2021 Construction Updates

Bituminous Updates

John Garrity, Greg Johnson, Chelsea Bennett

Bituminous Office Staff

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Bituminous Resources on Bituminous Office Webpage

Bituminous Manual

Bituminous Knowledge Guide

Summary of experience and knowledge related to aggregate and bituminous testing in Minnesota.

Knowledge Guide

Dave Linell Knowledge Book

3 Update Items Today

- General Bituminous Items (John)
- Coring Guidance (Greg)
- Smoothness (Chelsea)

COVID19 Impact

- Everyday Life
  - Teleworking, conferences, restaurants, schools, social distancing, masks, etc.
- Plant monitoring and inspection
  - Social distancing & masks, use of photos, facetime, MDMS (e-Tickets), etc.
- Paving Awards
  - Even the bituminous paving awards were Virtual evaluation this year.

Superpave 5


TH 251


TH 25

Superpave 5 Background

- Superpave 5 designs mixtures at 5% air voids and also compacts mixtures in the field at 5% air voids
  - Currently, mixes are designed at 4% air voids and compacted at 8% air voids in the field
- Superpave 5 focuses on aggregate gradation changes and reduced gyrations without significant changes to asphalt binder content

Benefits of Increased Density

- Improved Performance & Durability
  - » Better fatigue life
  - » Reduced oxidation
  - » Reduced permeability
  - » Minimizes potential for rutting and shoving
  - » Minimizes potential for raveling

Superpave 5
TH 61 in Lake City-District 6

Two day test constructed in 2019

- Control Section
  - Lift 1 SPWEB440, 5.0% AC
  - Lift 2 SPWEB440, 5.3% AC
- 90 gyrations
- Avg. Air Voids 3.9%
- Avg. Density 93.4%

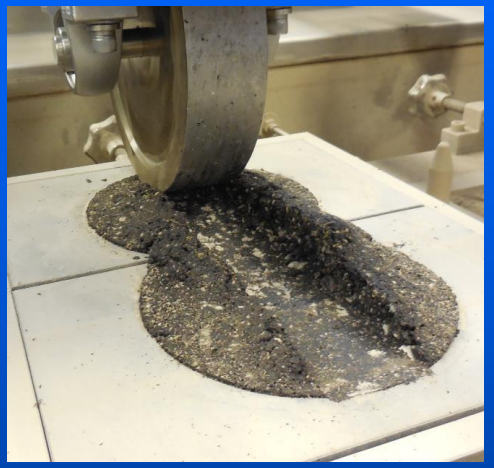
- Superpave 5 Test Section
  - Lift 1 SPWEB450, 5.2% AC
  - Lift 2 SPWEB450, 5.6% AC
- 50 gyrations
- Avg. Air Voids 5.2%
- Avg. Density 94.8%

Superpave 5 Pilot Provision Used in 2020

Table 2360-7 Mixture Requirements				
Traffic Level	**2**	**3**	**4**	**5**
20 year design ESALs	< 1 million	1 – 3 million	3 – 10 million	10 – 30 million
Gyratory mixture requirements:				
Gyrations for N_{design}	30	30	50	50
% Air voids at N_{design}, wear	5.0	5.0	5.0	5.0
% Air voids at N_{design}, Non-wear and all shoulder	5.0	5.0	5.0	5.0
Hamburg Wheel Test Minimum # of Passes with less than 12.5 mm Rut Depth (122°F)	10,000	10,000	15,000	20,000
Adjusted Asphalt Film Thickness, minimum µ	8.5	8.5	8.5	8.5
TSR*, *minimum %*	75‖	75‖	80†	80†
Fines/effective asphalt	0.6 – 1.2	0.6 – 1.2	0.6 – 1.2	0.6 – 1.2

* Use 6 in [150 mm] specimens in accordance with 2360.2.I, "Field Tensile Strength Ratio (TSR)."
‖ MnDOT minimum = 65
† MnDOT minimum = 70

Hamburg Wheel Track Tester



Hamburg Requirements

- Option to have MnDOT test samples:

Option B

At least 7 calendar days before actual production, submit sample to the Office of Material and Road Research for Hamburg Wheel Track Testing. Batch and cure in accordance with Option A. Compact and submit briquettes in accordance with the following:

Option B Mixture Requirements	
Item	**Gyratory Design**
Number of compacted briquettes*	4
Compacted briquette air void content	4.5 % – 5.5 %
* 6 in diameter and 62 mm high specimens.	

Density Requirements

Table 2360-19 Required Minimum Lot Density (Mat)	
	SP Mixtures*
% Gmm	95

Table 2360-20 Longitudinal Joint Density Requirement		
Location	Confined Edge of Mat*	Unconfined Edge of Mat
Long joint wear and shoulder (5% air voids)	91.0	89.5

Table 2360-22 Payment Schedule for Maximum Mat Density		
SP5 Wear and SP5 Shoulders (5% Void) Density, %*	Mat Density Pay Factor A	
	Traffic Level 2 & 3	Traffic Level 4 & 5
≥ 96.0	1.02	1.03
95.5 – 95.9	1.01	1.02
95.0 – 95.4	1.00	1.00
93.5 – 94.9	1.00	1.00
92.0 – 93.4	1.00	1.00
91.0 – 91.9	0.91	0.91
90.0 – 90.9	0.85	0.85
89.0 – 89.9	0.70	0.70
< 89.0	†	†

2020 Superpave5 Projects

District	Project	TH	Location	Project Information	Length	
6	2408-23	251	From the Jct. I-35 to TH 218	60,000 tons SPWEB350B (M&O)	16 mi	Ulland
6	7901-52	42	Plainview to TH 61	42,000 tons SPWEB350B (M&O)	12 mi	Mathy By SA
1	1604-45	61	RP 133.78 to RP 150.8	100,000 tons SPWEA450C (FDR & HMA)	17 mi	Northland Carry over
2	1102-70	2	East of Cass CSAH 91 to CSAH 18	60,000 tons SPWEB450F and SPWEB250B (M&O)	13 mi	Hawkinson
2	1118-23	371	Hackensack to TH 200	16,000 tons SPWEB350B (M&O)	9 mi	Hawkinson
Metro	1007-21	25	Mayer to Watertown	28,000 tons SPWEB350C (4" M&O)	6 mi	Valley

2020 Superpave5 Projects Density Results

District	Project	TH	Average Field Density (% of Gmm)	Standard Deviation	Average Lab Density (% Air Voids)	Standard Deviation
6	2408-23	251	94.6	1.96	4.9	0.5
6	7901-52	42				
1	1604-45	61				
2	1102-70	2				
2	1118-23	371				
Metro	1007-21	25				

2020 Superpave5 Projects Density Results: Traffic Level 3

District	Project	TH	Average Field Density (% of Gmm)	Standard Deviation	Average Lab Density (% Air Voids)	Standard Deviation
6	2408-23	251	94.9	1.50	5.0	0.54
6	7901-52	42				
2	1118-23	371				
Metro	1007-21	25				

2020 Superpave5 Projects Density Results: Traffic Level 4

District	Project	TH	Average Field Density (% of Gmm)	Standard Deviation	Average Lab Density (% Air Voids)	Standard Deviation
1	1604-45	61	94.0	1.86	4.9	0.42
2	1102-70	2				

2020 Superpave5 Projects Hamburg Results

District	Project	TH	Average Max Rut Depth (mm)	Required Cycles	Pass/Fail?
6	2408-23	251	4.73	10,000	Pass
6	7901-52	42	6.29	10,000	Pass
1	1604-45	61	7.51	15,000	Pass
2	1102-70	2	1.50	10,000	Pass
2	1118-23	371	3.98	10,000	Pass

2021 Superpave5 Projects

District	Project	TH	Location	Project Information	Length	Letting
6	2319-20	250	Lanesboro to TH 30	SPWEB350B (M&O)	8.5 mi	1/29/21
6	7403-30	30	Ellendale to CSAH 45	SPWEB350B (M&O)	5.6 mi	1/29/21
6	6605-37	21	I35 to TH 99	SPWEB350B (M&O)	8 mi	10/23/20
Metro	7011-29	282	Jordan to TH 13	SPWEA350C (SFDR & 3")	6.8 mi	10/23/20
1	1604-45	61	RP 133.78 to RP 150.8	100,000 tons SPWEA450C (FDR & HMA)	17 mi	Northland Carry over

Superpave5--What Next?

- Final Specification Development (Agency/Industry)
  - Continue working with U of M on research effort.
  - Evaluate data from pilot projects.
- Current Implementation Plans:
  - No immediate plans for full implementation.
    - » Continue district by district project selection.
- Future Implementation Plans:
  - Superpave vs Superpave5

New Test Summary Sheet

- When completed, we will allow only the New Test Summary Sheet (TSS) to be used on projects.
  - Greg and Chelsea are currently working on developing the New TSS.
    - » Will be looking for Pilot projects in 2021 season.
  - Will combine elements of current TSS and State Aid TSS (Bumann sheet).

New Test Summary Worksheet (Pilot)

Test ID: 423 | **Date:** 5/23/2019 | **SP:** 9999-99

Gmm	
Container ID	
Container in Air	
Cont. + Sample in Air*	2049.6
Dry Wt of Sample	2049.6
Container in Water	2074.4
Cont. + Sample in Water	3302.3
Wt of Sample in Water	1227.9
Volume of Sample	821.7
Max. Sp.G (Gmm)	2.49434

Gmb	#1	#2
Thickness	110.8	110.2
Dry wt in Air	4565.2	4542.1
Immersed Wt	2630.3	2618.1
SSD Wt.	4567.2	4544.4
Volume	1936.9	1926.3
Bulk Sp.G (Gmb)	2.35696	2.35794
Avg. Gmb	2.357451124	
% Air Voids	5.488017722	

Ignition	
Mix Calibration Factor	0.32
Basket ID	
Basket wt.	2612
Initial wet wt. + basket	4626.9
Final dry wt. + basket	4515
Sample Moisture Content	
(if mix is not dried to constant mass before placing in Ignition Oven)	
Container ID	
Container Wt.	177.3
Intial - Basket + Sample	1313.9
Final - Basket + Sample	1313.9
Sample Moisture Content, %	0
% AC (Corrected)	5.23363 A
AC Method Used	Ignition

Chemical Extraction	
Bowl #	
Bowl Wt.	
Sample Wt.	
Celite Wt.	
Filter Wt.	
Final - Aggr. Dry Wt.	
Final - Wt. of Filter	
Extracted Aggr. Wt.	
Fines in Filter	
% AC	

Gradation	Weights		
Sieve size	Ind. Retain	Cum. Wt.	%Passing
1"	0	1941.7	100
3/4"	0	1941.7	100
1/2"	285.6	1656.1	85.2912
3/8"	110.4	1545.7	79.6055
#4	250.2	1295.5	66.7199
#8	167	1128.5	58.1192
#16	170.8	957.7	49.3228
#30	249.8	707.9	36.4577
#50	369.8	338.1	17.4126
#100	187.7	150.4	7.74579
#200	75.2	75.2	3.87289
Pan	9.3		
Washing Efficiency	12%		
Wt Before Washing	1902.5		
Wt After Washing	1836.6		
Loss By Washing	65.9		

Adj. AFT	
Adj. AFT	8.00031
Effective Asphalt Content, Pbe	4.69156

FAA	
Average Specific Gravity	2.66318
Cylinder Vol.	100.45
Cylinder Tare	251.2
Wt. Trial 1	409
Wt. Trial 2	408.6
Avg. FAA	41.1
Avg. FAA (Integer)	41.1

CAA	
Total Retained on #4	646.4
Wt. One Faced	556.8
Wt. Two Faced	
% One Faced	86.1386
% Two Faced	0

Specific Gravities	
Composite Aggregate SpG	2.66318
"-4 Composite Aggregate SpG	2.65806
Asphalt Cement SpG	1.041

VMA	
VMA	16.1125

Mix Moisture	
Container Wt.	
Intial - Basket + Sample	
Final - Basket + Sample	
Sample Moisture Content, %	

Contractor QC & Agency Verification Volumetric Summary

		QC	Verif.	QC	Verif.	QC	Verif.	QC	Verif.	QC	Verif.
	Test #	423		424		425		426		427	
	Date	5/23/2019		5/23/2019		5/23/2019		6/5/2019		1/0/1900	
	Tons Rep	500		500		500		500		500	
	MDR #	0-2019-027		0-2019-027		0-2019-027		0-2019-027		0-2019-027	
Sp.G	Aggr. Total Sp. G	2.66317613		2.664088874		2.664088874		2.664349016		2.674	
	Aggr. -#4 Sp. G	2.658062475		2.65799278		2.65799278		2.658043895		2.673	
	AC Sp. G	1.041		1.041		1.041		1.041		1.035	
Gradation Results	1 inch	100	100	100		~~100~~	90	100	100	100	100
	100 100	Mov. Avg.	===	===	===	===	===	97.5		97.5	
	3/4 inch	100	100	100		100		100	96	100	
	97 100	Mov. Avg.	===	===	===	===	===	100		100	
	1/2 inch	85.2912	89	90.9823		91.3283		87.5972		97.7997	
	85 100	Mov. Avg.	===	Mov. Avg.	===	Mov. Avg.	===	88.79976126		Mov. Avg.	===
	3/8 inch	79.6055	82	82.3143		83.2079		78.0187		89.3298	
	35 90	Mov. Avg.	===	Mov. Avg.	===	Mov. Avg.	===	80.78660139		83.21766956	
	#4	66.7199	68	66.9492		68.4777		62.8868		76.0267	
	30 80	Mov. Avg.	===	Mov. Avg.	===	Mov. Avg.	===	66.25839331		68.58509771	
	#8	58.1192	59	58.4455		59.3502		53.9959		59.8772	
	25 65	Mov. Avg.	===	Mov. Avg.	===	Mov. Avg.	===	57.47767068		57.91716959	
	#16	49.3228	49	49.1788		49.6502		45.2319		44.3151	
	#30	36.4577	36	36.0867		35.9748		32.9084		30.9426	
	#50	17.4126	16	16.6949		16.4688		15.608		17.741	
	#100	7.74579	6	6.62817		6.54617		6.4685		9.23899	
	#200	3.87289	4.0	4.51944		4.55316		4.42693		5.68758	
	2.0 7.0	Mov. Avg.	===	Mov. Avg.	===	Mov. Avg.	===	4.343108968		4.796781108	
% Asphalt Cement	Ign Oven Corr. Factor	0.32		0.32		0.32		0.32		0.7	
	Individual	5.23363	5.4	5.67393		5.75298		5.68954		5.9969	
	Measurement Metho	-	Ignition	-		-		-		-	
	ndividual Requiremer	4.8		4.8		4.8		4.8		4.8	
	Mov. Avg.	-	-	-	-	-	-	-	-	-	-
	Mov. Avg. Requiremen	-	-	-	-	-	-	-	-	-	-
	Effective AC	4.69156	4.98101	5.13461		5.36072		5.37305		5.56307	
New/Total %AC	Add AC	4.3		0		0		0		0	
	Indiv. New/Total AC	82.161	????	0		0		0		0	
	Indiv. Required	66		66		66		66		66	
	Mov. Avg New/Total AC	-	-	-	-	-	-	-	-	-	-
	Mov. Avg. Required	-	-	-	-	-	-	-	-	-	-
Mix Specific Gravity	Gmm	2.49434	2.481	2.479		2.46753		2.46557		2.46923	
	Moving Avg.	-	-	-	-	-	-	-	-	-	-
	Gmb	2.35745	2.355	2.40097		2.37901		2.41363		2.4202	


Tack Talk

Tack Sampling Best Practices

- Tack Sampling
  - Store sample in a plastic container.
  - Sample tack from spigot on distributor or nozzle on the bar.
  - Might be a good idea to run distributor down the road to “shake up” the load before sampling.
  - Waste some material before taking sample.

Tack Acceptance

- Tack Acceptance Criteria
  - Penetration
  - Residual Asphalt

Tack Issues Penetration

- Sample contamination
  - Not wasting material before sample is drawn. Contamination from diesel fuel used to clean bar.
- Distributor tank contamination
  - Diesel fuel used to clean spray bar or pump is drawn or wasted into emulsion tank contaminating entire tank.

Verification Sampling

- FHWA Quality Review Summary
  - MnDOT needs to educate our people on randomness of selecting Verification Samples.
- Verification Sampling in 2020 Spec Book
  - MnDOT needs to say when the Verification Sample will be taken.
  - MnDOT needs to determine random numbers for mixture sampling AND density cores.
  - MnDOT needs to be present and take immediate possession of sample after it is taken.


EXIT 234B
7th St
HOSPITAL
EXIT ONLY
Thank You

Pavement Smoothness

Chelsea Bennett | Assistant Bituminous Engineer

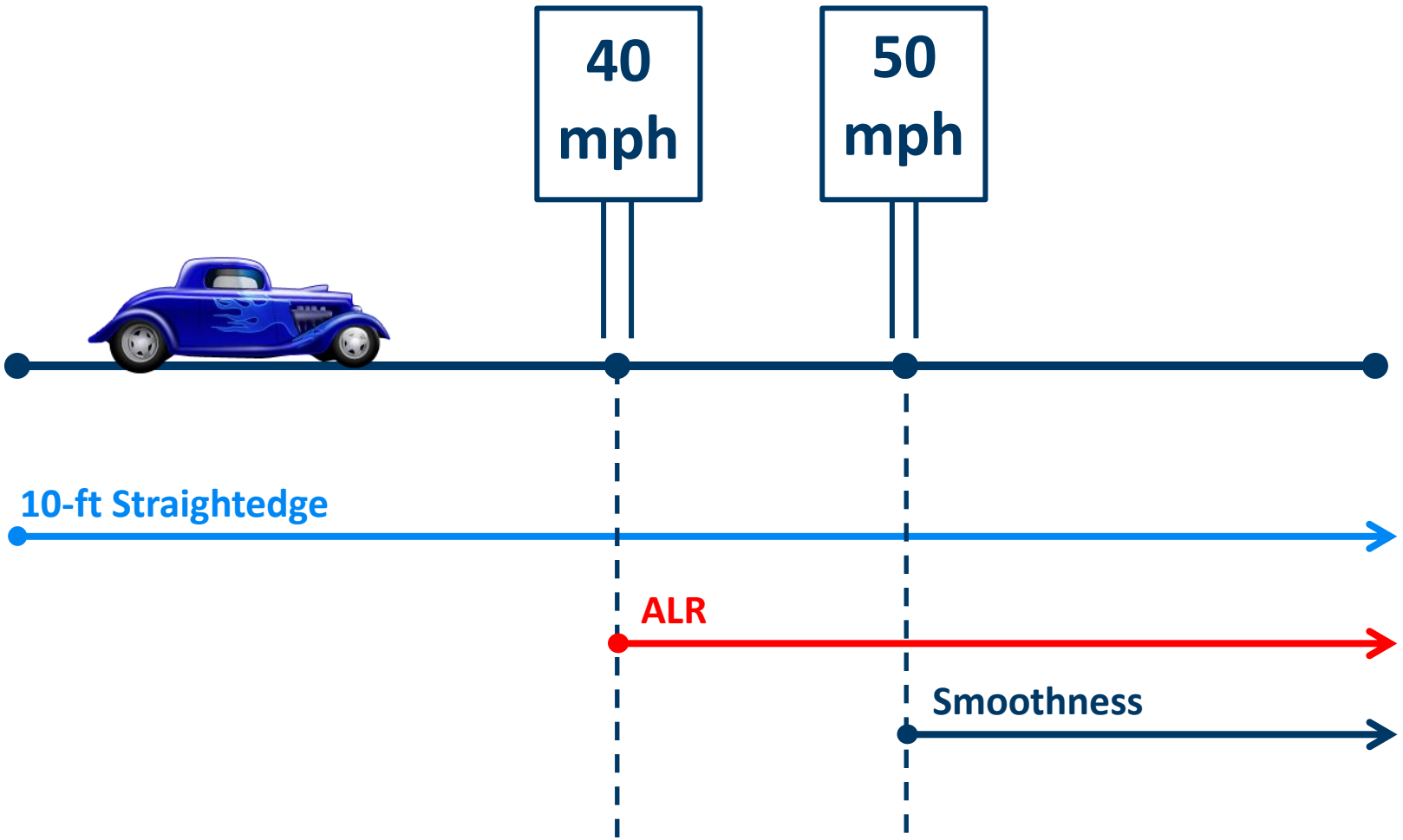
Pavement Smoothness

- Found in the Spec Book under 2399 “Pavement Surface Smoothness”
- Definition of International Roughness Index (IRI)
  - Roughness measurement that represents how the road “feels” to drivers and passengers
- How is IRI measured?
  - The longitudinal profile of a road is approximated with an inertial profiler.
  - The accumulation of the vehicle’s suspension movement is measured.
- Definition of Mean Roughness Index (MRI)
  - Average of left and right wheel path IRIs

Pavement Smoothness

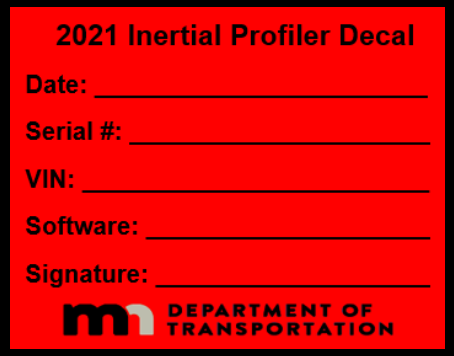
- There are two IRI-based measures
  - Smoothness: single MRI value that represents the overall roughness of an entire 528-foot (0.1 mile) pavement segment
  - Area of Localized Roughness (ALR): short-interval roughness using a continuous 25 ft. baseline length for analysis.
    - MRI > 175.0 in/mi considered an Area of Localized Roughness

Speed: What Part of the Specification Applies?



Pavement Smoothness

- Day of Profiling
  - Need from IP Operator:
    - Printout of IP's settings
    - LWP and RWP IRI values
    - IP Operator Signature
    - .ppf and .kml electronic files
- Paving Completed
  - A paper ProVAL summary report for each lane profiled must be submitted within 5 calendar days after paving is complete



1-Feb-2020

2020 Bituminous Profile Summary

File Name(s)	190715-MN-95-I-1-12500-18500
Date Measured	July 15, 2019
S.P./S.A.P.	0125-85
T.H./CSAH	TH 95
Lane Description	Mainline: lane 1

Smoothness Equation	HMA-B
Posted Vehicle Speed	> 45 mph
Mainline Density Lots	Failure Rate: ≤ 25%
Certified Inertial Profiler	Yes
Certified Operator	Yes
Additional Information	

Stationing	Section 1	Section 2	Section 3
Beginning	125+00		
End	185+00		

Areas of Localized Roughness (ALR)	
175.0 ≤ ALR < 225.0 (linear ft)	
ALR ≥ 225.0 (linear ft)	

	Beginning Station	End Station	Segment Length (ft)	Final Smoothness (in/mi)	Segment Pay Adjustment	
S1	125+00	130+28	528	35.0	$216.00	S1
↓	130+28	135+56	528	45.0	$108.00	↓
↓	135+56	140+84	528	43.0	$129.60	↓
↓	140+84	146+12	528	44.5	$113.40	↓
↓	146+12	151+40	528	47.8	$77.76	↓
↓	151+40	156+68	528	85.0	CW	↓
↓	156+68	161+96	528	53.1	$20.52	↓

Total Pay Adjustment	Smoothness Corrective Work Required
Areas of Localized Roughness Deduction	
Total Pay Adjustment + Areas of Localized Roughness Deduction	

Data Entered By	
Signature	

Data Checked By	
Signature	

Pavement Smoothness

Smoothness Pay Adjustments and Corrective Work		
Equation	**Smoothness Thresholds (Max Incentive and CW)**	**Pay Adjustment per 0.1 mi or Corrective Work**
HMA-A	< 25.0 in/mi	$400.00
	> 75.0 in/mi	Corrective Work to 50.0 in/mi
HMA-B	< 30.0 in/mi	$270.00
	> 80.0 in/mi	Corrective Work to 55.0 in/mi
HMA-C	< 35.0 in/mi	$180.00
	> 95.0 in/mi	Corrective Work to 65.0 in/mi
PI	> 70.0%	$180.00
	< 0.0%	Corrective Work to at least 0.0%

NOTE: The Engineer will not pay any positive Total Pay Adjustments if greater than 25 percent of all mainline density lots for the project fail to meet the minimum density requirements in accordance with 2360, “Plant Mixed Asphalt Pavement.”

Pavement Smoothness

ALR Monetary Deductions and Corrective Work Requirements		
Equation	**25-ft Continuous MRI, in/mi**	**Corrective Work or Monetary Deduction, per linear 1.0 ft**
HMA-A or HMA-B, and a posted vehicle speed > 45 mph	< 175.0	Acceptable
	≥ 175.0 and < 225.0	Corrective Work unless both the Engineer and the Contractor agree to a monetary deduct of $25.00
	≥ 225.0	Corrective Work unless both the Engineer and the Contractor agree to a monetary deduct of $125.00

Step-by-Step Ride Guide

http://www.dot.state.mn.us/materials/smoothnessdocs/Ride_Guide_2-29-2016.docx

This is the 2016 version of the Ride Guide, but it will be updated.

Step-by-Step Ride Guide for Inspectors & Project Engineers

At Any Time

- **If you have a smoothness related question or would like assistance with any of the steps enumerated in this document, please contact one of the following individuals.**
  - Tom Nordstrom, Pavement Management Analyst: 651-366-5537
  - Rob Golish, Assistant Concrete Engineer: 651-366-5576
  - Greg Schneider, Assistant Bituminous Engineer: 651-366-5403

Before Any Profiling is Performed by Contractor

- **Familiarize yourself with the following pavement terms:**
  - International Roughness Index (IRI): roughness measurement that represents how the road "feels" to drivers and passengers
  - Mean Roughness Index (MRI): average of left and right wheel path IRI
  - Smoothness: 528-foot MRI
  - Area(s) of Localized Roughness (ALR): 25-foot continuous MRI ≥ 175.0 in/mi
  - ERD file: text file that contains pavement elevation data
  - ProVAL (Profile Viewing and Analysis): FHWA software application used to view and analyze pavement profiles
- **Ask inertial profiler (IP) operator to provide evidence of current, valid operator and inertial profiler certifications.**
  Operator certification is valid for multiple years, but inertial profiler certification expires at the end of each calendar year. Both certifications can be verified by accessing the Profiler Certification page of MnDOT's Smoothness website: http://www.dot.state.mn.us/materials/profilercertification.html.

2019 Contractor Scorecard – HMA-A

Contractor	Project	Mean Smoothness (in/mi)
A	A-1	26.4
B	B-1	33.1
C	C-1	51.5
D	D-1	38.4
	D-2	36.3
	D-3	31.3
E	E-1	53.7
F	F-1	55.4

2019 Contractor Scorecard – HMA-B

Contractor	Project	Mean Smoothness (in/mi)
A	A-1	33.6
	A-2	32.3
	A-3	30.1
	A-4	38.3
	A-5	38.8
B	B-1	28.7
C	C-1	34.0
	C-2	34.2
	C-3	29.3
D	D-1	40.6
	D-2	38.8
	D-3	37.8
E	E-1	40.6
	E-2	33.4
F	F-1	34.5
	F-2	35.2

Contractor	Project	Mean Smoothness (in/mi)
G	G-1	33.1
	G-2	30.0
	G-3	34.5
	G-4	29.5
	G-5	28.3
	G-6	29.1
	G-7	34.0
	G-8	27.0
	G-9	28.0
	G-10	28.2
H	H-1	29.8
	H-2	42.8
I	I-1	35.8
J	J-1	71.9
K	K-1	33.7
	K-2	39.4
L	L-1	42.4

2019 Contractor Scorecard – HMA-C

Contractor	Project	Mean Smoothness (in/mi)
A	A-1	37.1
B	B-1	44.3
	B-2	37.4
C	C-1	41.3
D	D-1	66.5
	D-2	48.2

Thank you!!!

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