay Adjustment + Areas of Localized Roughness Deduction	

Data Entered By	Kevin Jones	Avg. MRI	45.75
Signature/Certification #	CI778	Total Distance (ft)	4000.0

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

EXERCISES

Problem 1

Length	Roughness	Profile Index
0.100 mi.	0.10 in.	_____in./mi.
0.100 mi.	0.10 in.	_____in./mi.
0.100 mi.	0.00 in.	_____in./mi.
0.142 mi.	0.45 in.	_____in./mi.
_____mi.	_____ in.	_____in./mi.

How many feet _____is 0.142 miles?

Problem 2

Length	Roughness	Profile Index
0.100 mi.	2.09 in.	_____ in./mi.
0.100 mi.	2.64 in.	_____ in./mi.
0.100 mi.	1.39 in.	_____ in./mi.
0.100 mi.	1.62 in.	_____ in./mi.
0.100 mi.	1.22 in.	_____ in./mi.
0.100 mi.	1.89 in.	_____ in./mi.
0.100 mi.	2.19 in.	_____ in./mi.
0.100 mi.	1.27 in.	_____ in./mi.
0.087 mi.	2.04 in.	_____ in./mi.
_____ mi.	_____in.	_____ in./mi.

Average Profile Index Example:

What is the Average Profile Index in a days profile; given 36.65 inches for measured roughness in the Inside Wheel Track and 27.63 inches of measured roughness in the Outside Wheel Track for a segment length 2.644 miles?_____

Problem 3

Inside Wheeltrack (IWT)				Outside Wheeltrack (OWT)				
Length	Roughness	Profile Index		Length	Roughness	Profile Index		PI Average(Total In. / Total Mi.
(mi.)	(in.)	(in./mi.)		(mi.)	(in.)	(in./mi.)		(in./mi.)
0.100	0.30			0.100	0.20			
0.100	0.15			0.100	0.65			
0.078	0.20			0.077	0.40			

Note: Average PI = $\frac{\text{(IWT Roughness+OWT Roughness)}}{\text{(IWT Length +OWT Length)}}$

Calculation:

IM341, I. Reporting Part 6

- English: Given;

Length to 3 decimal places, miles

Measured Roughness to 2 decimal places, inches (0.01 for computers, 0.05 for manuals)

Profile Index to 2 decimal places, PI = inches/miles

1 inch of Trace = 25 feet traveled pavement

5280 feet = 1 mile

1. 21.12 inches of trace is how many feet of traveled pavement?
2. 21.12 inches of trace is how many miles, rounded according to the given above?
3. 3.Given 14.86 inches of measured roughness and 2.578 miles, what is the Profile Index, rounded properly?
4. What is the Profile Index for 1.05 inches of Measured Roughness in 0.046 miles?

2317.05 Pay Adjustment

- How many dollar incentive/disincentive are paid for a HMA Interstate section of highway whose segments are 11.40in/mi, 5.00in/mi, 12.50in/mi, 12.00in./mi, and 14.00in./mi respectively.

2317.05 Pay Adjustment

- How many dollar incentive/disincentive are paid for a PCC Primary section of highway whose segments are 24.40in/mi, 20.00in/mi, 22.50in/mi, 22.60in./mi, and 23.90in./mi respectively.

2317 Ramp Example

- How many total dollars are reported for a PCC Interstate Ramp whose average Profile Index averages are 22.30, 23.61, 21.90, and 22.85in./mi.?

2428 example
Bridge Deck Overlay

Inside Wheeltrack (IWT)				Outside Wheeltrack (OWT)				
Length	Roughness	Profile Index		Length	Roughness	Profile Index		PI Average
(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?

IM 216

PI Example

- Example:

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

SSI Profiler V3.2 - Report of Pavement Smoothness
Licensed to Iowa Department of Transportation , of Ames, Iowa

ta File: HWY 1 NB LINN-JONES 7-16-14.rhd

ations: Run 1 - 334+63.0 to 362+29.9

te [Paved/Corrected]: Run 1 - Wednesday, July 16, 2014
te Tested: Run 1 - Monday, July 21, 2014

le Modifications
Run 1 - No Modifications Found

oject Parameters
Project No: HSIX-1-6(31)--3L-52
State: IA
County: Johnson
Contractor: Jones
Pavement Type: HMA
Traffic Direction: SB
Number of Lanes: 2
Direction of Paving: NB
Tested by:
Paving Action:
Special Provisions:
Report Specification:
Report Memo:
libration Settings
Accelerometer Calibration Date: 7/18/2014
Accelerometer Constant(Track 1): 11665.123046875
Accelerometer Constant(Track 2): 11785.654296875
Distance: 1597811 in 2559 ft
lter Settings
Filter Type: Butterworth Filter
Filter Width: 2.000 ft
Filter Gain: 1.00
allop Parameters
Minimum Height: 0.030 in (Inclusive)
Minimum Length: 2.000 ft
Resolution: 0.010 in
Blanking Band: 0.000 in
calized Roughness Settings
mulated Profilograph Data Used for Defects Analysis
Defect Template Bump Height: 0.500 in
Defect Template Bump Width: 25.000 ft
Defect Template Dip Depth: 0.500 in
Defect Template Dip Width: 25.000 ft
rrection Settings
No corrections applied

n 1 - Speed (Ave, Max, Min) = 29.8, 33.9, 12.7

Track 1				Track 2				Average
Seg	Station (ft)	Rough (in)	PRI (in/mi)	Seg	Station (ft)	Rough (in)	PRI (in/mi)	PRI (in/mi)
1	334+63.0 339+91.0	1.490	14.900	1	334+63.0 339+91.0	1.200	12.000	13.450
2	339+91.0 345+19.0	0.910	9.100	2	339+91.0 345+19.0	1.070	10.700	9.900
3	345+19.0 350+47.0	1.220	12.200	3	345+19.0 350+47.0	1.300	13.000	12.600
4	350+47.0 355+75.0	1.020	10.200	4	350+47.0 355+75.0	1.100	11.000	10.600
5	355+75.0 362+29.9	1.710	13.786	5	355+75.0 362+29.9	3.240	26.121	19.954
	334+63.0 362+29.9	**6.350**	**12.119**		**334+63.0 362+29.9**	**7.910**	**15.096**	**13.606**

fect Locations:

n 1:

Defect	Type	Track	Segment	Start		End	Length (ft)
1	Dip	2	5	361+86.0	to	361+88.8	2.8
2	Bump	1	5	361+95.2	to	362+02.3	7.1
3	Bump	2	5	361+95.3	to	362+05.3	10.1

ack 1 Defects: 1
ack 2 Defects: 2
otal Defects: 3

No user events detected.

IOWA DOT

☐ Revised Report
Changes Lab. No.

PAVEMENT TEST REPORT
25-FOOT CALIFORNIA STYLE PROFILOGRAPH

☐ For Information Only ☐ Preliminary ☑ Final

Lab No. KJ16-001
Date Reported 2/1/2016
Route No. Ia 1
Date Paved 7/16/2014
Project No. HSIX-1-6(31)--3L-52
County Johnson
Contractor Jones

Tested By K. Jones Date 7/21/2014
Trace Reduced By K. Jones Date 7/21/2014

2317
HMA Resurfacing

Tested at: Wheel Track
Blanking Band: 0.0-Inch

Roadway Type: ☑ 2-Lane ☑ 4-Lane ☐ Ramp ☐ Other

Northbound
☐ Inside Lane
Direction (4-Lane Only)
☐ Outside Lane

Length (Miles)	**Wheel Track Measured Roughness** (Inches)	**Inside Profile Index** (Inches/Mile)	**Location** (Station)	**Length** (Miles)	**Wheel Track Measured Roughness** (Inches)	**Outside Profile Index** (Inches/Mile)	**Index Average** (In./Mi.)	**Incent./ Deduct**
0.100	1.49	14.90	334+63	0.100	1.20	12.00	13.45	$350
0.100	0.91	9.10		0.100	1.07	10.70	9.90	$750
0.100	1.22	12.20		0.100	1.30	13.00	12.60	$350
0.100	1.02	10.20		0.100	1.10	11.00	10.60	$500
0.124	1.71	13.79	362+30	0.124	3.24	26.13	19.96	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.524	6.35			0.524	7.91			$1,950

AVG = 12.12 AVG = 15.10

Incentive Levels 2317 HMA Other <10.0, $750; 10.1-11.5, $500; 11.6-13.5, $350; 13.6-15.5, $200; 15.6-35.0, $0; 35.1-40.0, -$200; 40.1+, Grind

1/2" Bump Locations

Station	**Station**
361+89 Dip	
361+95 Bump	

Copies:
Special Investigations, Ames
District Materials Engineer
Resident Construction Engineer
Jones Construction

IOWA DOT

☐ Revised Report
Changes Lab. No.

PAVEMENT TEST REPORT
25-FOOT CALIFORNIA STYLE PROFILOGRAPH

☐ For Information Only ☐ Preliminary ☐ Final

Lab No. ______ Route No. ______ Project No. ______
Date Reported ______ Date Paved ______ County ______
Contractor ______
Tested By ______ Date ______
Trace Reduced By ______ Date ______

2317 ▾ Tested at: Wheel Track ▾
HMA Resurfacing ▾ Blanking Band: 0.0-Inch ▾

Roadway Type: ☐ 2-Lane ☑ 4-Lane ☐ Ramp ☐ Other ______

Northbound ▾ **Direction (4-Lane Only)** ▾
☐ Inside Lane ☑ Outside Lane

Length (Miles)	**Wheel Track Measured Roughness** (Inches)	**Inside Profile Index** (Inches/Mile)	**Location** (Station)	**Length** (Miles)	**Wheel Track Measured Roughness** (Inches)	**Outside Profile Index** (Inches/Mile)	**Index Average** (In./Mi.)	**Incent./ Deduct**
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00	--		0.000	0.00	--	--	$0
0.000	0.00			0.000	0.00			$0

AVG = ##### AVG = #DIV/0!

Incentive Levels: 2317 HMA Int. & 4-lane <10.0, $850; 10.1-11.5, $650; 11.6-13.5, $500; 13.6-15.5, $350; 15.6-35.0, $0; 35.1-40.0, -$350; 40.1+, Grind ▾

Station **1/2" Bump Locations** **Station**

Copies: Special Investigations, Ames
District Materials Engineer
Resident Construction Engineer

______

IOWADOT
Form 821301wd (12-14)

☐ Revised Report
Changes Lab. No. _____

25 – FOOT CALIFORNIA PROFILOGRAPH

☐ For Information Only ☐ Preliminary ☐ Intermediate ☐ Final

Lab No. _____ Route No. _____ Project No. _____

Date Reported _____ Date Paved _____ County _____

Tested At: ☐ ¼ Point ☐ Wheel Track Contractor _____

Tested By _____ Date _____

Trace Reduced By _____ Date _____

☐ Primary Schedule A ☐ PCC Slip Form ☐ ACC Paving
☐ Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing
☐ Secondary ☐ PCC Bonded Overlay ☐ ACC Patches
☐ Municipal ☐ PCC Unbonded Overlay
☐ Other ☐ PCC Patches

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

☐ Northbound ☐ Eastbound ≥ Direction ⎫ ☐ Southbound ☐ Westbound
☐ Inside Lane ≥ (4-Lane Only) ⎭ ☐ Outside Lane

Length Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)	**Location** (Station)	**Length** Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)

Station ≥ ½" (12.7 mm) **Bump Locations** ⎫ **Station**
or
½" (12.7 mm) **Dip Locations**

Copies

District Materials Engineer

IOWADOT
Form 821301wd (12-14)

☐ Revised Report
Changes Lab. No. _____

25 – FOOT CALIFORNIA PROFILOGRAPH

☐ For Information Only ☐ Preliminary ☐ Intermediate ☐ Final

Lab No. _____ Route No. _____ Project No. _____

Date Reported _____ Date Paved _____ County _____

Tested At: ☐ ¼ Point ☐ Wheel Track Contractor _____

Tested By _____ Date _____

Trace Reduced By _____ Date _____

☐ Primary Schedule A ☐ PCC Slip Form ☐ ACC Paving
☐ Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing
☐ Secondary ☐ PCC Bonded Overlay ☐ ACC Patches
☐ Municipal ☐ PCC Unbonded Overlay
☐ Other ☐ PCC Patches

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

☐ Northbound ☐ Eastbound ≥ Direction ⎫ ☐ Southbound ☐ Westbound
☐ Inside Lane ≥ (4-Lane Only) ⎭ ☐ Outside Lane

Length Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)	**Location** (Station)	**Length** Miles (km)	**Measured Roughness** Inches (mm)	**Profile Index** Inches/Miles (mm/km)

Station ≥ ½" (12.7 mm) **Bump Locations** ⎫ **Station**
or
½" (12.7 mm) **Dip Locations**

Copies

District Materials Engineer

HOMEWORK

Review #1
Homework
Ride Quality

Review #1 Smoothness PI Report

Contractor Results

Inside Wheeltrack			Outside Wheeltrack			
Length	Measured Roughness	Profile Index	Length	Measured Roughness	Profile Index	Profile Index Average
0.100 mi.	2.02in.	20.20in./mi	0.100 mi.	1.50in.	15.00in./mi.	**#1**
0.100 mi.	1.94in.	**#2**	0.100 mi.	2.10in.	21.00in./mi.	20.20in./mi.
0.100 mi.	2.44in.	24.40in./mi.	0.100 mi.	2.07in.	**#3**	22.55in./mi.
0.100 mi.	1.77in.	17.70in./mi.	0.100 mi.	1.39in.	13.90in./mi.	15.80in./mi.
0.055 mi.	0.68in.	12.36in./mi.	0.055 mi.	0.68in.	12.36in./mi.	12.36in./mi.
#4	8.85in.	19.45in./mi.	0.455 mi.	7.74in.	**#5**	18.23in./mi.

IDOT Results

Inside Wheeltrack			Outside Wheeltrack			
Length	Measured Roughness	Profile Index	Length	Measured Roughness	Profile Index	Profile Index Average
0.100 mi.	1.56in.	**#6**	0.100 mi.	1.40in.	14.00in./mi.	14.80in./mi.
0.100 mi.	1.98in.	19.80in./mi.	0.100 mi.	2.31in.	**#7**	21.45in./mi.
0.100 mi.	2.27in.	22.70in./mi.	0.100 mi.	2.19in.	21.90in./mi.	**#8**
0.100 mi.	2.06in.	**#9**	0.100 mi.	1.88in.	18.80in./mi.	19.70in./mi.
0.055 mi.	0.93in.	16.91in./mi.	0.055 mi.	0.92in.	16.73in./mi.	16.82in./mi.
0.455 mi.	8.80in.	19.34in./mi.	**#10**	**#11**	19.12in./mi.	**#12**

Review #1 Answers Smoothness PI Report

Contractor Results

Inside Wheeltrack			Outside Wheeltrack			
Length	Measured Roughness	Profile Index	Length	Measured Roughness	Profile Index	Profile Index Average
0.100 mi.	2.02in.	20.20in./mi	0.100 mi.	1.50in.	15.00in./mi.	**17.60in./mi**
0.100 mi.	1.94in.	**19.40in./mi**	0.100 mi.	2.10in.	21.00in./mi.	20.20in./mi.
0.100 mi.	2.44in.	24.40in./mi.	0.100 mi.	2.07in.	**20.70in./mi**	22.55in./mi.
0.100 mi.	1.77in.	17.70in./mi.	0.100 mi.	1.39in.	13.90in./mi.	15.80in./mi.
0.055 mi.	0.68in.	12.36in./mi.	0.055 mi.	0.68in.	12.36in./mi.	12.36in./mi.
0.455mi.	8.85in.	19.45in./mi.	0.455 mi.	7.74in.	**17.01in./mi**	18.23in./mi.

IDOT Results

Inside Wheeltrack			Outside Wheeltrack			
Length	Measured Roughness	Profile Index	Length	Measured Roughness	Profile Index	Profile Index Average
0.100 mi.	1.56in.	**15.60in./mi**	0.100 mi.	1.40in.	14.00in./mi.	14.80in./mi.
0.100 mi.	1.98in.	19.80in./mi.	0.100 mi.	2.31in.	**23.10in./mi**	21.45in./mi.
0.100 mi.	2.27in.	22.70in./mi.	0.100 mi.	2.19in.	21.90in./mi.	**22.30in./mi**
0.100 mi.	2.06in.	**20.60in./mi**	0.100 mi.	1.88in.	18.80in./mi.	19.70in./mi.
0.055 mi.	0.93in.	16.91in./mi.	0.055 mi.	0.92in.	16.73in./mi.	16.82in./mi.
0.455 mi.	8.80in.	19.34in./mi.	**0.455mi.**	**8.70in.**	19.12in./mi.	**19.23in./mi**

Review #1 (IM216)

Example: Independent Assurance

Use Review #1 Question and Answers……

According to IM216 for “Pavement Profile Index (0.2”Blanking Band)” and contractor’s final results 18.23in./mi. and your answer for question #12…Are the two results within the tolerance?

Review #1 (IM216)

Example of Independent Assurance:

Contactor results 18.23in./mi

IDOT Verification results 19.23in./mi

IM216 tolerance +/-2.0in./mi

IM216 Complies

Pavement Profile Index (0.2" blanking band)	IM 341	Tolerance
Verification Profile Index Test Result		
Inches/mile (mm/km)		
6.0 (95) or less		1.0 in./mi. (16 mm/km)
6.1 to 20.0 (96 to 315)		2.0 in./mi. (32 mm/km)
20.1 to 40.0 (316 to 630)		3.0 in./mi. (47 mm/km)
More than 40.0 (630)		5.0 in./mi. (79 mm/km)