

Evaluating the Use of High Speed Laser Line Sensors for Improved Rideability Measurement



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16. Abstract <p>This research project compared rideability readings and repeatability for both point laser and line laser systems on the high-speed profiler. Both systems were Dynatest 5051 Mark III Road Surface Profilers, one equipped with single point lasers and the other with GoCator wide footprint lasers. Each system collected data for pavement surface textures SCDOT requires rideability measurements for contractor pay. Data was collected simultaneously in order to help eliminate factors including start/stop points, different times of day, as well as temperature differences.</p> <p>The SCDOT predicted that there would be significant differences between the two lasers on textured pavements and not as much, if any, on dense graded surfaces. Based on the findings from this research, the SCDOT will update rideability specifications to reflect the use of line lasers for acceptance on construction projects. Statistical analysis was performed on the gathered data. The SCDOT's findings supported the anticipated outcome and proved that line lasers give a lower IRI measurement for the textured surfaces and similar measurements for dense graded surfaces. The SCDOT's rideability specifications have been updated as a result of this research to reflect the new target values.</p>					
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Table of Contents

List of Figures	4
List of Tables	4
Acknowledgements.....	5
Introduction	6
Purpose and Scope.....	6
Data Used.....	6
Results and Discussion	7
Conclusions and Recommendations	36
Implementation	38
Bibliography	38
Appendices.....	39
Appendix 1: Statistical Analysis.....	40
Appendix 2: Recommended Updates for SC – M-403 Table 6.....	136
Appendix 3: Updated SC-M-403	147
Appendix 4: Updated SC-M-502	168

List of Figures

Figure 1. Line Laser IRI vs. Point Laser IRI for Existing AC Pavements	8
Figure 2. Line Laser IRI vs. Point Laser IRI for Existing AC Pavements with Outliers Removed	9
Figure 3. Line Laser IRI vs. Point Laser IRI for Overlaid AC Pavements	10
Figure 4. Line Laser IRI vs. Point Laser IRI for Overlaid AC Pavements with Outliers removed.....	10
Figure 5. Line Laser IRI vs. Point Laser IRI for OGFC AC Pavements	11
Figure 6. Line Laser IRI vs. Point Laser IRI for OGFC AC Pavements with Outliers removed	11
Figure 7. Line Laser MRI vs. Point Laser MRI for New PCC Pavements	12
Figure 8. Line Laser MRI vs. Point Laser MRI for New PCC Pavements with Outliers removed	13

List of Tables

Table 1: Miles of Data Collected	7
Table 2: (PCC) SC-M-502 - Table 2: Schedule for Adjusted Payment – Existing Construction	14
Table 3: (PCC) SC-M-502 - Table 1: Schedule for Adjusted Payment – New Construction	14
Table 4: (OGFC) SC-M-403 Table 1: Schedule for Adjusted Payment	15
Table 5: (OGFC) SC-M-403 Table 1: Schedule for Adjusted Payment	15
Table 6: (New AC) SC-M-403 Table 1: Schedule for Adjusted Payment	16
Table 7: (Multiple Lift Overlay) SC-M-403 Table 3: Schedule for Adjusted Payment	16
Table 8: (Reclamation) Based on SC-M-403 Table 4, assuming initial ride of 300 in./mile	17
Table 9: Existing AC Pavement.....	17
Table 10: Recommended Updates for SC-M-403 Table 1.....	36
Table 11: Recommended Updates for SC-M-403 Table 3.....	36
Table 12: Recommended Updates for SC-M-403 Table 4.....	37
Table 13: Recommended Updates for SC-M-403 Table 5.....	37
Table 14: Recommended Updates for SC-M-502 Table 1.....	37
Table 15: Recommended Updates for SC-M-502 Table 2.....	38

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Introduction

Rideability is the comparative discomfort the driver feels caused by traveling over a section of pavement; it is typically measured by the International Roughness Index (IRI). The smoothness of a pavement, especially a newly constructed pavement, is one of the main qualities the traveling public will notice and use to assess the quality of the pavement. Smooth-riding pavements are considered to be in better condition both functionally and structurally than rough-riding pavements. Because a smooth-riding pavement also correlates to better construction practices, IRI measurements are used as an acceptance criterion by SCDOT for paving projects.

South Carolina has been employing high-speed inertial profilers with single point lasers to measure the rideability of asphalt pavements. Baus and Hong (2004) performed a research project to develop the original IRI specifications for the profilers; the requirements that were developed corresponded with both other state agencies and historical SCDOT values from the Mays Ride Meter.

Since then the SCDOT has provided the requirements for rideability for SCDOT construction projects pavements. These specifications have been through multiple iterations to seek quality rideability to the best possible extent after all construction activities. Newer technologies have allowed the use of line lasers, in lieu of point lasers, to reduce noise caused by textured surfaces.

Purpose and Scope

The purpose of this study was to evaluate laser sensor with a wide footprint (or line laser) for high-speed inertial profiling to determine if these sensors can provide rideability readings that are more consistent, repeatable, and accurate than the current measurements using single-point lasers. This evaluation was conducted by installing the wide footprint, GoCator, laser sensors on the high-speed profiling equipment similar to that used for rideability testing of construction projects by SCDOT Pavement Evaluation Unit at the Office of Materials and Research (OMR). The new sensors were compared against the existing equipment and reference devices for a variety of pavement surface textures. If the initial evaluation of the GoCator laser shows an improvement over the single-point laser, then the new laser sensors will be installed on two profilers to evaluate the reproducibility of the new equipment.

Data Used

The Pavement Evaluation Unit of the SCDOT Office of Materials and Research performs rideability measurements on projects in South Carolina that meet the conditions specified in SC-M-403 (2014). This generally includes projects in which a new asphalt surface is placed on a continuous section over 0.5 miles with a speed limit of 40 mph or greater. Projects that are planned for a single-lift asphalt overlay are also tested to determine the existing rideability and the final rideability pay factor is based on the existing rideability. In addition to single-lift overlays, other typical rehabilitation techniques and overlay (either single or multi-lift) after full-depth reclamation (either 6, 8, or 10 inches) of the existing pavement.

The project level rideability measurements were collected with Dynatest high-speed inertial profilers with single-point laser sensors according to test procedure SC-T-125(2006). IRI values were calculated from the profiles for each wheel path using ProVAL and averaged to determine mean ride index (MRI)

values. For each 0.1-mile segment, MRI is calculated based on the average of three test run results. This report uses the term IRI to refer to the average of the two IRI values for each wheel path to correspond with the wording used in South Carolina specifications.

For this research project, rideability data was collected using the Dynatest high-speed profiler with the single point lasers followed by the Dynatest high-speed profiler with the GoCator (line) lasers. The profilers were run simultaneously in order to help eliminate factors including start/stop points, different times of day, as well as temperature differences. For this research project a total of 237.4 lane miles were tested. Of the 237.4 lane miles tested, 208.5 lane miles were used for statistical analysis. A breakdown of the lane miles tested can be seen below.

Table 1: Miles of data collected

Surface	Lane-miles tested	Lane-miles used for statistical analysis	Notes*
Existing AC	47.0	43.6	
Newly overlaid AC	109.0	91.4	Removed sections w/IRI>177in./mile
OGFC	44.5	38.8	
New Concrete	36.9	34.7	

* Removed intersections, bridges, and outlier sections

Results and Discussion

Figure 1 shows the existing IRI plotted against the final IRI for the 470 existing segments in this study. The R^2 , or coefficient of determination, is a statistical measure of how well the regression line approximates the real data points. An R^2 of 1 indicates that the regression line perfectly fits the data. Figure 1 shows an R^2 of 0.951, indicating a very close fit between both the point and line laser data.

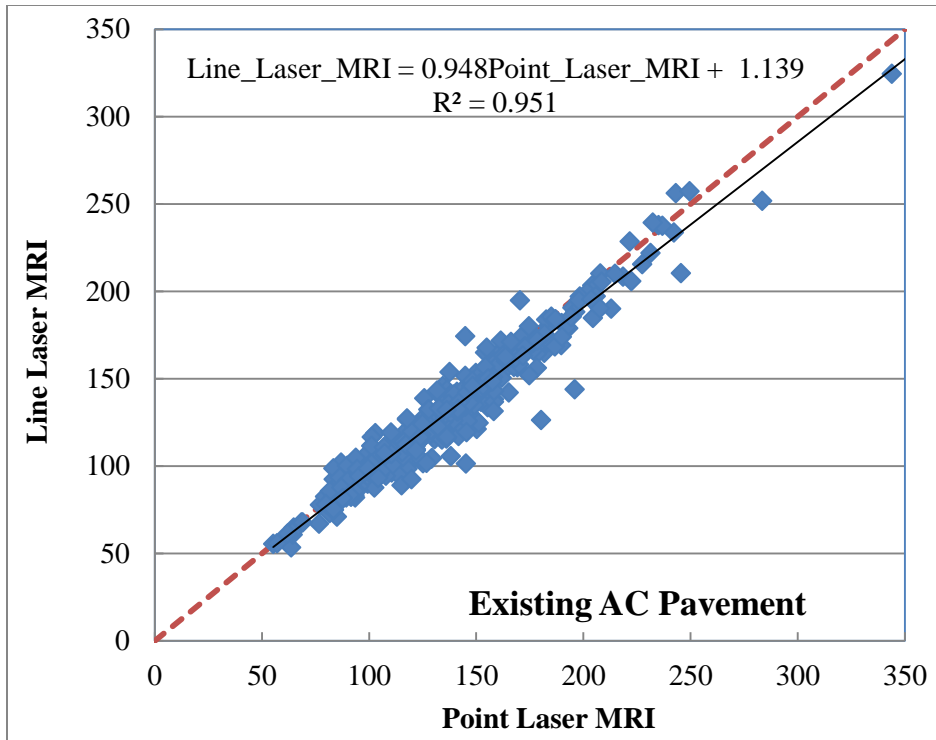


Figure 1. Line Laser IRI vs. Point Laser IRI for Existing AC Pavements

Once intersections, bridges and other outlier sections were removed, the remaining 436, 0.1-mile segments were analyzed. Figure 2 shows the results of this analysis. Although the R^2 value isn't as close to 1, it still represents a relatively good fit.

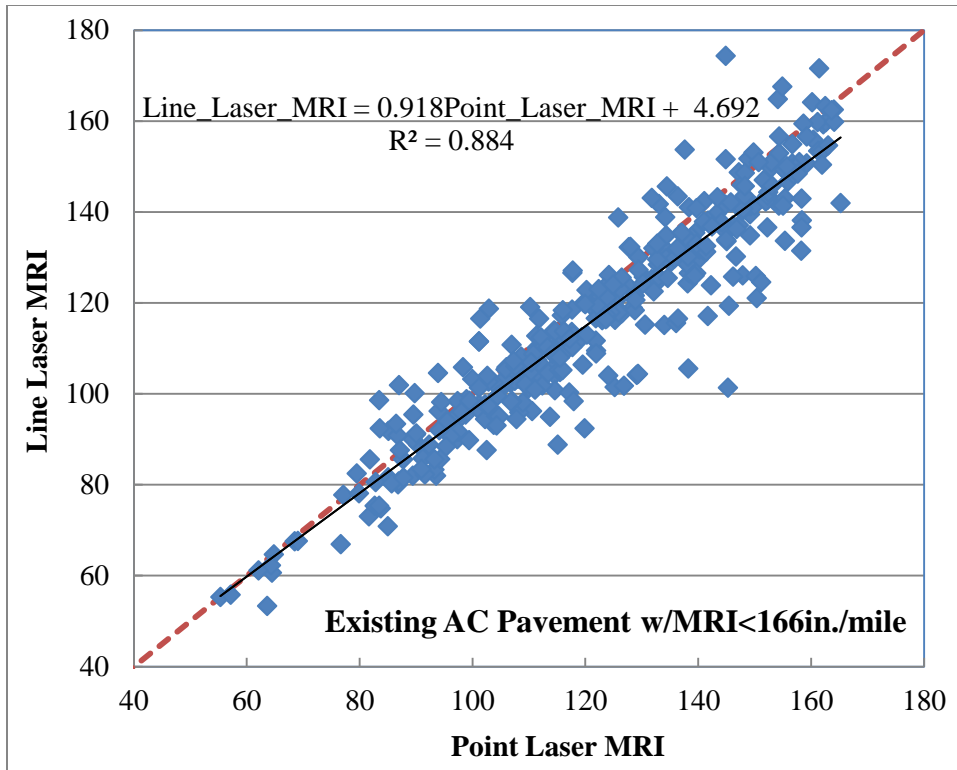


Figure 2. Line Laser IRI vs. Point Laser IRI for Existing AC Pavements with Outliers Removed

This analysis was performed on each of the different pavement type sections for the SCDOT and is presented below. Figures 3 (1090 segments) and 4(914 segments) represent Overlaid Asphalts.

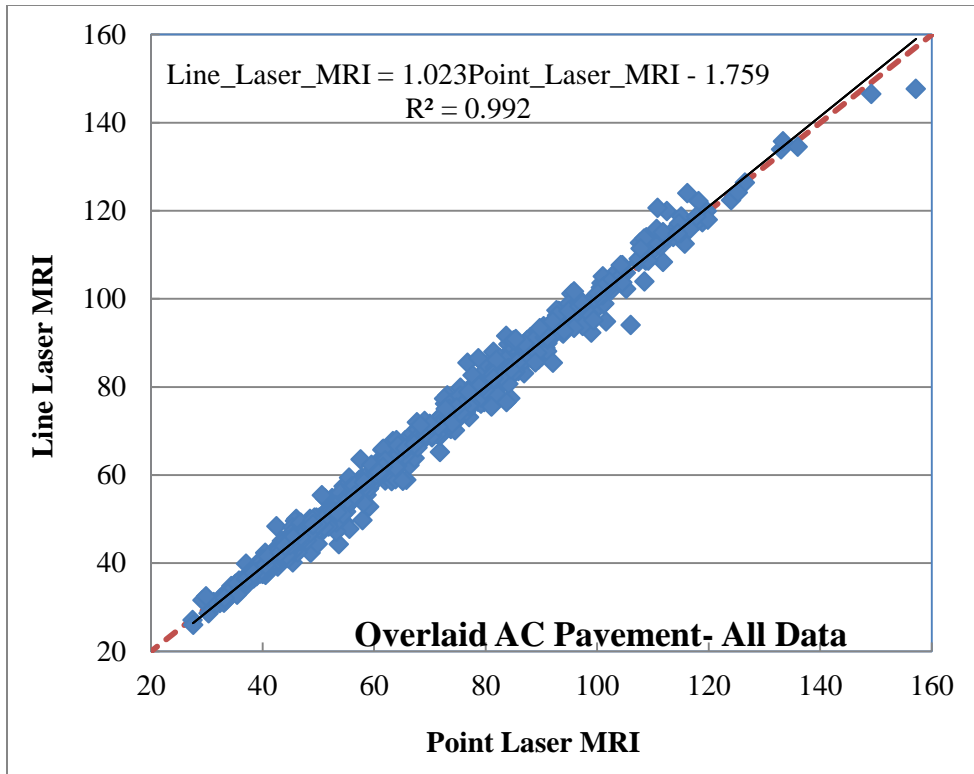


Figure 3. Line Laser IRI vs. Point Laser IRI for Overlaid AC Pavements

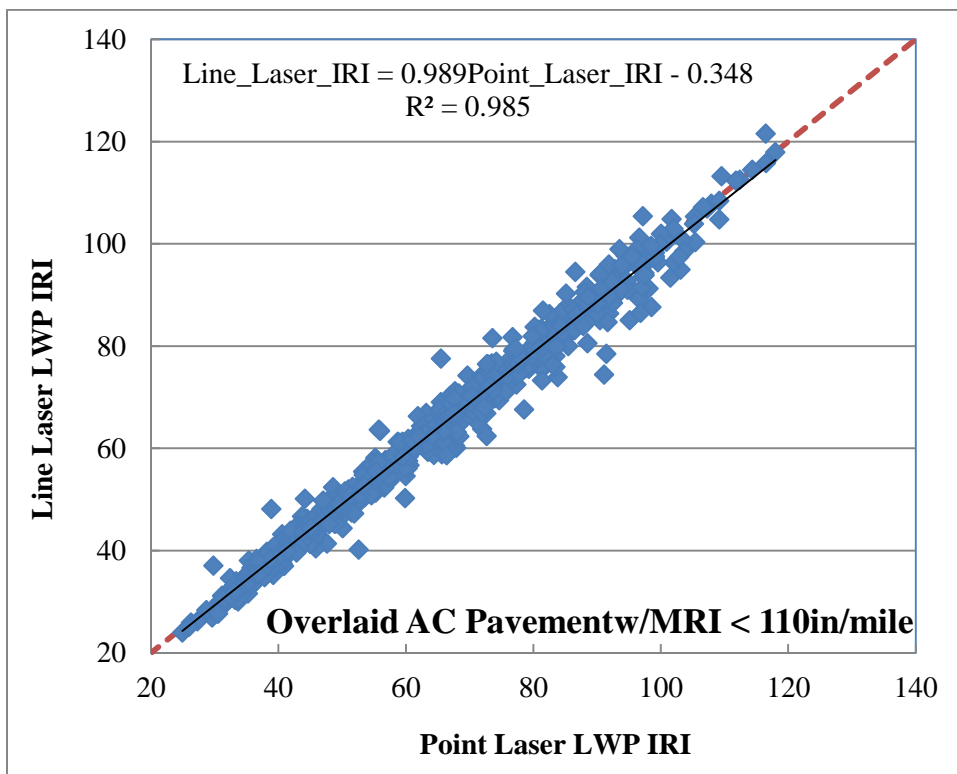


Figure 4. Line Laser IRI vs. Point Laser IRI for Overlaid AC Pavements with Outliers removed

Open Graded Friction Course (OGFC) is represented in Figures 5 (445 segments) and 6 (388 segments).

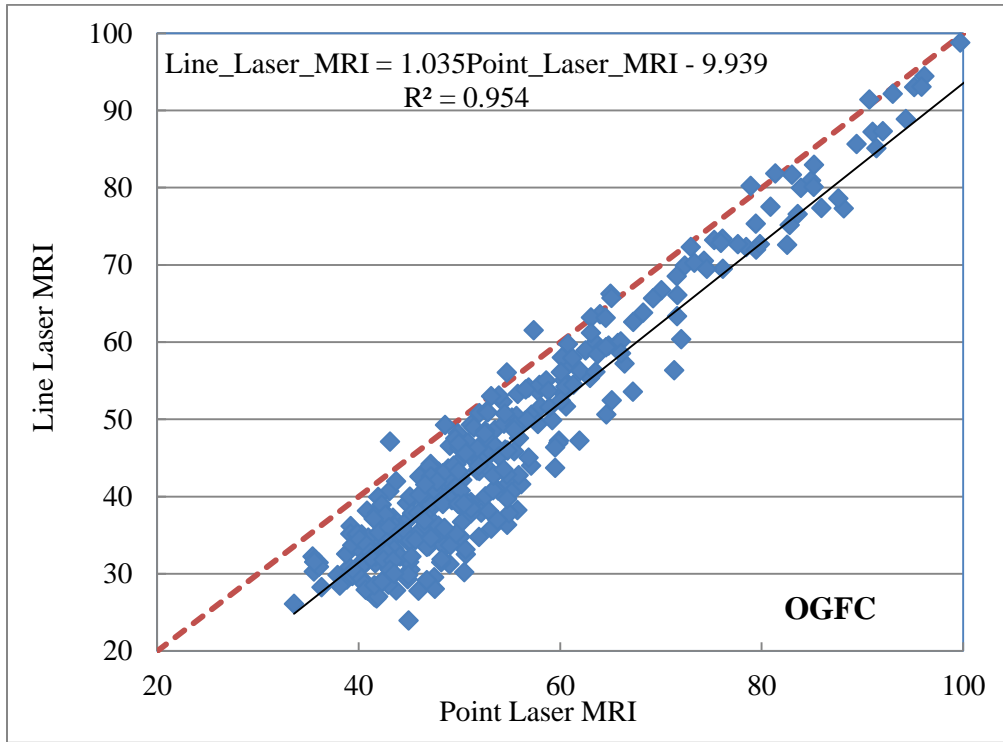


Figure 5. Line Laser IRI vs. Point Laser IRI for OGFC AC Pavements

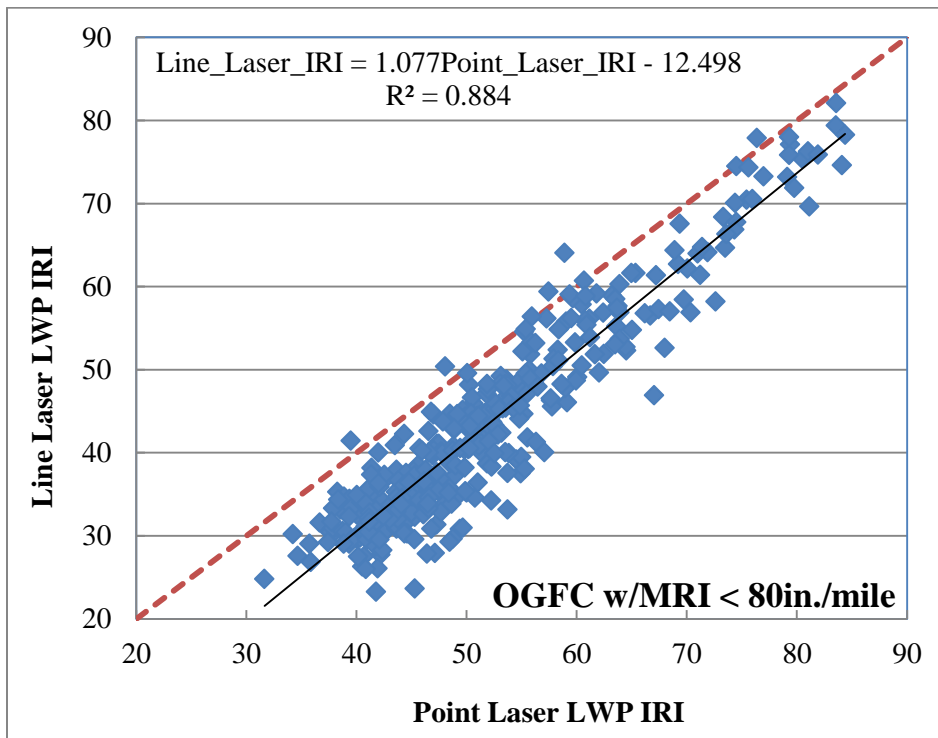


Figure 6. Line Laser IRI vs. Point Laser IRI for OGFC AC Pavements with Outliers removed

New Portland Cement Concrete (PCC) pavements are represented in Figures 7 (369 segments) and 8 (347 segments).

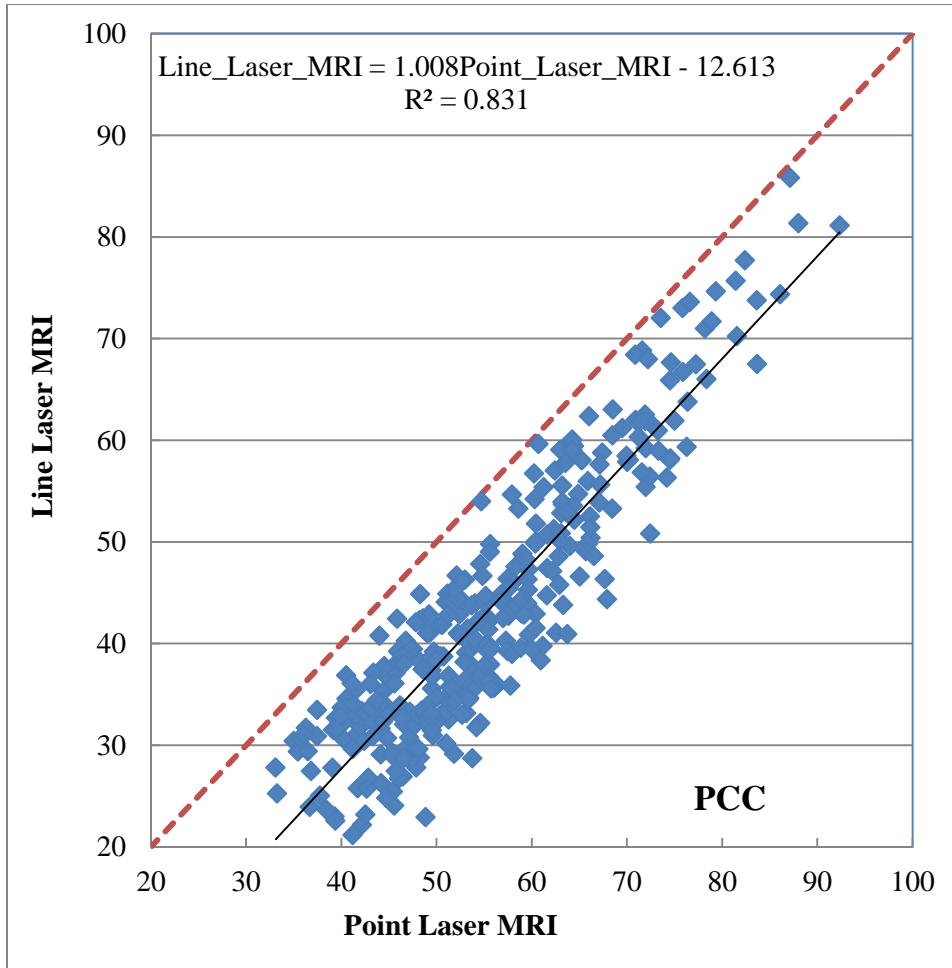


Figure 7. Line Laser MRI vs. Point Laser MRI for New PCC Pavements

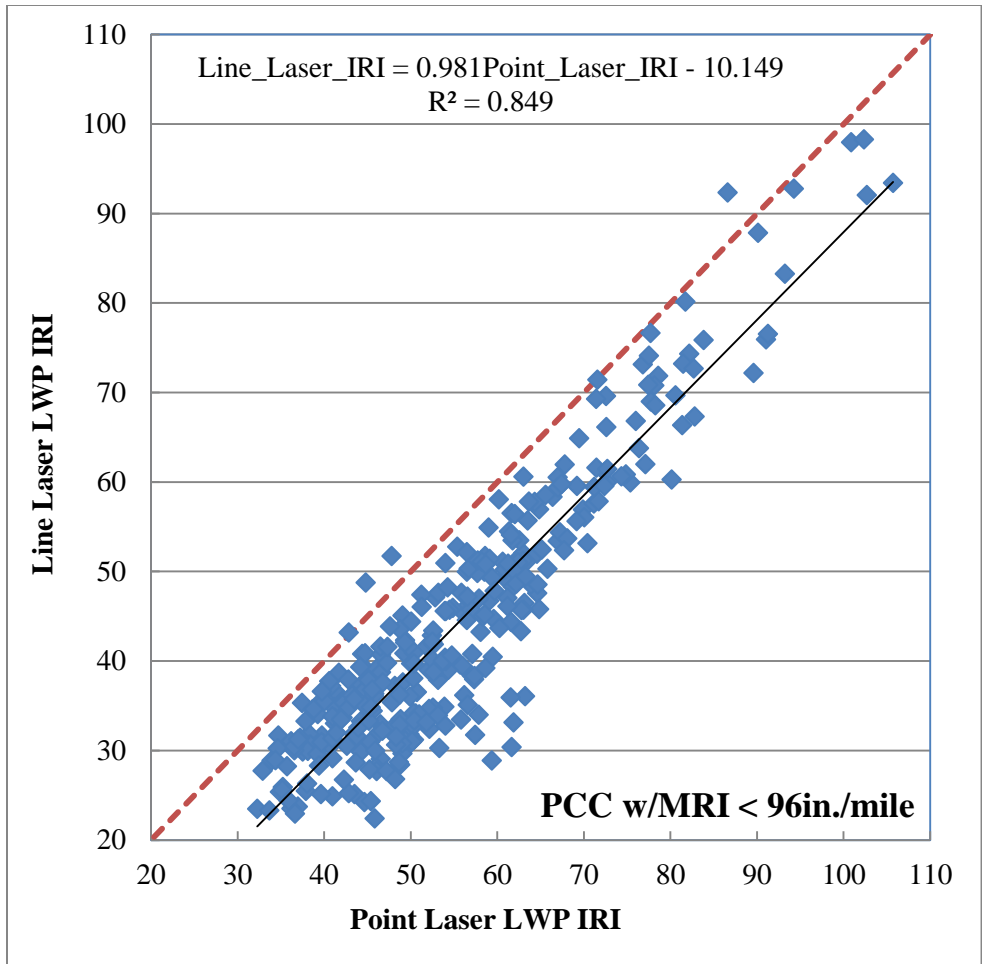


Figure 8. Line Laser MRI vs. Point Laser MRI for New PCC Pavements with Outliers removed

Some of the variation between the two profilers can also be explained by drivers not measuring over the same exact path, especially over existing pavements. With different cracking and surface variations, this could affect roughness measurements by several inches per mile if the same wheel paths are not identically measured.

Based on the above regression analyses, a current specification conversion was performed on each of our current specs.

Table 2: (PCC) SC-M-502 Table 2: Schedule for Adjusted Payment – Existing Construction

MRI (in./mile)		Adjusted Unit Price
Point Laser	Line Laser	
0 - 60	0 - 48	125%
61 - 74	49 - 62	110%
75 - 90	63 - 78	100%
91 - 99	79 - 87	90%
>99	>87	Correction

Table 3: (PCC) SC-M-502 Table 1: Schedule for Adjusted Payment – New Construction

MRI (in./mile)		Adjusted Unit Price
Point Laser	Line Laser	
0 - 60	0 - 47	105%
61 - 65	48 - 52	103%
66 - 70	53 - 57	101%
71 - 80	58 - 66	100%
81 - 85	67 - 71	95%
86 - 90	72 - 76	90%
91 - 95	77 - 81	80%
≥ 96	≥ 82	See note

Table 4: (OGFC) SC-M-403 Table 1: Schedule for Adjusted Payment

MRI (in./mile)		Adjusted Unit Price
Point Laser	Line Laser	
< 40	< 31	107%
40 - 44	31 - 36	105%
45 - 65	37 - 57	100%
66 - 70	58 - 63	95%
71 - 75	64 - 68	90%
76 - 80	69 - 73	80%
> 80	> 73	Payment reduction

Table 5: (OGFC) SC-M-403 Table 1: Schedule for Adjusted Payment

MRI (in./mile)		Adjusted Unit Price
Point Laser	Line Laser	
< 40	< 31	107%
40 - 44	31 - 35	105%
45 - 65	36 - 58	100%
66 - 70	59 - 64	95%
71 - 75	65 - 69	90%
76 - 80	70 - 75	80%
> 80	> 75	Payment reduction

Table 6 : (New AC) SC-M-403 Table 1: Schedule for Adjusted Payment

MRI (in./mile)		Adjusted Unit Price
Point Laser	Line Laser	
< 40	< 39	107%
40 - 44	39 - 43	105%
45 - 65	44 - 65	100%
66 - 70	66 - 70	95%
71 - 75	71 - 75	90%
76 - 80	76 - 80	80%
> 80	> 80	Payment reduction

Table 7: (Multiple Lift Overlay) SC-M-403 Table 3: Schedule for Adjusted Payment

MRI (in./mile)		Adjusted Unit Price
Point Laser	Line Laser	
< 46	0 - 45	107%
46 - 55	45 - 54	105%
56 - 90	55 - 90	100%
91 - 95	91 - 95	95%
96 - 100	96 - 101	90%
101 - 105	102 - 106	85%
106 - 110	107 - 111	80%
> 110	> 111	Payment reduction

Table 8: (Reclamation) Based on SC-M-403 Table 4, assuming initial ride of 300 in./mile

MRI (in./mile)		Adjusted Unit Price
Point Laser	Line Laser	
< 77	< 77	107%
77 - 86	77 - 86	105%
87 - 132	87 - 133	100%
133 - 144	134 - 146	95%
> 144	> 146	Repair

Table 9: Existing AC Pavement

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
59	46	55	80	86	57	45	55	80	86	1	0	0	0
60	46	55	80	86	58	45	55	80	86	1	0	0	0
61	46	55	80	86	59	45	55	80	86	1	0	0	0
62	46	55	80	86	60	45	55	80	86	1	0	0	0
63	46	55	80	86	61	45	55	80	86	1	0	0	0
64	46	55	80	86	62	45	55	80	86	1	0	0	0
65	46	55	80	86	63	45	55	80	86	1	0	0	0
66	46	55	80	86	64	45	55	80	86	1	0	0	0
67	46	55	80	87	65	45	55	80	87	1	0	0	0
68	46	55	80	87	66	45	55	80	87	1	0	0	0
69	46	55	80	88	67	45	55	80	88	1	0	0	0
70	46	55	80	88	67	45	55	80	88	1	0	0	0
71	46	55	80	89	68	45	55	80	89	1	0	0	0
72	46	55	80	89	69	45	55	80	89	1	0	0	0
73	46	55	80	90	70	45	55	80	90	1	0	0	0

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
74	46	55	80	90	71	45	55	80	90	1	0	0	0
75	46	55	80	91	72	45	55	80	91	1	0	0	0
76	46	55	81	91	73	45	55	81	91	1	0	0	0
77	46	55	81	92	74	45	55	81	92	1	0	0	0
78	46	55	81	92	75	45	55	81	92	1	0	0	0
79	46	55	82	93	76	45	55	82	93	1	0	0	0
80	46	55	82	93	77	45	55	82	93	1	0	0	0
81	46	55	82	93	78	45	55	82	93	1	0	0	0
82	46	55	82	94	79	45	55	82	94	1	0	0	0
83	46	55	83	94	80	45	55	83	94	1	0	0	0
84	46	55	83	95	81	45	55	83	95	1	0	0	0
85	46	55	83	95	82	45	55	83	95	1	0	0	0
86	46	55	84	96	83	45	55	84	96	1	0	0	0
87	46	55	84	96	84	45	55	84	96	1	0	0	0
88	46	55	84	96	85	45	55	84	96	1	0	0	0
89	46	55	84	96	86	45	55	84	96	1	0	0	0
90	46	55	85	97	86	45	55	85	97	1	0	0	0
91	46	55	85	97	87	45	55	85	97	1	0	0	0
92	46	55	85	97	88	45	55	85	97	1	0	0	0
93	46	55	86	98	89	45	55	86	98	1	0	0	0
94	46	55	86	98	90	45	55	86	98	1	0	0	0
95	46	55	86	98	91	45	55	86	98	1	0	0	0
96	46	55	86	98	92	45	55	86	98	1	0	0	0
97	46	55	87	99	93	45	55	87	100	1	0	0	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
98	46	55	87	99	94	45	55	87	100	1	0	0	-1
99	46	55	87	99	95	45	55	87	100	1	0	0	-1
100	46	55	87	99	96	45	55	87	100	1	0	0	-1
101	46	55	88	100	97	45	55	88	101	1	0	0	-1
102	46	55	88	100	98	45	55	88	101	1	0	0	-1
103	46	55	88	100	99	45	55	88	101	1	0	0	-1
104	46	55	88	100	100	45	55	88	101	1	0	0	-1
105	46	55	89	101	101	45	55	89	102	1	0	0	-1
106	46	55	89	101	102	45	55	89	102	1	0	0	-1
107	46	55	89	101	103	45	55	89	102	1	0	0	-1
108	46	55	90	102	104	45	55	90	103	1	0	0	-1
109	46	55	90	102	104	45	55	90	103	1	0	0	-1
110	46	55	90	102	105	45	55	90	103	1	0	0	-1
111	46	55	90	102	106	45	55	90	103	1	0	0	-1
112	46	55	91	103	107	45	55	91	104	1	0	0	-1
113	46	55	91	103	108	45	55	91	104	1	0	0	-1
114	46	55	91	103	109	45	55	91	104	1	0	0	-1
115	46	55	91	103	110	45	55	91	104	1	0	0	-1
116	46	55	92	104	111	45	55	92	105	1	0	0	-1
117	46	55	92	104	112	45	55	92	105	1	0	0	-1
118	46	55	92	104	113	45	55	92	105	1	0	0	-1
119	46	55	92	104	114	45	55	92	105	1	0	0	-1
120	46	55	93	105	115	45	55	93	106	1	0	0	-1
121	46	55	93	105	116	45	55	93	106	1	0	0	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
122	46	55	93	105	117	45	55	93	106	1	0	0	-1
123	46	55	93	105	118	45	55	93	106	1	0	0	-1
124	46	55	94	106	119	45	55	94	107	1	0	0	-1
125	46	55	94	106	120	45	55	94	107	1	0	0	-1
126	46	55	94	106	121	45	55	94	107	1	0	0	-1
127	46	55	94	106	122	45	55	94	107	1	0	0	-1
128	46	55	95	107	122	45	55	95	108	1	0	0	-1
129	46	55	95	107	123	45	55	95	108	1	0	0	-1
130	46	55	95	107	124	45	55	95	108	1	0	0	-1
131	46	55	95	107	125	45	55	95	108	1	0	0	-1
132	46	55	96	108	126	45	55	96	109	1	0	0	-1
133	46	55	96	108	127	45	55	96	109	1	0	0	-1
134	46	55	96	108	128	45	55	96	109	1	0	0	-1
135	46	55	96	108	129	45	55	96	109	1	0	0	-1
136	46	55	96	108	130	45	55	96	109	1	0	0	-1
137	46	55	97	109	131	45	55	97	110	1	0	0	-1
138	46	55	97	109	132	45	55	97	110	1	0	0	-1
139	46	55	97	109	133	45	55	97	110	1	0	0	-1
140	46	55	98	110	134	45	55	98	111	1	0	0	-1
141	46	55	98	110	135	45	55	98	111	1	0	0	-1
142	46	55	98	110	136	45	55	98	111	1	0	0	-1
143	46	55	98	110	137	45	55	98	111	1	0	0	-1
144	46	55	99	111	138	45	55	100	112	1	0	-1	-1
145	46	55	99	111	139	45	55	100	112	1	0	-1	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
146	46	55	99	111	140	45	55	100	112	1	0	-1	-1
147	46	55	99	111	140	45	55	100	112	1	0	-1	-1
148	46	55	100	112	141	45	55	101	113	1	0	-1	-1
149	46	55	100	112	142	45	55	101	113	1	0	-1	-1
150	46	55	100	112	143	45	55	101	113	1	0	-1	-1
151	46	55	100	112	144	45	55	101	113	1	0	-1	-1
152	46	55	100	112	145	45	55	101	113	1	0	-1	-1
153	46	55	101	113	146	45	55	102	114	1	0	-1	-1
154	46	55	101	113	147	45	55	102	114	1	0	-1	-1
155	46	55	101	113	148	45	55	102	114	1	0	-1	-1
156	46	55	101	113	149	45	55	102	114	1	0	-1	-1
157	47	56	102	114	150	46	56	103	115	1	0	-1	-1
158	47	56	102	114	151	46	56	103	115	1	0	-1	-1
159	47	56	102	114	152	46	56	103	115	1	0	-1	-1
160	47	56	102	114	153	46	56	103	115	1	0	-1	-1
161	48	57	103	115	154	47	57	104	116	1	0	-1	-1
162	48	57	103	115	155	47	57	104	116	1	0	-1	-1
163	48	57	103	115	156	47	57	104	116	1	0	-1	-1
164	48	57	103	115	157	47	57	104	116	1	0	-1	-1
165	49	58	104	116	158	48	58	105	117	1	0	-1	-1
166	49	58	104	116	159	48	58	105	117	1	0	-1	-1
167	49	58	104	116	159	48	58	105	117	1	0	-1	-1
168	49	58	104	116	160	48	58	105	117	1	0	-1	-1
169	49	58	104	116	161	48	58	105	117	1	0	-1	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
170	50	59	105	117	162	49	59	106	118	1	0	-1	-1
171	50	59	105	117	163	49	59	106	118	1	0	-1	-1
172	50	59	105	117	164	49	59	106	118	1	0	-1	-1
173	50	59	105	117	165	49	59	106	118	1	0	-1	-1
174	51	60	106	118	166	50	60	107	119	1	0	-1	-1
175	51	60	106	118	167	50	60	107	119	1	0	-1	-1
176	51	60	106	118	168	50	60	107	119	1	0	-1	-1
177	51	60	106	118	169	50	60	107	119	1	0	-1	-1
178	52	61	107	119	170	51	61	108	120	1	0	-1	-1
179	52	61	107	119	171	51	61	108	120	1	0	-1	-1
180	52	61	107	119	172	51	61	108	120	1	0	-1	-1
181	52	61	107	119	173	51	61	108	120	1	0	-1	-1
182	52	61	107	119	174	51	61	108	120	1	0	-1	-1
183	53	62	108	120	175	52	62	109	121	1	0	-1	-1
184	53	62	108	120	176	52	62	109	121	1	0	-1	-1
185	53	62	108	120	177	52	62	109	121	1	0	-1	-1
186	53	62	108	120	177	52	62	109	121	1	0	-1	-1
187	54	63	109	121	178	53	63	110	122	1	0	-1	-1
188	54	63	109	121	179	53	63	110	122	1	0	-1	-1
189	54	63	109	121	180	53	63	110	122	1	0	-1	-1
190	54	63	109	121	181	53	63	110	122	1	0	-1	-1
191	54	63	109	121	182	53	63	110	122	1	0	-1	-1
192	55	64	110	122	183	55	64	111	123	0	0	-1	-1
193	55	64	110	122	184	55	64	111	123	0	0	-1	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
194	55	64	110	122	185	55	64	111	123	0	0	-1	-1
195	55	64	110	122	186	55	64	111	123	0	0	-1	-1
196	56	65	111	123	187	56	65	112	124	0	0	-1	-1
197	56	65	111	123	188	56	65	112	124	0	0	-1	-1
198	56	65	111	123	189	56	65	112	124	0	0	-1	-1
199	56	65	111	123	190	56	65	112	124	0	0	-1	-1
200	56	65	111	123	191	56	65	112	124	0	0	-1	-1
201	57	66	112	124	192	57	66	113	125	0	0	-1	-1
202	57	66	112	124	193	57	66	113	125	0	0	-1	-1
203	57	66	112	124	194	57	66	113	125	0	0	-1	-1
204	57	66	112	124	195	57	66	113	125	0	0	-1	-1
205	57	66	112	124	195	57	66	113	125	0	0	-1	-1
206	58	67	113	125	196	58	67	114	126	0	0	-1	-1
207	58	67	113	125	197	58	67	114	126	0	0	-1	-1
208	58	67	113	125	198	58	67	114	126	0	0	-1	-1
209	58	67	113	125	199	58	67	114	126	0	0	-1	-1
210	59	68	114	126	200	59	68	115	127	0	0	-1	-1
211	59	68	114	126	201	59	68	115	127	0	0	-1	-1
212	59	68	114	126	202	59	68	115	127	0	0	-1	-1
213	59	68	114	126	203	59	68	115	127	0	0	-1	-1
214	59	68	114	126	204	59	68	115	127	0	0	-1	-1
215	60	69	115	127	205	60	69	116	128	0	0	-1	-1
216	60	69	115	127	206	60	69	116	128	0	0	-1	-1
217	60	69	115	127	207	60	69	116	128	0	0	-1	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
218	60	69	115	127	208	60	69	116	128	0	0	-1	-1
219	60	69	115	127	209	60	69	116	128	0	0	-1	-1
220	61	70	116	128	210	61	70	117	129	0	0	-1	-1
221	61	70	116	128	211	61	70	117	129	0	0	-1	-1
222	61	70	116	128	212	61	70	117	129	0	0	-1	-1
223	61	70	116	128	213	61	70	117	129	0	0	-1	-1
224	62	71	117	129	213	62	71	118	130	0	0	-1	-1
225	62	71	117	129	214	62	71	118	130	0	0	-1	-1
226	62	71	117	129	215	62	71	118	130	0	0	-1	-1
227	62	71	117	129	216	62	71	118	130	0	0	-1	-1
228	62	71	117	129	217	62	71	118	130	0	0	-1	-1
229	63	72	118	130	218	63	72	119	131	0	0	-1	-1
230	63	72	118	130	219	63	72	119	131	0	0	-1	-1
231	63	72	118	130	220	63	72	119	131	0	0	-1	-1
232	63	72	118	130	221	63	72	119	131	0	0	-1	-1
233	63	72	118	130	222	63	72	119	131	0	0	-1	-1
234	64	73	119	131	223	64	73	120	132	0	0	-1	-1
235	64	73	119	131	224	64	73	120	132	0	0	-1	-1
236	64	73	119	131	225	64	73	120	132	0	0	-1	-1
237	64	73	119	131	226	64	73	120	132	0	0	-1	-1
238	64	73	119	131	227	64	73	120	132	0	0	-1	-1
239	65	74	120	132	228	65	74	121	133	0	0	-1	-1
240	65	74	120	132	229	65	74	121	133	0	0	-1	-1
241	65	74	120	132	230	65	74	121	133	0	0	-1	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
242	65	74	120	132	231	65	74	121	133	0	0	-1	-1
243	65	74	120	132	232	65	74	121	133	0	0	-1	-1
244	66	75	121	133	232	66	75	122	134	0	0	-1	-1
245	66	75	121	133	233	66	75	122	134	0	0	-1	-1
246	66	75	121	133	234	66	75	122	134	0	0	-1	-1
247	66	75	121	133	235	66	75	122	134	0	0	-1	-1
248	66	75	121	133	236	66	75	122	134	0	0	-1	-1
249	67	76	122	134	237	67	76	123	135	0	0	-1	-1
250	67	76	122	134	238	67	76	123	135	0	0	-1	-1
251	67	76	122	134	239	67	76	123	135	0	0	-1	-1
252	67	76	122	134	240	67	76	123	135	0	0	-1	-1
253	67	76	122	134	241	67	76	123	135	0	0	-1	-1
254	68	77	123	135	242	68	77	124	136	0	0	-1	-1
255	68	77	123	135	243	68	77	124	136	0	0	-1	-1
256	68	77	123	135	244	68	77	124	136	0	0	-1	-1
257	68	77	123	135	245	68	77	124	136	0	0	-1	-1
258	68	77	123	135	246	68	77	124	136	0	0	-1	-1
259	69	78	124	136	247	69	78	125	137	0	0	-1	-1
260	69	78	124	136	248	69	78	125	137	0	0	-1	-1
261	69	78	124	136	249	69	78	125	137	0	0	-1	-1
262	69	78	124	136	250	69	78	125	137	0	0	-1	-1
263	69	78	124	136	250	69	78	125	137	0	0	-1	-1
264	70	79	125	137	251	70	79	126	138	0	0	-1	-1
265	70	79	125	137	252	70	79	126	138	0	0	-1	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
266	70	79	125	137	253	70	79	126	138	0	0	-1	-1
267	70	79	125	137	254	70	79	126	138	0	0	-1	-1
268	70	79	125	137	255	70	79	126	138	0	0	-1	-1
269	71	80	126	138	256	71	80	127	139	0	0	-1	-1
270	71	80	126	138	257	71	80	127	139	0	0	-1	-1
271	71	80	126	138	258	71	80	127	139	0	0	-1	-1
272	71	80	126	138	259	71	80	127	139	0	0	-1	-1
273	71	80	126	138	260	71	80	127	139	0	0	-1	-1
274	72	81	127	139	261	72	81	128	140	0	0	-1	-1
275	72	81	127	139	262	72	81	128	140	0	0	-1	-1
276	72	81	127	139	263	72	81	128	140	0	0	-1	-1
277	72	81	127	139	264	72	81	128	140	0	0	-1	-1
278	72	81	127	139	265	72	81	128	140	0	0	-1	-1
279	73	82	128	140	266	73	82	129	141	0	0	-1	-1
280	73	82	128	140	267	73	82	129	141	0	0	-1	-1
281	73	82	128	140	268	73	82	129	141	0	0	-1	-1
282	73	82	128	140	268	73	82	129	141	0	0	-1	-1
283	73	82	128	140	269	73	82	129	141	0	0	-1	-1
284	74	83	129	141	270	74	83	130	142	0	0	-1	-1
285	74	83	129	141	271	74	83	130	142	0	0	-1	-1
286	74	83	129	141	272	74	83	130	142	0	0	-1	-1
287	74	83	129	141	273	74	83	130	142	0	0	-1	-1
288	74	83	129	141	274	74	83	130	142	0	0	-1	-1
289	74	83	129	141	275	74	83	130	142	0	0	-1	-1

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
290	75	84	130	142	276	75	84	131	144	0	0	-1	-2
291	75	84	130	142	277	75	84	131	144	0	0	-1	-2
292	75	84	130	142	278	75	84	131	144	0	0	-1	-2
293	75	84	130	142	279	75	84	131	144	0	0	-1	-2
294	75	84	130	142	280	75	84	131	144	0	0	-1	-2
295	76	85	131	143	281	76	85	132	145	0	0	-1	-2
296	76	85	131	143	282	76	85	132	145	0	0	-1	-2
297	76	85	131	143	283	76	85	132	145	0	0	-1	-2
298	76	85	131	143	284	76	85	132	145	0	0	-1	-2
299	76	85	131	143	285	76	85	132	145	0	0	-1	-2
300	77	86	132	144	286	77	86	133	146	0	0	-1	-2
301	77	86	132	144	286	77	86	133	146	0	0	-1	-2
302	77	86	132	144	287	77	86	133	146	0	0	-1	-2
303	77	86	132	144	288	77	86	133	146	0	0	-1	-2
304	77	86	132	144	289	77	86	133	146	0	0	-1	-2
305	78	87	133	145	290	78	87	134	147	0	0	-1	-2
306	78	87	133	145	291	78	87	134	147	0	0	-1	-2
307	78	87	133	145	292	78	87	134	147	0	0	-1	-2
308	78	87	133	145	293	78	87	134	147	0	0	-1	-2
309	78	87	133	145	294	78	87	134	147	0	0	-1	-2
310	78	87	133	145	295	78	87	134	147	0	0	-1	-2
311	79	88	134	146	296	79	88	135	148	0	0	-1	-2
312	79	88	134	146	297	79	88	135	148	0	0	-1	-2
313	79	88	134	146	298	79	88	135	148	0	0	-1	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
314	79	88	134	146	299	79	88	135	148	0	0	-1	-2
315	79	88	134	146	300	79	88	135	148	0	0	-1	-2
316	80	89	135	147	301	80	89	136	149	0	0	-1	-2
317	80	89	135	147	302	80	89	136	149	0	0	-1	-2
318	80	89	135	147	303	80	89	136	149	0	0	-1	-2
319	80	89	135	147	304	80	89	136	149	0	0	-1	-2
320	80	89	135	147	304	80	89	136	149	0	0	-1	-2
321	80	89	135	147	305	80	89	136	149	0	0	-1	-2
322	81	90	136	148	306	81	90	137	150	0	0	-1	-2
323	81	90	136	148	307	81	90	137	150	0	0	-1	-2
324	81	90	136	148	308	81	90	137	150	0	0	-1	-2
325	81	90	136	148	309	81	90	137	150	0	0	-1	-2
326	81	90	136	148	310	81	90	137	150	0	0	-1	-2
327	82	91	137	149	311	82	91	138	151	0	0	-1	-2
328	82	91	137	149	312	82	91	138	151	0	0	-1	-2
329	82	91	137	149	313	82	91	138	151	0	0	-1	-2
330	82	91	137	149	314	82	91	138	151	0	0	-1	-2
331	82	91	137	149	315	82	91	138	151	0	0	-1	-2
332	82	91	137	149	316	82	91	138	151	0	0	-1	-2
333	83	92	138	150	317	83	92	139	152	0	0	-1	-2
334	83	92	138	150	318	83	92	139	152	0	0	-1	-2
335	83	92	138	150	319	83	92	139	152	0	0	-1	-2
336	83	92	138	150	320	83	92	139	152	0	0	-1	-2
337	83	92	138	150	321	83	92	139	152	0	0	-1	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
338	84	93	139	151	322	84	93	140	153	0	0	-1	-2
339	84	93	139	151	323	84	93	140	153	0	0	-1	-2
340	84	93	139	151	323	84	93	140	153	0	0	-1	-2
341	84	93	139	151	324	84	93	140	153	0	0	-1	-2
342	84	93	139	151	325	84	93	140	153	0	0	-1	-2
343	84	93	139	151	326	84	93	140	153	0	0	-1	-2
344	85	94	140	152	327	85	94	141	154	0	0	-1	-2
345	85	94	140	152	328	85	94	141	154	0	0	-1	-2
346	85	94	140	152	329	85	94	141	154	0	0	-1	-2
347	85	94	140	152	330	85	94	141	154	0	0	-1	-2
348	85	94	140	152	331	85	94	141	154	0	0	-1	-2
349	86	95	141	153	332	86	95	142	155	0	0	-1	-2
350	86	95	141	153	333	86	95	142	155	0	0	-1	-2
351	86	95	141	153	334	86	95	142	155	0	0	-1	-2
352	86	95	141	153	335	86	95	142	155	0	0	-1	-2
353	86	95	141	153	336	86	95	142	155	0	0	-1	-2
354	86	95	141	153	337	86	95	142	155	0	0	-1	-2
355	87	96	142	154	338	87	96	144	156	0	0	-2	-2
356	87	96	142	154	339	87	96	144	156	0	0	-2	-2
357	87	96	142	154	340	87	96	144	156	0	0	-2	-2
358	87	96	142	154	341	87	96	144	156	0	0	-2	-2
359	87	96	142	154	341	87	96	144	156	0	0	-2	-2
360	87	96	142	154	342	87	96	144	156	0	0	-2	-2
361	88	97	143	155	343	88	97	145	157	0	0	-2	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
362	88	97	143	155	344	88	97	145	157	0	0	-2	-2
363	88	97	143	155	345	88	97	145	157	0	0	-2	-2
364	88	97	143	155	346	88	97	145	157	0	0	-2	-2
365	88	97	143	155	347	88	97	145	157	0	0	-2	-2
366	88	97	143	155	348	88	97	145	157	0	0	-2	-2
367	89	98	144	156	349	89	98	146	158	0	0	-2	-2
368	89	98	144	156	350	89	98	146	158	0	0	-2	-2
369	89	98	144	156	351	89	98	146	158	0	0	-2	-2
370	89	98	144	156	352	89	98	146	158	0	0	-2	-2
371	89	98	144	156	353	89	98	146	158	0	0	-2	-2
372	90	99	145	157	354	90	100	147	159	0	-1	-2	-2
373	90	99	145	157	355	90	100	147	159	0	-1	-2	-2
374	90	99	145	157	356	90	100	147	159	0	-1	-2	-2
375	90	99	145	157	357	90	100	147	159	0	-1	-2	-2
376	90	99	145	157	358	90	100	147	159	0	-1	-2	-2
377	90	99	145	157	359	90	100	147	159	0	-1	-2	-2
378	91	100	146	158	359	91	101	148	160	0	-1	-2	-2
379	91	100	146	158	360	91	101	148	160	0	-1	-2	-2
380	91	100	146	158	361	91	101	148	160	0	-1	-2	-2
381	91	100	146	158	362	91	101	148	160	0	-1	-2	-2
382	91	100	146	158	363	91	101	148	160	0	-1	-2	-2
383	91	100	146	158	364	91	101	148	160	0	-1	-2	-2
384	92	101	147	159	365	92	102	149	161	0	-1	-2	-2
385	92	101	147	159	366	92	102	149	161	0	-1	-2	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
386	92	101	147	159	367	92	102	149	161	0	-1	-2	-2
387	92	101	147	159	368	92	102	149	161	0	-1	-2	-2
388	92	101	147	159	369	92	102	149	161	0	-1	-2	-2
389	92	101	147	159	370	92	102	149	161	0	-1	-2	-2
390	93	102	148	160	371	93	103	150	162	0	-1	-2	-2
391	93	102	148	160	372	93	103	150	162	0	-1	-2	-2
392	93	102	148	160	373	93	103	150	162	0	-1	-2	-2
393	93	102	148	160	374	93	103	150	162	0	-1	-2	-2
394	93	102	148	160	375	93	103	150	162	0	-1	-2	-2
395	93	102	148	160	376	93	103	150	162	0	-1	-2	-2
396	94	103	149	161	377	94	104	151	163	0	-1	-2	-2
397	94	103	149	161	377	94	104	151	163	0	-1	-2	-2
398	94	103	149	161	378	94	104	151	163	0	-1	-2	-2
399	94	103	149	161	379	94	104	151	163	0	-1	-2	-2
400	94	103	149	161	380	94	104	151	163	0	-1	-2	-2
401	94	103	149	161	381	94	104	151	163	0	-1	-2	-2
402	95	104	150	162	382	95	105	152	164	0	-1	-2	-2
403	95	104	150	162	383	95	105	152	164	0	-1	-2	-2
404	95	104	150	162	384	95	105	152	164	0	-1	-2	-2
405	95	104	150	162	385	95	105	152	164	0	-1	-2	-2
406	95	104	150	162	386	95	105	152	164	0	-1	-2	-2
407	95	104	150	162	387	95	105	152	164	0	-1	-2	-2
408	96	105	151	163	388	96	106	153	165	0	-1	-2	-2
409	96	105	151	163	389	96	106	153	165	0	-1	-2	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
410	96	105	151	163	390	96	106	153	165	0	-1	-2	-2
411	96	105	151	163	391	96	106	153	165	0	-1	-2	-2
412	96	105	151	163	392	96	106	153	165	0	-1	-2	-2
413	96	105	151	163	393	96	106	153	165	0	-1	-2	-2
414	97	106	152	164	394	97	107	154	166	0	-1	-2	-2
415	97	106	152	164	395	97	107	154	166	0	-1	-2	-2
416	97	106	152	164	396	97	107	154	166	0	-1	-2	-2
417	97	106	152	164	396	97	107	154	166	0	-1	-2	-2
418	97	106	152	164	397	97	107	154	166	0	-1	-2	-2
419	97	106	152	164	398	97	107	154	166	0	-1	-2	-2
420	98	107	153	165	399	98	108	155	167	0	-1	-2	-2
421	98	107	153	165	400	98	108	155	167	0	-1	-2	-2
422	98	107	153	165	401	98	108	155	167	0	-1	-2	-2
423	98	107	153	165	402	98	108	155	167	0	-1	-2	-2
424	98	107	153	165	403	98	108	155	167	0	-1	-2	-2
425	98	107	153	165	404	98	108	155	167	0	-1	-2	-2
426	99	108	154	166	405	100	109	156	168	-1	-1	-2	-2
427	99	108	154	166	406	100	109	156	168	-1	-1	-2	-2
428	99	108	154	166	407	100	109	156	168	-1	-1	-2	-2
429	99	108	154	166	408	100	109	156	168	-1	-1	-2	-2
430	99	108	154	166	409	100	109	156	168	-1	-1	-2	-2
431	99	108	154	166	410	100	109	156	168	-1	-1	-2	-2
432	100	109	155	167	411	101	110	157	169	-1	-1	-2	-2
433	100	109	155	167	412	101	110	157	169	-1	-1	-2	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
434	100	109	155	167	413	101	110	157	169	-1	-1	-2	-2
435	100	109	155	167	414	101	110	157	169	-1	-1	-2	-2
436	100	109	155	167	414	101	110	157	169	-1	-1	-2	-2
437	100	109	155	167	415	101	110	157	169	-1	-1	-2	-2
438	101	110	156	168	416	102	111	158	170	-1	-1	-2	-2
439	101	110	156	168	417	102	111	158	170	-1	-1	-2	-2
440	101	110	156	168	418	102	111	158	170	-1	-1	-2	-2
441	101	110	156	168	419	102	111	158	170	-1	-1	-2	-2
442	101	110	156	168	420	102	111	158	170	-1	-1	-2	-2
443	101	110	156	168	421	102	111	158	170	-1	-1	-2	-2
444	101	110	156	168	422	102	111	158	170	-1	-1	-2	-2
445	102	111	157	169	423	103	112	159	171	-1	-1	-2	-2
446	102	111	157	169	424	103	112	159	171	-1	-1	-2	-2
447	102	111	157	169	425	103	112	159	171	-1	-1	-2	-2
448	102	111	157	169	426	103	112	159	171	-1	-1	-2	-2
449	102	111	157	169	427	103	112	159	171	-1	-1	-2	-2
450	102	111	157	169	428	103	112	159	171	-1	-1	-2	-2
451	103	112	158	170	429	104	113	160	172	-1	-1	-2	-2
452	103	112	158	170	430	104	113	160	172	-1	-1	-2	-2
453	103	112	158	170	431	104	113	160	172	-1	-1	-2	-2
454	103	112	158	170	432	104	113	160	172	-1	-1	-2	-2
455	103	112	158	170	432	104	113	160	172	-1	-1	-2	-2
456	103	112	158	170	433	104	113	160	172	-1	-1	-2	-2
457	104	113	159	171	434	105	114	161	173	-1	-1	-2	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
458	104	113	159	171	435	105	114	161	173	-1	-1	-2	-2
459	104	113	159	171	436	105	114	161	173	-1	-1	-2	-2
460	104	113	159	171	437	105	114	161	173	-1	-1	-2	-2
461	104	113	159	171	438	105	114	161	173	-1	-1	-2	-2
462	104	113	159	171	439	105	114	161	173	-1	-1	-2	-2
463	104	113	159	171	440	105	114	161	173	-1	-1	-2	-2
464	105	114	160	172	441	106	115	162	174	-1	-1	-2	-2
465	105	114	160	172	442	106	115	162	174	-1	-1	-2	-2
466	105	114	160	172	443	106	115	162	174	-1	-1	-2	-2
467	105	114	160	172	444	106	115	162	174	-1	-1	-2	-2
468	105	114	160	172	445	106	115	162	174	-1	-1	-2	-2
469	105	114	160	172	446	106	115	162	174	-1	-1	-2	-2
470	106	115	161	173	447	107	116	163	175	-1	-1	-2	-2
471	106	115	161	173	448	107	116	163	175	-1	-1	-2	-2
472	106	115	161	173	449	107	116	163	175	-1	-1	-2	-2
473	106	115	161	173	450	107	116	163	175	-1	-1	-2	-2
474	106	115	161	173	450	107	116	163	175	-1	-1	-2	-2
475	106	115	161	173	451	107	116	163	175	-1	-1	-2	-2
476	106	115	161	173	452	107	116	163	175	-1	-1	-2	-2
477	107	116	162	174	453	108	117	164	176	-1	-1	-2	-2
478	107	116	162	174	454	108	117	164	176	-1	-1	-2	-2
479	107	116	162	174	455	108	117	164	176	-1	-1	-2	-2
480	107	116	162	174	456	108	117	164	176	-1	-1	-2	-2
481	107	116	162	174	457	108	117	164	176	-1	-1	-2	-2

Point Laser IRI (in./mile)					Line Laser IRI (in./mile)					IRI Difference (in./mile)			
Initial	107%	105%	100%	95%	Initial	107%	105%	100%	95%	107%	105%	100%	95%
482	107	116	162	174	458	108	117	164	176	-1	-1	-2	-2
483	108	117	163	175	459	109	118	165	177	-1	-1	-2	-2
484	108	117	163	175	460	109	118	165	177	-1	-1	-2	-2
485	108	117	163	175	461	109	118	165	177	-1	-1	-2	-2
486	108	117	163	175	462	109	118	165	177	-1	-1	-2	-2
487	108	117	163	175	463	109	118	165	177	-1	-1	-2	-2
488	108	117	163	175	464	109	118	165	177	-1	-1	-2	-2
489	108	117	163	175	465	109	118	165	177	-1	-1	-2	-2
490	109	118	164	176	466	110	119	166	178	-1	-1	-2	-2
491	109	118	164	176	467	110	119	166	178	-1	-1	-2	-2
492	109	118	164	176	468	110	119	166	178	-1	-1	-2	-2
493	109	118	164	176	469	110	119	166	178	-1	-1	-2	-2
494	109	118	164	176	469	110	119	166	178	-1	-1	-2	-2
495	109	118	164	176	470	110	119	166	178	-1	-1	-2	-2
496	110	119	165	177	471	111	120	167	179	-1	-1	-2	-2
497	110	119	165	177	472	111	120	167	179	-1	-1	-2	-2
498	110	119	165	177	473	111	120	167	179	-1	-1	-2	-2
499	110	119	165	177	474	111	120	167	179	-1	-1	-2	-2
500	110	119	165	177	475	111	120	167	179	-1	-1	-2	-2

Conclusions and Recommendations

This study analyzed rideability data collected by SCDOT using both point and line lasers to compare the IRI differences measured in order to convert SCDOT rideability specifications to reflect data collected from the updated line laser system. Based on the analyses, changes were proposed to promote equivalent rideability requirements in order to maintain the quality of ride expected on SCDOT construction projects. The recommended adjustments to SC-M-403 Rideability of Asphalt Mixtures and SC-M-502 PCC Pavement Rideability are shown below.

- Amend SC-M-403 Table 1 as follows:

Table 10 Recommended Updates for SC-M-403 Table 1

Table 1. Schedule For Adjusted Payment – New Construction and Multiple Lift Overlay on Interstate and Limited Access Segments	
Segment IRI (inches/mile)	Price Adjustment – Asphalt Final Riding Course
Less than 39	107%
39 – 43	105%
44 – 65	100%
66 – 70	95%
71 – 75	90%
76 – 80	80%
Greater than 80	For each additional increment of 5 inches per mile of roughness above 80 inches per mile, reduce payment by an additional 10% from 80% if the DCE determines the material may remain in place.

- Amend SC-M-403 Table 2 as follows:

Table 11 Recommended Updates for SC-M-403 Table 3

Table 3. Schedule For Adjusted Payment – Multiple Lift Overlay on Non-Limited Access Segments and Reclamation	
Segment IRI (inches/mile)	Price Adjustment – Asphalt Final Riding Course
Less than 46	107%
46 – 54	105%
55 – 90	100%
91 – 95	95%
96 – 101	90%
102 – 106	85%
107 – 111	80%
Greater than 111	For each additional increment of 5 inches per mile of roughness above 111 inches per mile, reduce payment by an additional 10% from 80% if the DCE determines the material may remain in place.

- Amend SC –M-403 to include Table 4 as follows:

Table 12 Recommended Updates for SC-M-403 Table 4

Table 4. Schedule For Adjusted Payment – OGFC Overlay	
Segment IRI (inches/mile)	Price Adjustment – Asphalt Final Riding Course
Less than 31	107%
31 – 36	105%
37 – 57	100%
58 – 63	95%
64 – 68	90%
69 – 73	80%
Greater than 73	For each additional increment of 5 inches per mile of roughness above 73 inches per mile, reduce payment by an additional 10% from 80% if the DCE determines the material may remain in place.

- Amend SC-M-403 to include Table 5 as follows:

Table 13 Recommended Updates for SC-M-403 Table 5

Table 5. Schedule For Adjusted Payment – Micro-Milling	
IRI Roughness (inches/mile)	Adjusted Unit Price
Less than or equal to 48	125%
49 - 62	110%
63 - 78	100%
79 - 87	90%
Greater than 87	Corrective Action Required

- Amend SC-M-403 Table 6, Rideability Resurfacing chart as shown in Appendix 2:
- Amend SC-M-502 Table 1 as follows:

Table 14 Recommended Updates for SC-M-502 Table 1

Table 1. Schedule For Adjusted Payment – New Construction	
IRI (inches/mile)	Adjusted Unit Price
Less than or equal to 47	105%
48 - 52	103%
53 - 57	101%
58 - 66	100%
67 - 71	95%
72 - 76	90%
77 - 81	80%
82 and above	See Note 1

- Amend SC-M-502 Table 2 as follows:

Table 15 Recommended Updates for SC-M-502 Table 2

Table 2. Schedule For Adjusted Payment – Existing Pavement	
IRI Roughness (inches/mile)	Adjusted Unit Price
Less than or equal to 48	125%
49 - 62	110%
63 - 78	100%
79 - 87	90%
Greater than 87	Corrective Action Required

Implementation

The updated SC-M-403 based on these recommendations was submitted to the State Pavement Design Engineer and State Materials and Research Engineer for review. Upon their approval, the document was reviewed by Federal Highway Administration has been implemented into construction bid lettings as of April 2016.

Bibliography

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South Carolina Department of Transportation (SCDOT), (2006) *Standard Method of Test for: Measurement of Pavement Rideability using the Dynatest 5051 Mark III Road Surface Profiler*. SC_T_125(06). Columbia.

South Carolina Department of Transportation (SCDOT), (2014). *Supplemental Technical Specification for Hot-Mix Asphalt Rideability*. SC-M-403(05/14). Columbia.

South Carolina Department of Transportation (SCDOT), (2009). *Supplemental Technical Specification for PCC Pavement Rideability*. SC-M-403(08/09). Columbia.

SPR 704, “Evaluating the Use of High Speed Laser Line Sensors for Improved Rideability Measurement”

Appendices

Appendix 1: Statistical Analysis

Paired t-test:

Null hypothesis H_0 : $\mu_{\text{Point_Laser_IRI}} = \mu_{\text{Line_Laser_IRI}}$
 Alternate hypothesis H_a : $\mu_{\text{Point_Laser_IRI}} \neq \mu_{\text{Line_Laser_IRI}}$
 Level of Significance α : 95%
 Rejection region: $p\text{-value} \leq 5\%$

Test statistic for H_0 : $t = \frac{\bar{d}}{s_{\bar{d}}}$

Where: \bar{d} = mean difference

$s_{\bar{d}}$ = standard error of the mean difference

Existing AC pavement paired t-test:

df = 435	LWP	RWP	MRI
t Stat	17.194	5.864	13.630
P(T<=t) one-tail	0.000	0.000	0.000
t Critical one-tail	1.648	1.648	1.648
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.965	1.965	1.965
Reject H_0 ?	Yes	Yes	Yes

F-test:

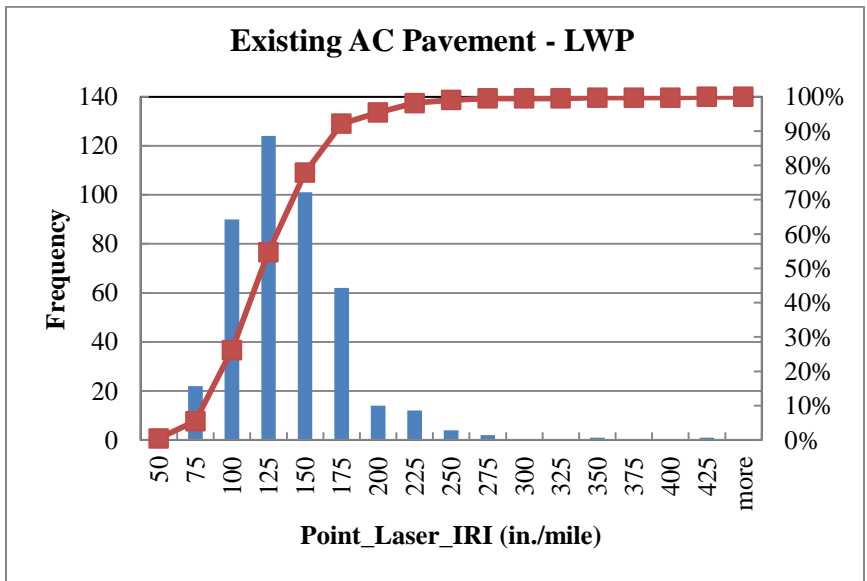
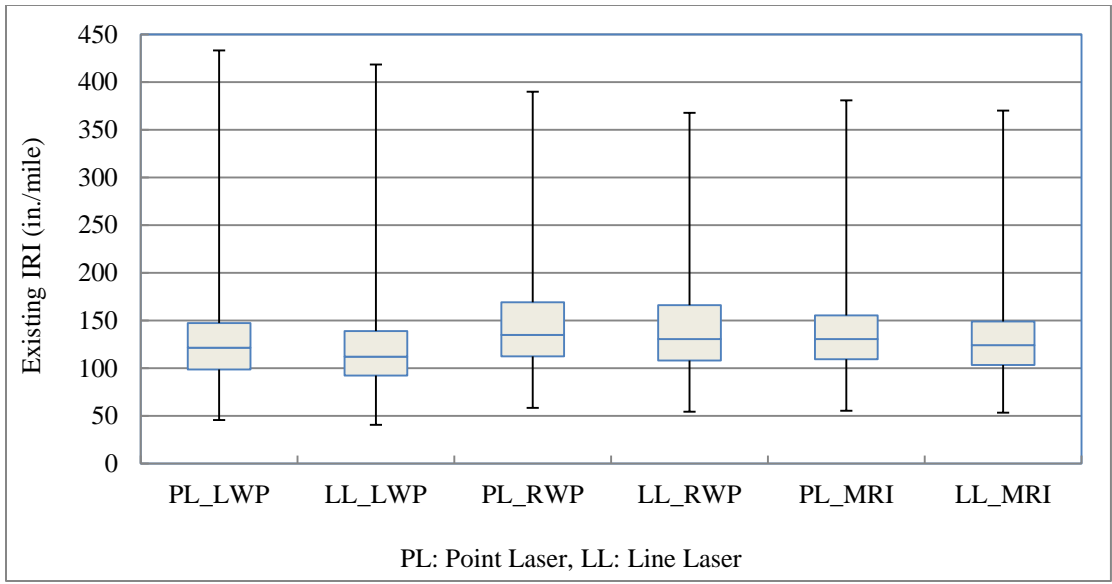
Null hypothesis H_0 : $\sigma_{\text{Point_Laser_IRI}}^2 = \sigma_{\text{Line_Laser_IRI}}^2$
 Alternate hypothesis H_a : $\sigma_{\text{Point_Laser_IRI}}^2 \neq \sigma_{\text{Line_Laser_IRI}}^2$
 Level of Significance α : 95%
 Rejection region: $p\text{-value} \leq 5\%$

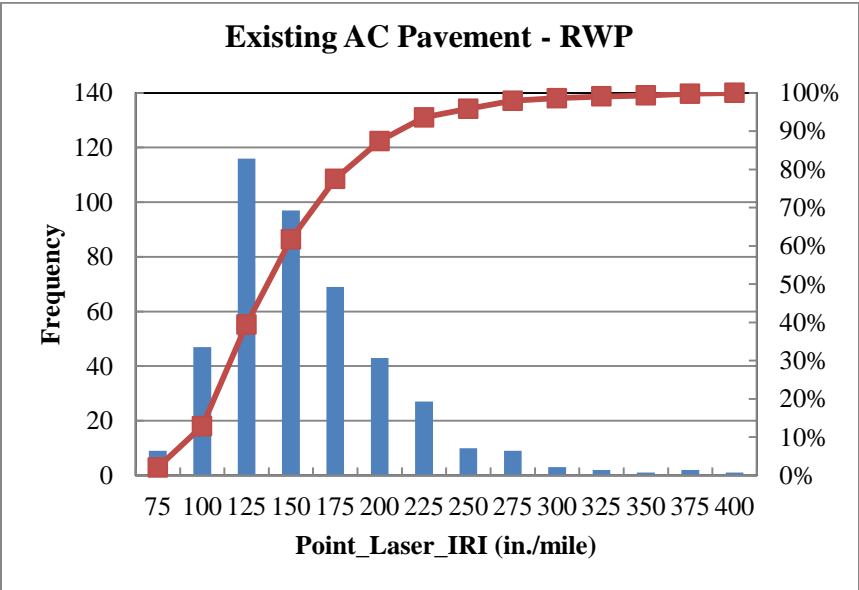
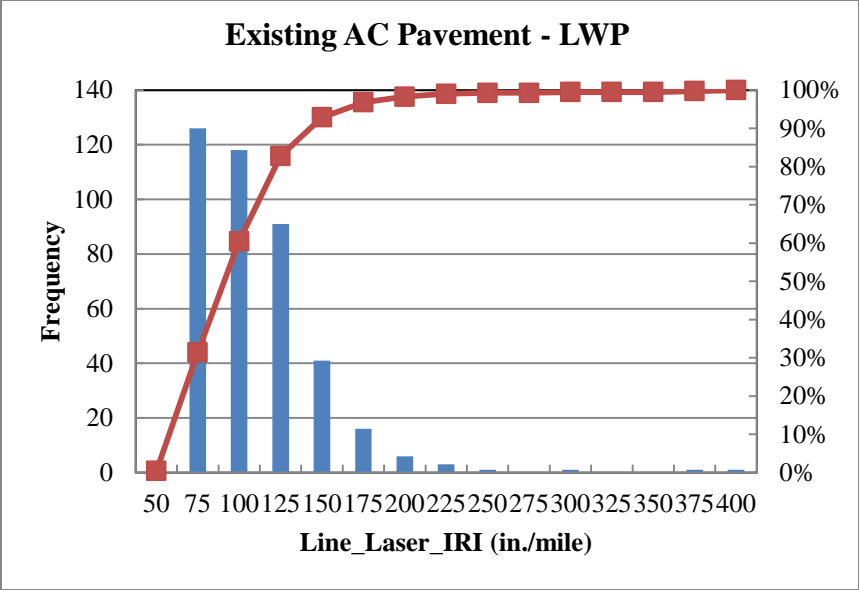
Existing AC pavement F-test:

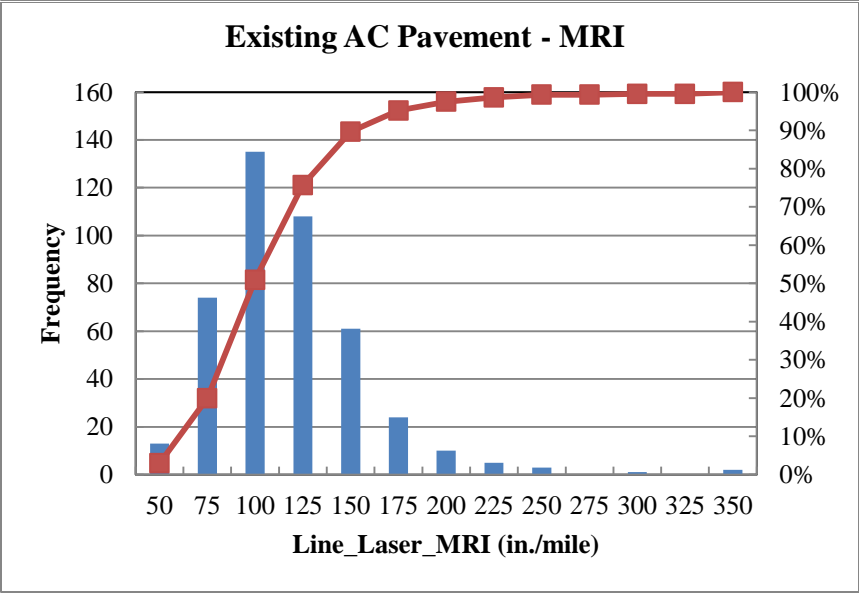
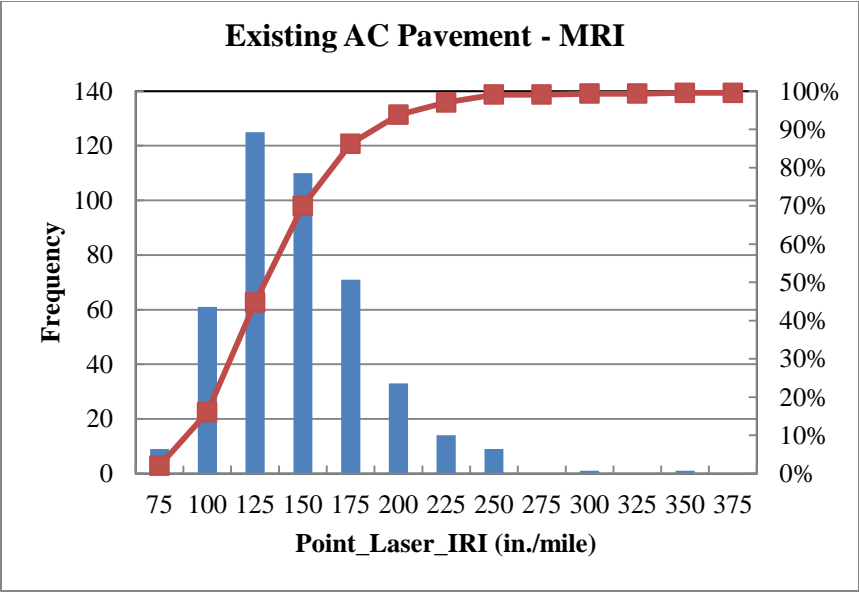
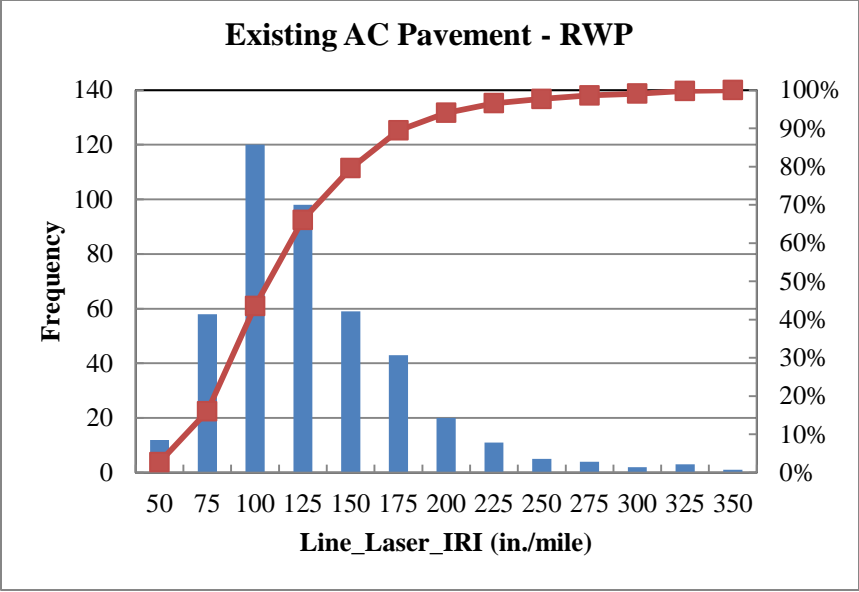
df = 435	LWP	RWP	MRI
F	1.097	1.004	1.058
P(F<=f) one-tail	0.167	0.482	0.278
F Critical one-tail	1.171	1.171	1.171
Reject H_0 ?	No	No	No

Existing AC pavement – IRI:

N = 436	Point Laser IRI			Line Laser IRI		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	126.70	145.53	136.12	118.61	141.73	130.17
Median (in./mile)	121.46	135.04	130.48	112.03	130.62	124.09
Standard Deviation	42.40	49.22	41.08	40.48	49.32	39.94
Minimum (in./mile)	45.67	58.29	55.34	45.67	54.40	53.29
Maximum (in./mile)	433.28	389.92	380.76	433.28	367.67	369.93

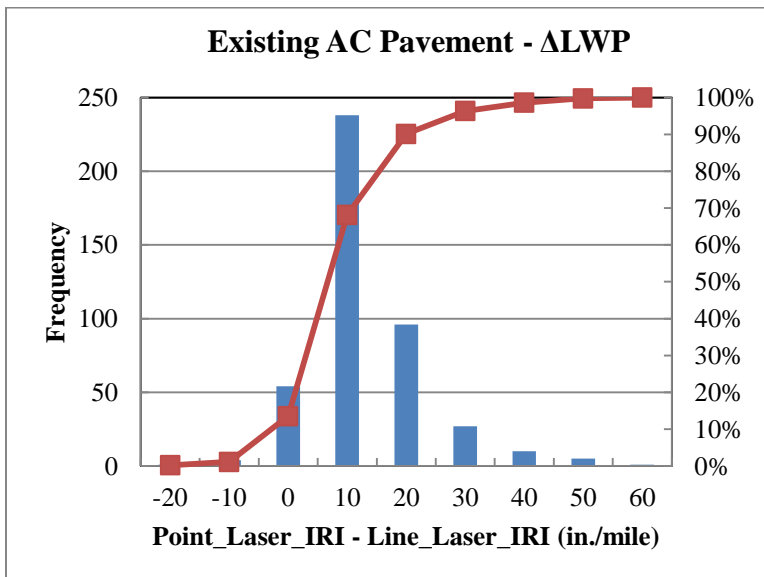
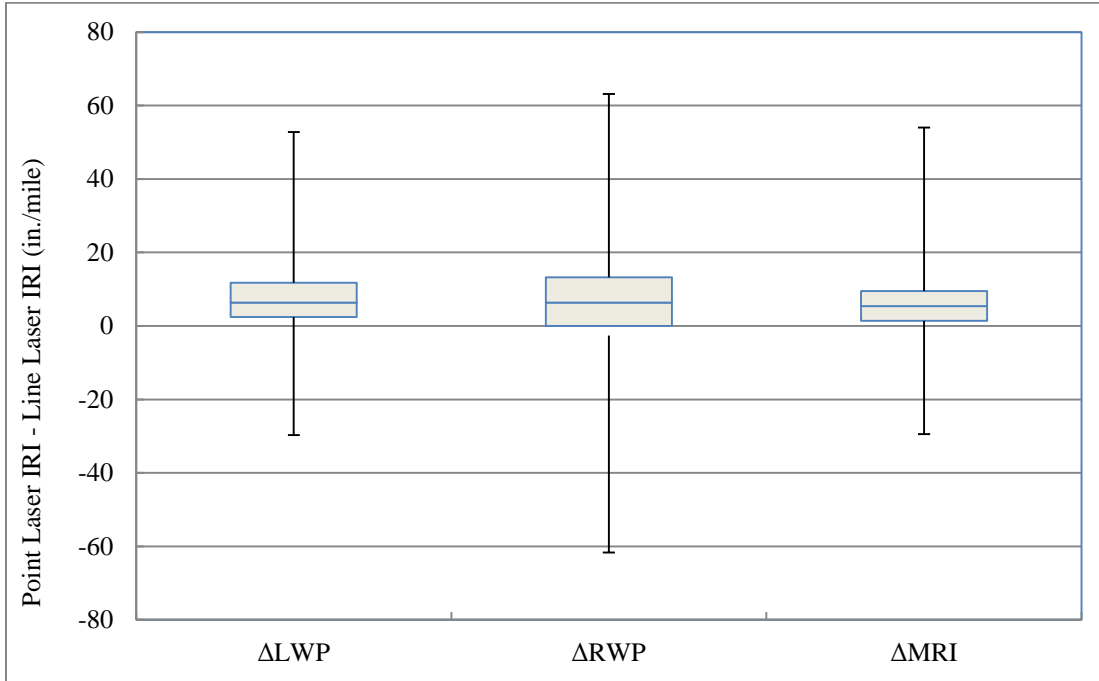


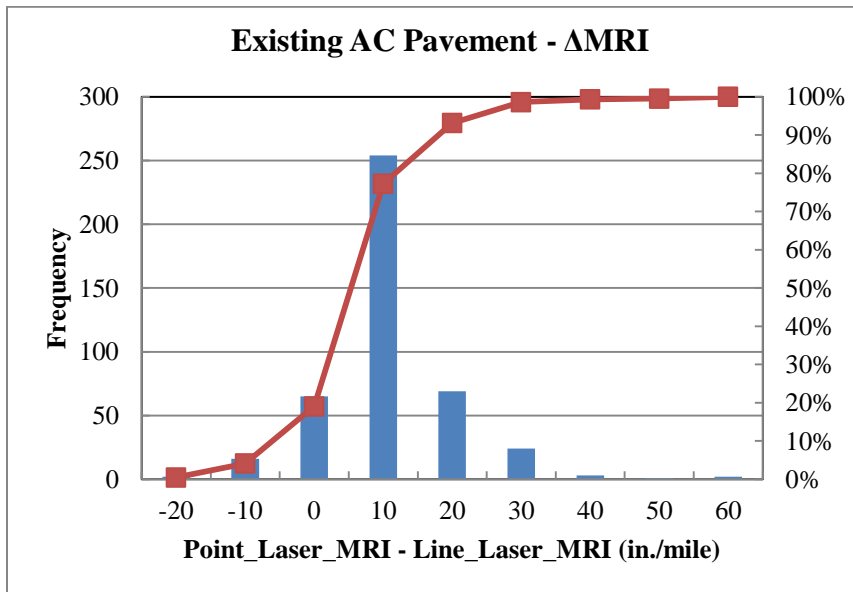
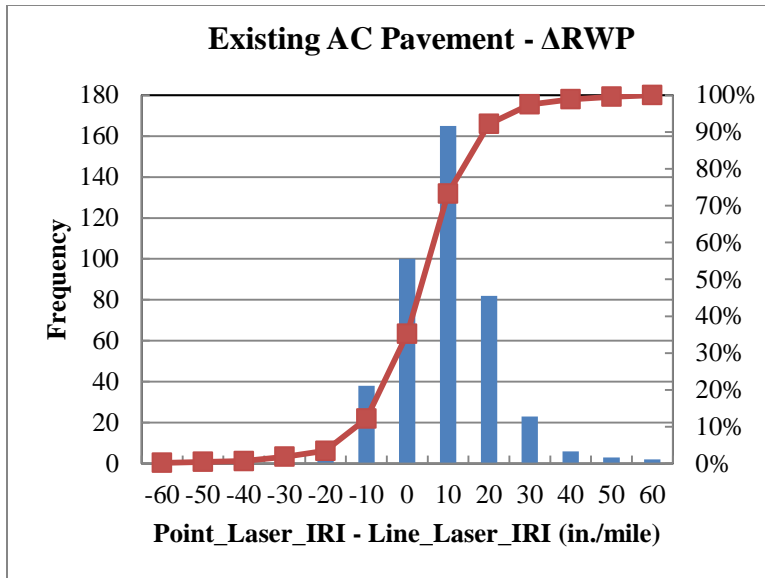




Existing AC pavement – (Point Laser IRI – Line Laser IRI):

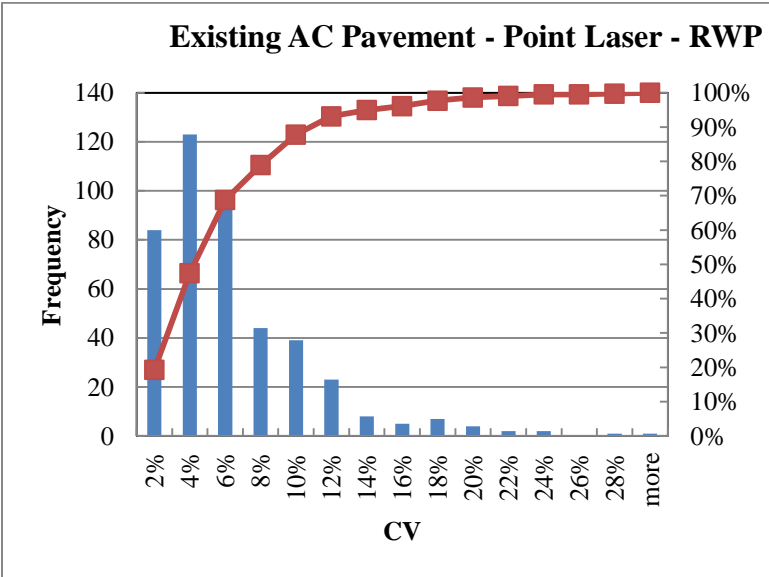
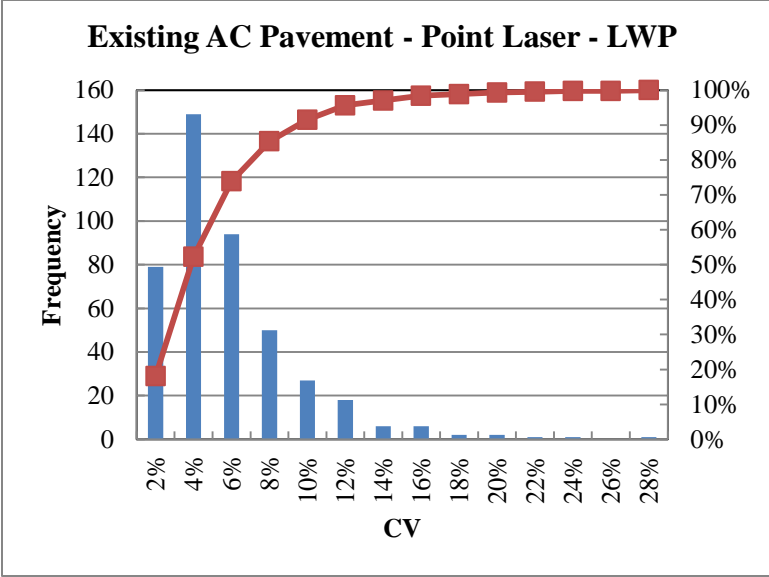
n = 436	ΔLWP	ΔRWP	ΔMRI
Mean (in./mile)	8.10	3.80	5.95
Median (in./mile)	6.36	3.76	5.41
Standard Deviation	9.83	13.54	9.11
Minimum (in./mile)	-29.70	-61.65	-29.41
Maximum (in./mile)	52.81	60.55	54.04

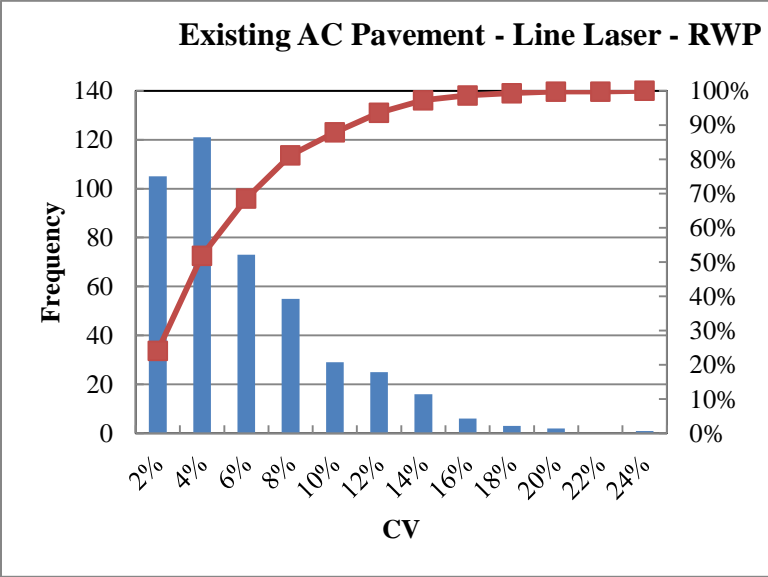
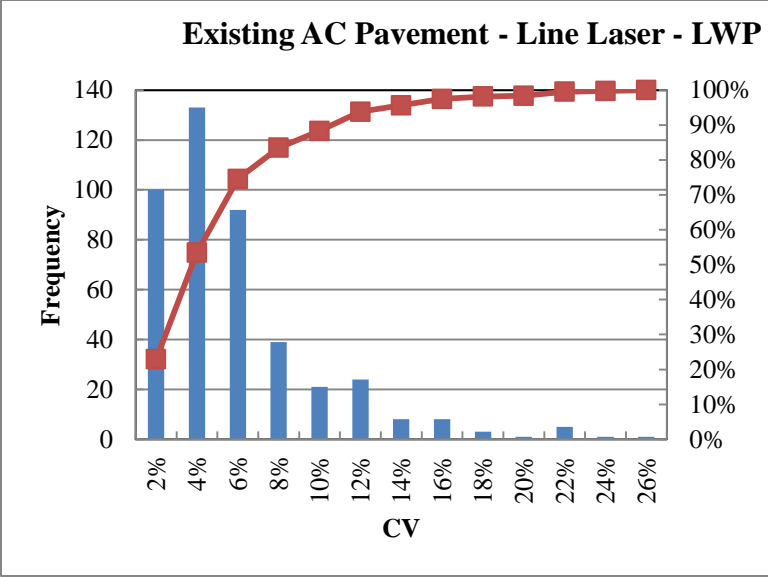


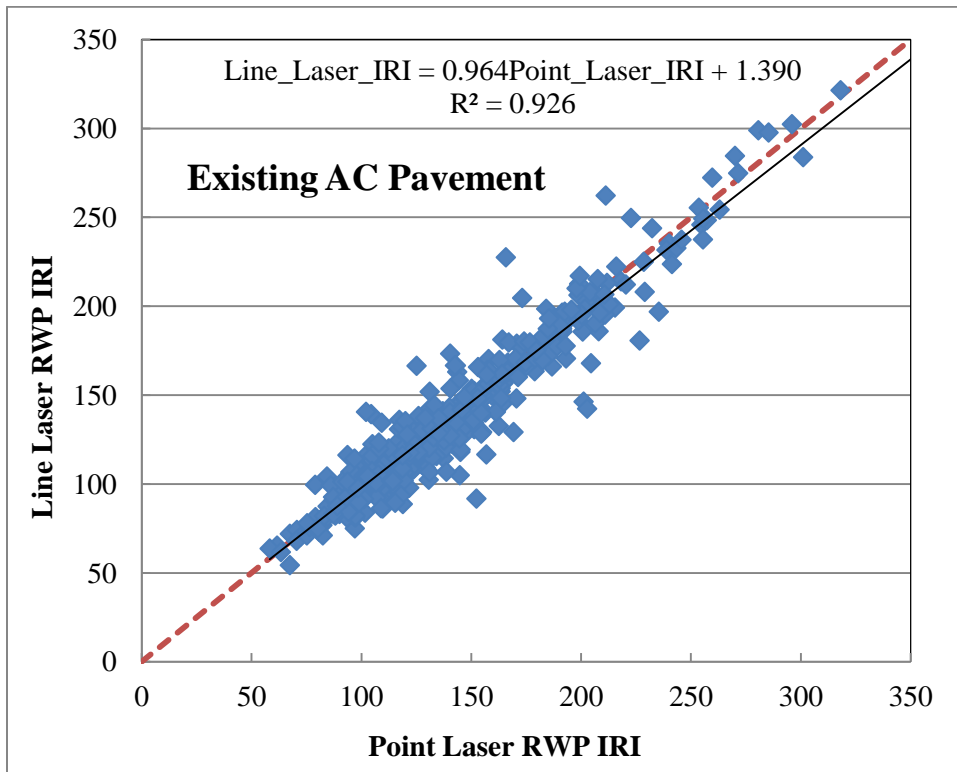
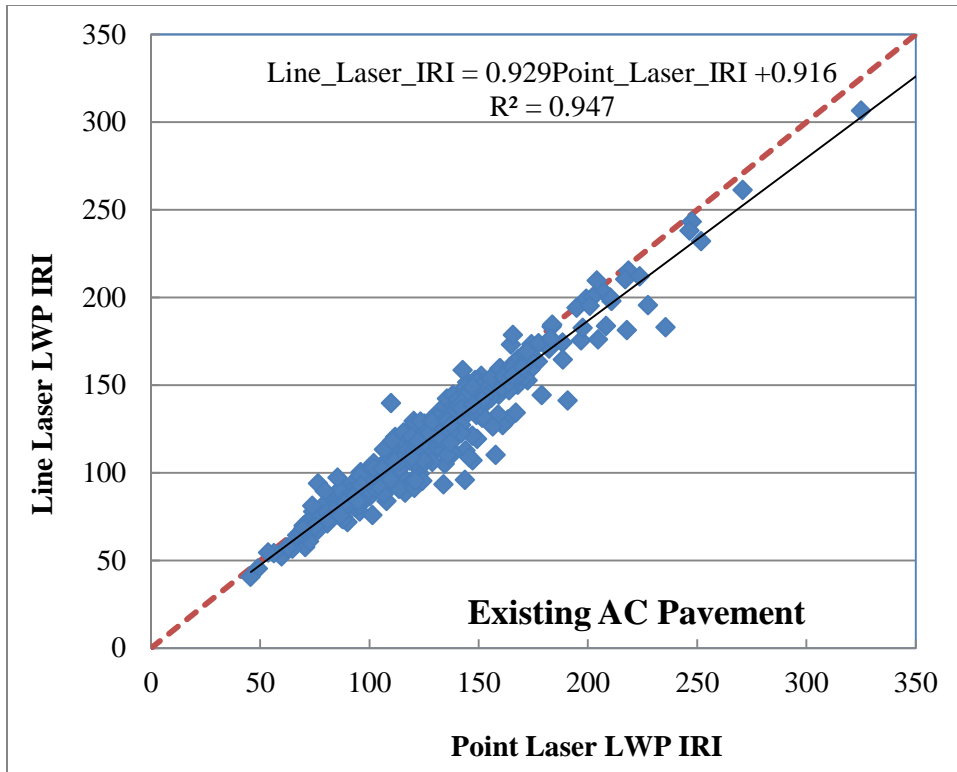


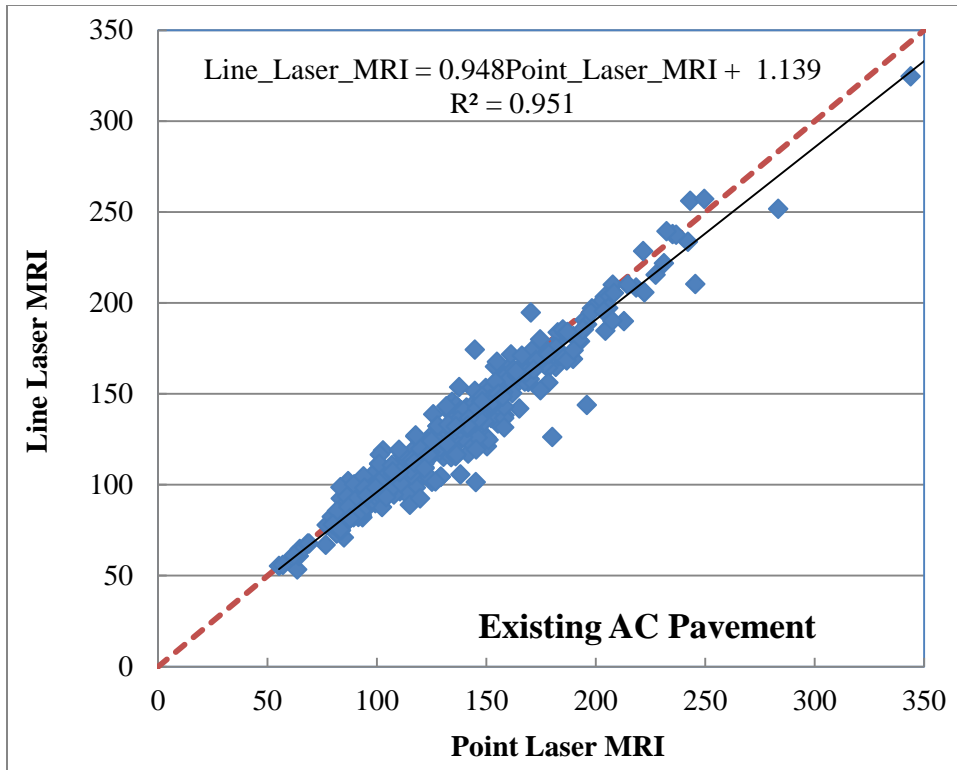
Existing AC pavement – Coefficient of Variation:

n = 436	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	4.80%	5.39%	4.84%	4.96%
Median	3.83%	4.31%	3.63%	3.87%
Standard Deviation	3.63%	4.46%	4.13%	3.82%
Minimum	0.15%	0.11%	0.05%	0.15%
Maximum	26.32%	36.08%	24.92%	22.27%









Existing AC pavement w/MRI < 166in./mile - Paired t-test:

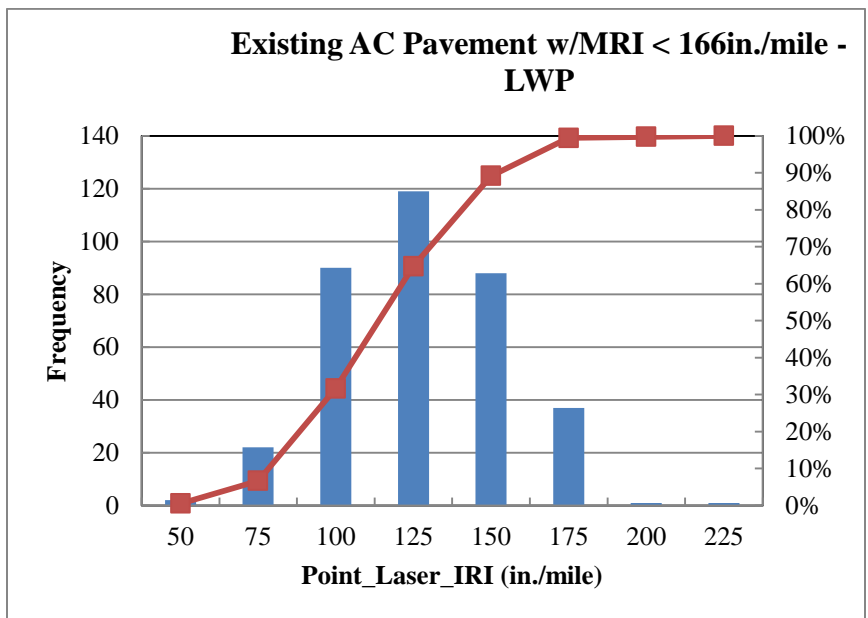
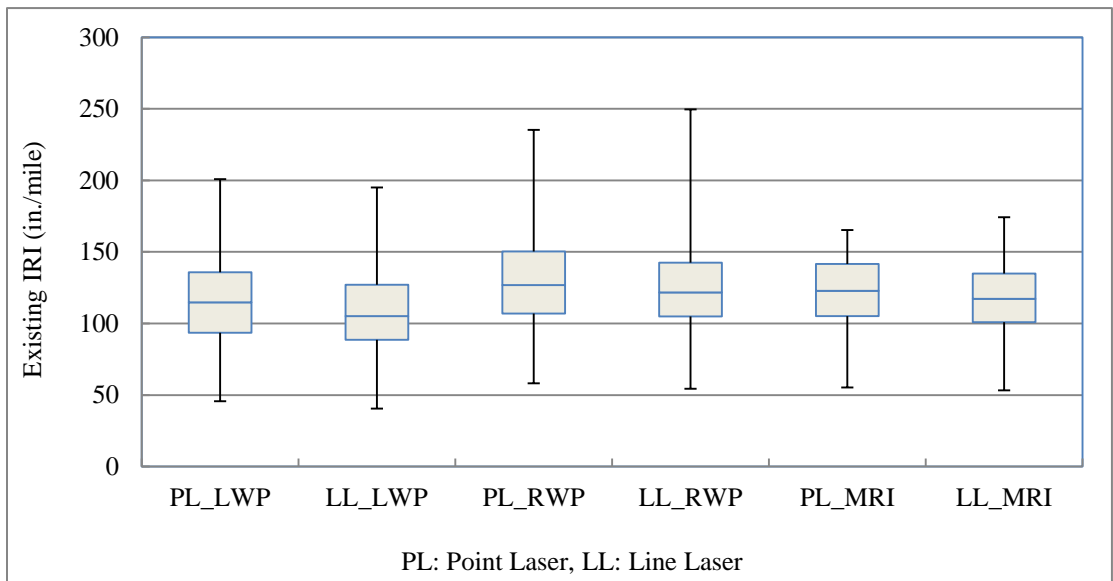
df = 359	LWP	RWP	MRI
t Stat	15.031	4.978	12.187
P(T<=t) one-tail	0.000	0.000	0.000
t Critical one-tail	1.649	1.649	1.649
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.967	1.967	1.967
Reject <i>H</i> ₀ ?	Yes	Yes	Yes

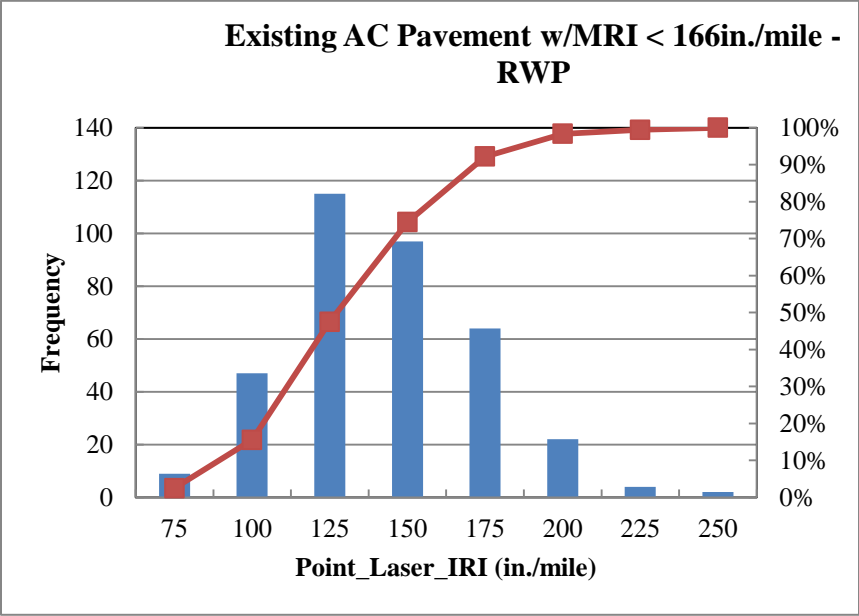
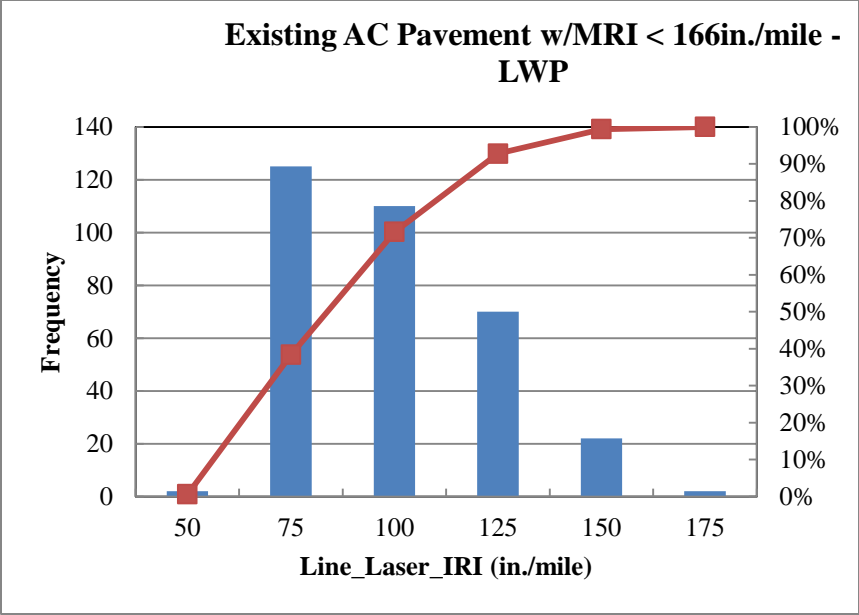
Existing AC pavement w/MRI < 166in./mile - F-test:

df = 359	LWP	RWP	MRI
F	1.071	1.034	1.048
P(F<=f) one-tail	0.257	0.376	0.327
F Critical one-tail	1.190	1.190	1.190
Reject <i>H</i> ₀ ?	No	No	No

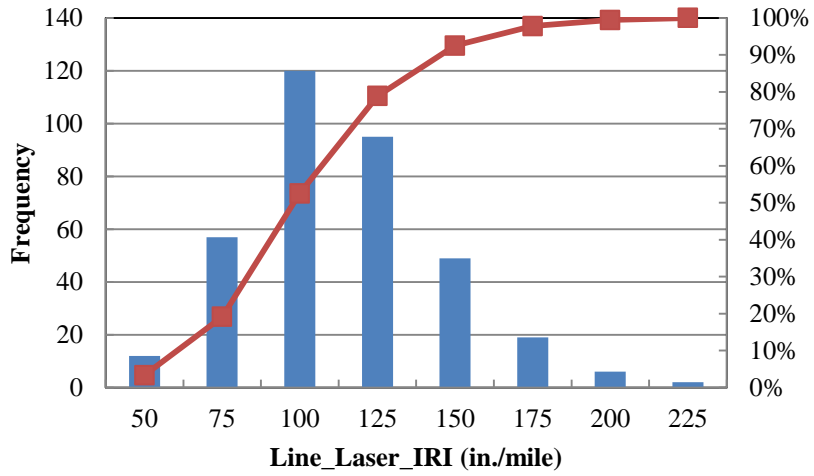
Existing AC pavement w/MRI < 166in./mile - IRI:

n = 360	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	114.96	129.61	122.29	107.64	126.27	116.96
Median (in./mile)	114.71	126.81	122.78	105.17	121.64	117.16
Standard Deviation	27.20	31.03	24.19	26.28	31.55	23.63
Minimum (in./mile)	45.67	58.29	55.34	45.67	54.40	53.29
Maximum (in./mile)	200.87	235.40	165.24	200.87	249.58	174.28

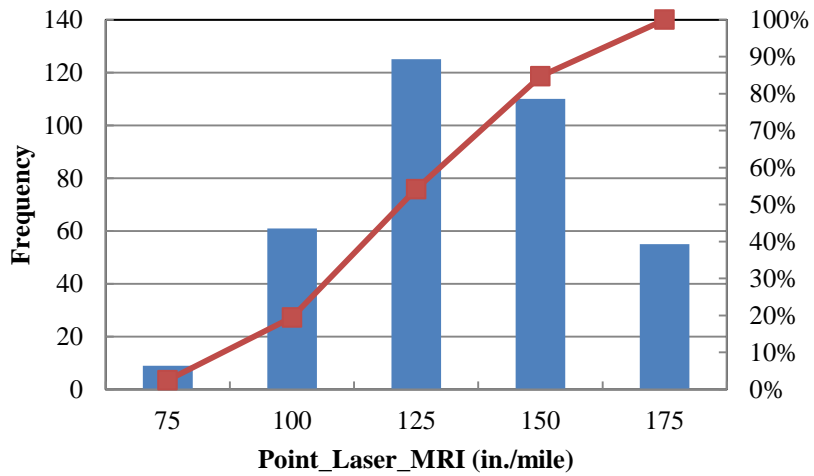


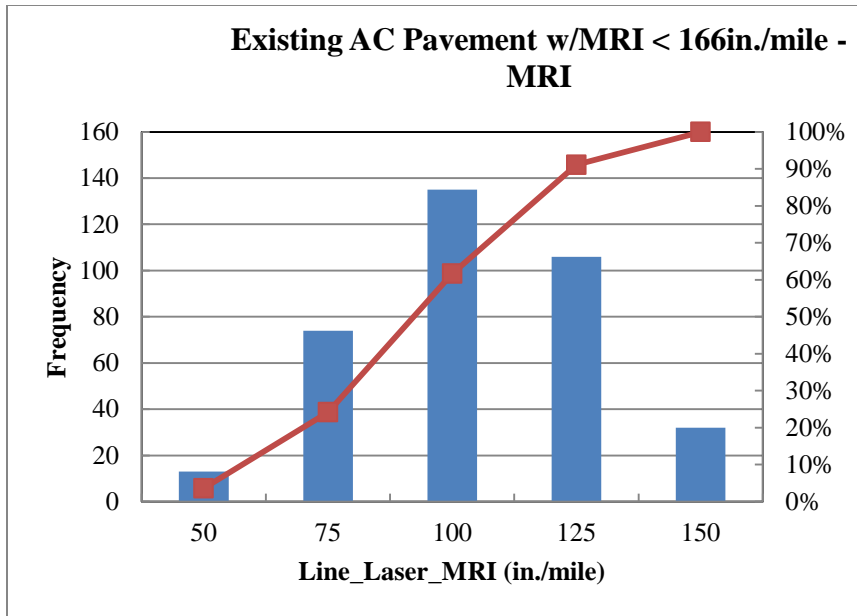


Existing AC Pavement w/MRI < 166in./mile - RWP



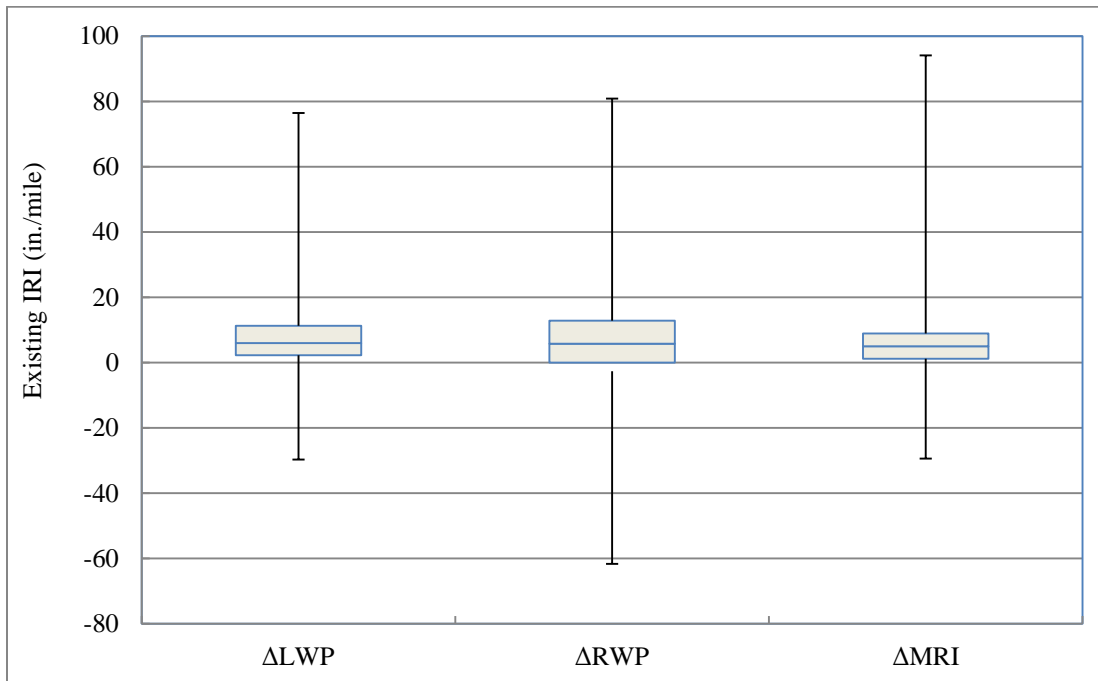
Existing AC Pavement w/MRI < 166in./mile - MRI



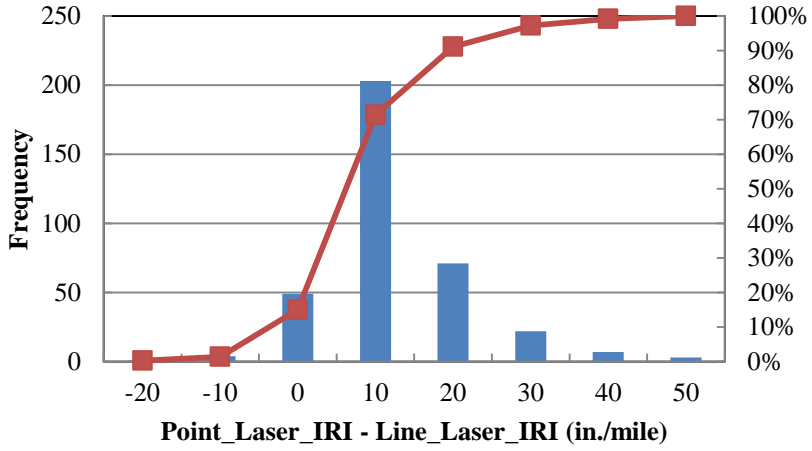


Existing AC pavement w/MRI < 166in./mile - (Point Laser IRI – Line Laser IRI):

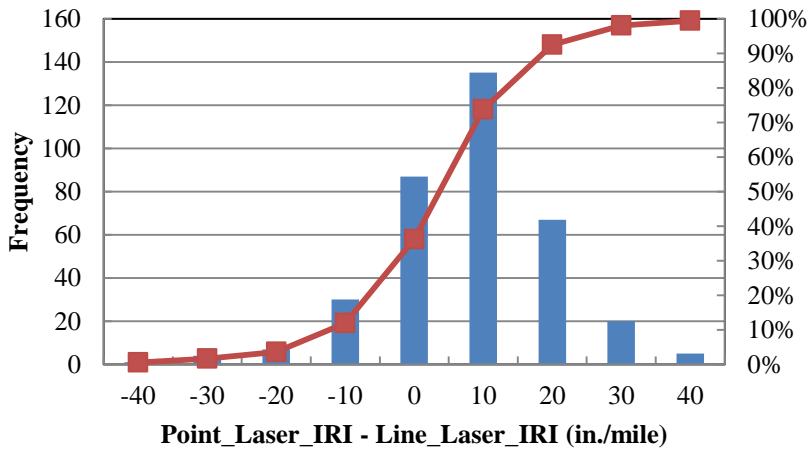
n = 914	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	7.32	3.34	7.32
Median (in./mile)	5.96	3.17	5.96
Standard Deviation	9.24	12.74	9.24
Minimum (in./mile)	-29.70	-61.65	-29.70
Maximum (in./mile)	47.85	60.55	47.85

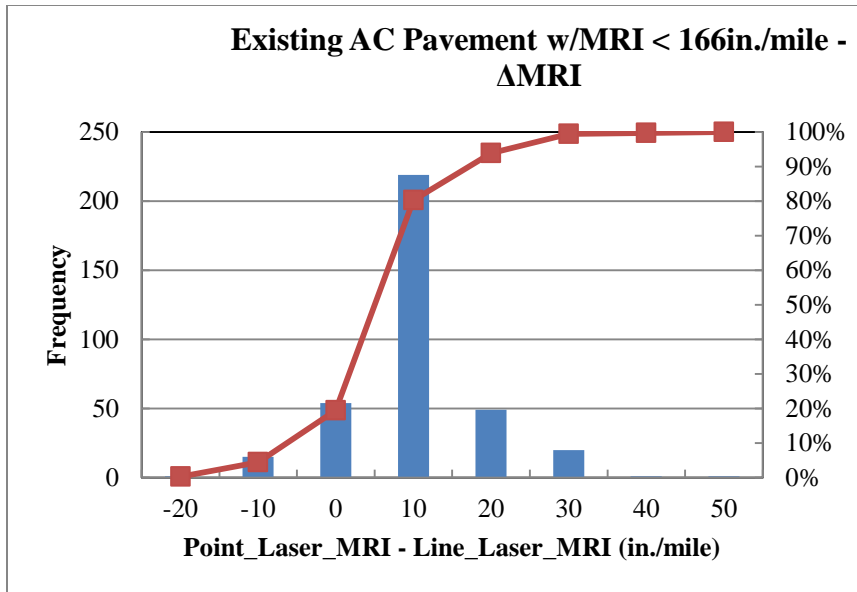


Existing AC Pavement w/MRI < 166in./mile - Δ LWP



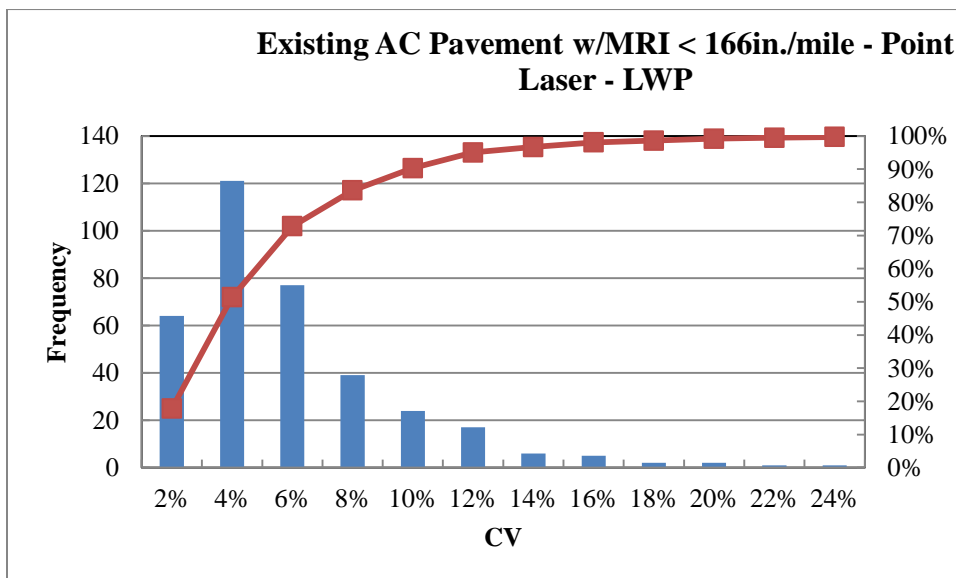
Existing AC Pavement w/MRI < 166in./mile - Δ RWP

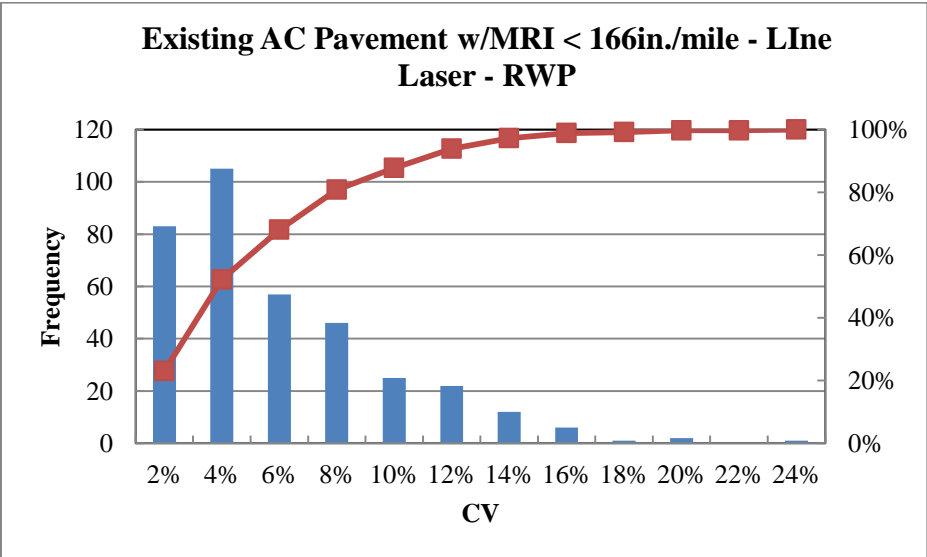
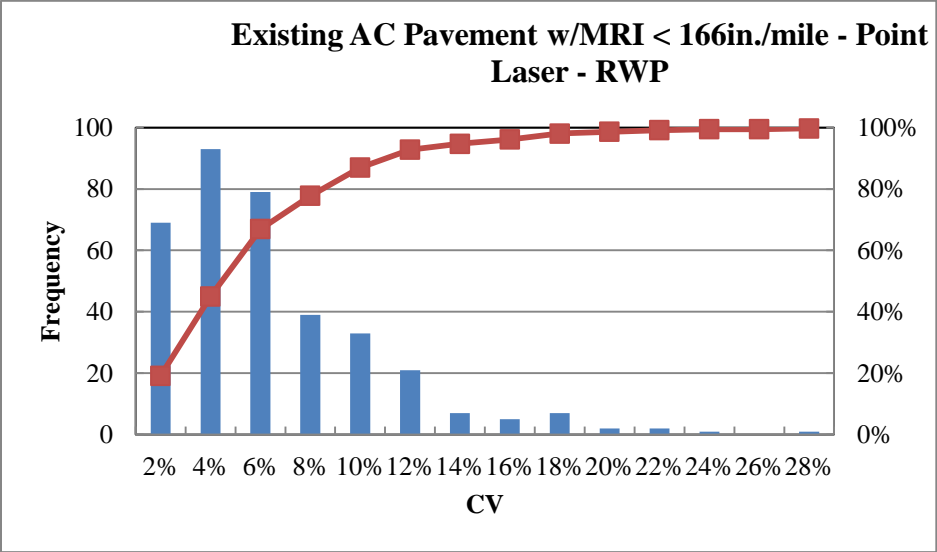
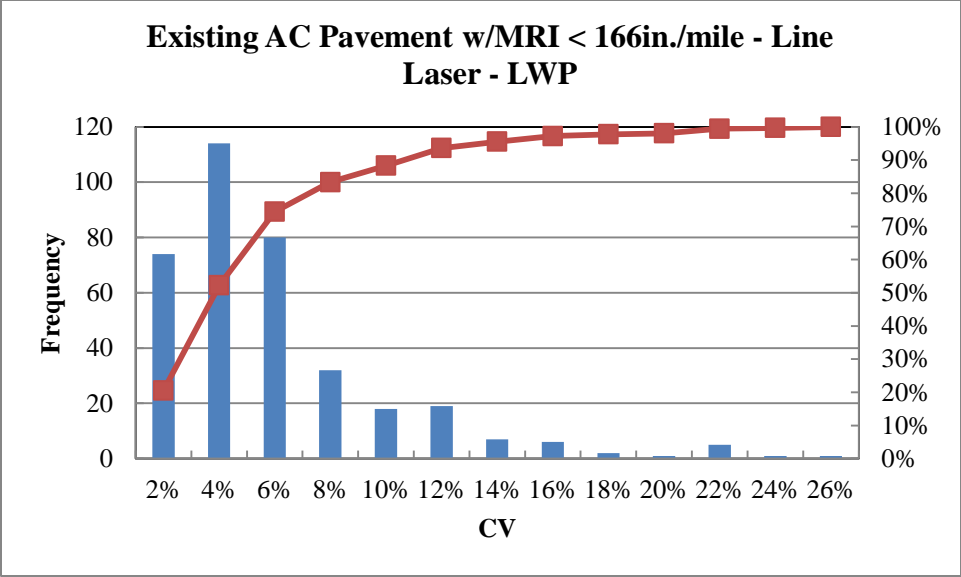


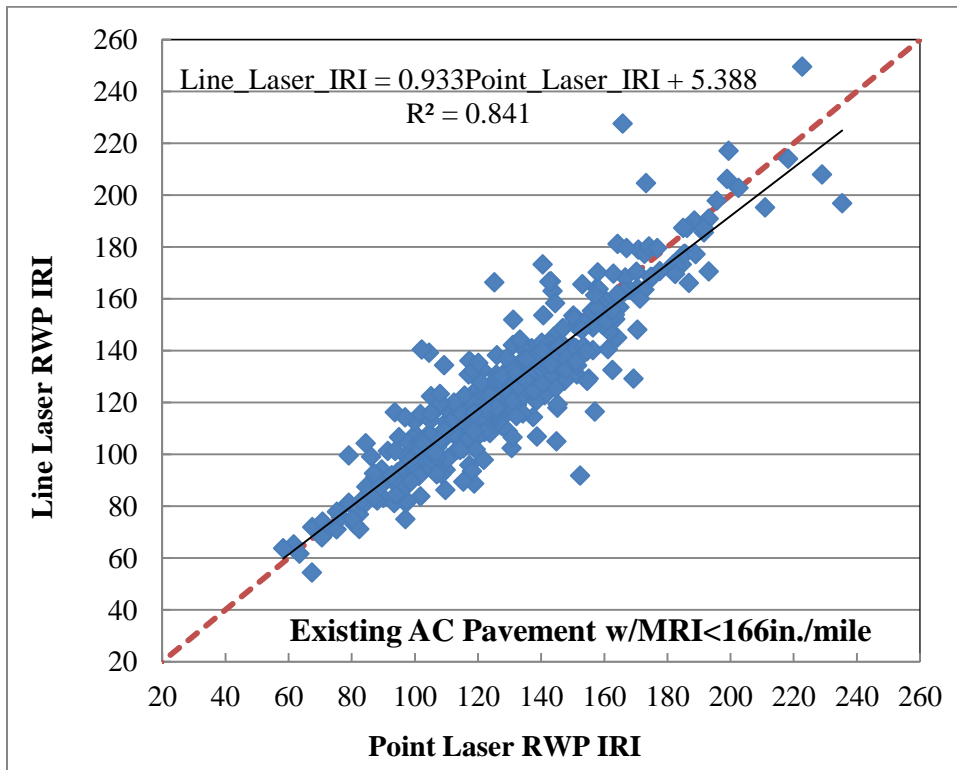
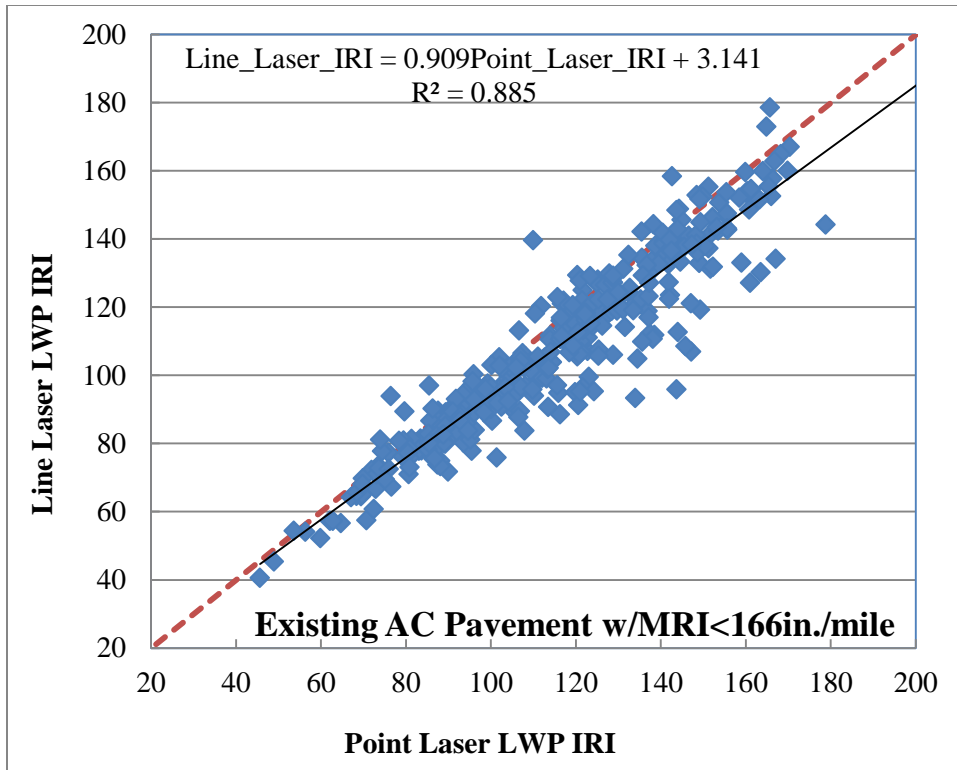


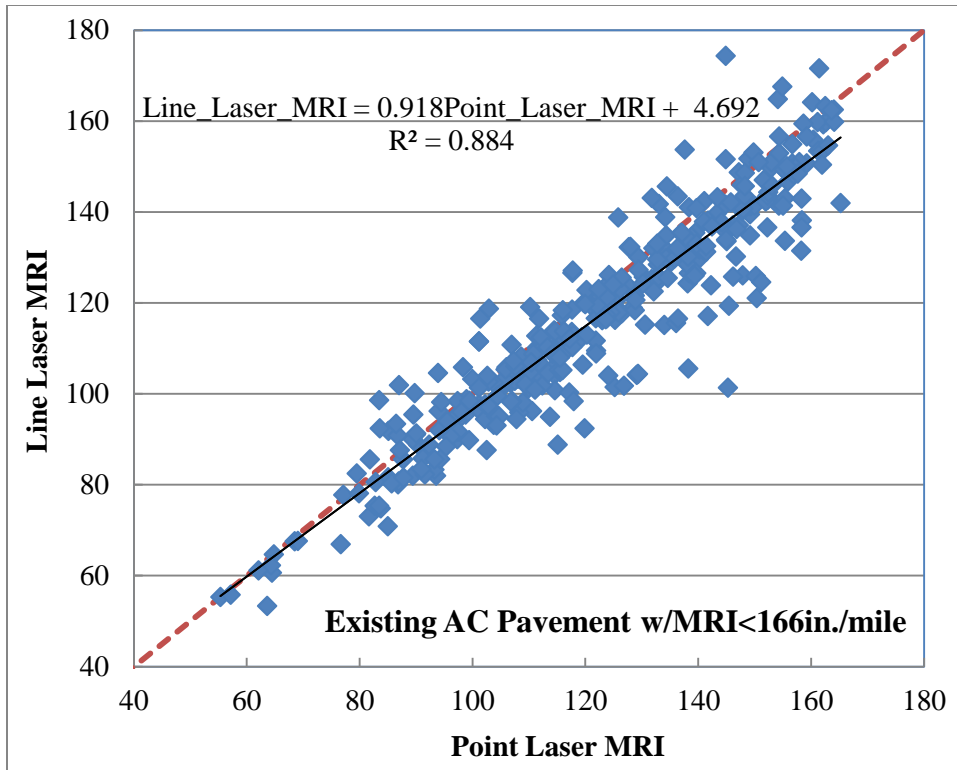
Existing AC pavement w/MRI < 166in./mile – Coefficient of Variation:

n = 360	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	4.96%	5.55%	4.93%	5.00%
Median	3.86%	4.50%	3.72%	3.87%
Standard Deviation	3.80%	4.52%	4.17%	3.80%
Minimum	0.15%	0.11%	0.19%	0.15%
Maximum	26.32%	36.08%	24.92%	22.27%









Existing AC pavement w/MRI < 150in./mile - Paired t-test:

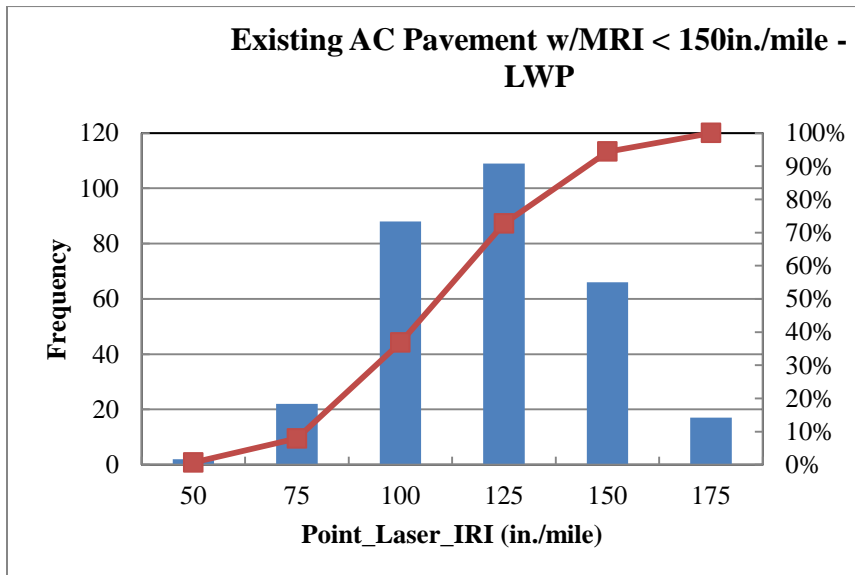
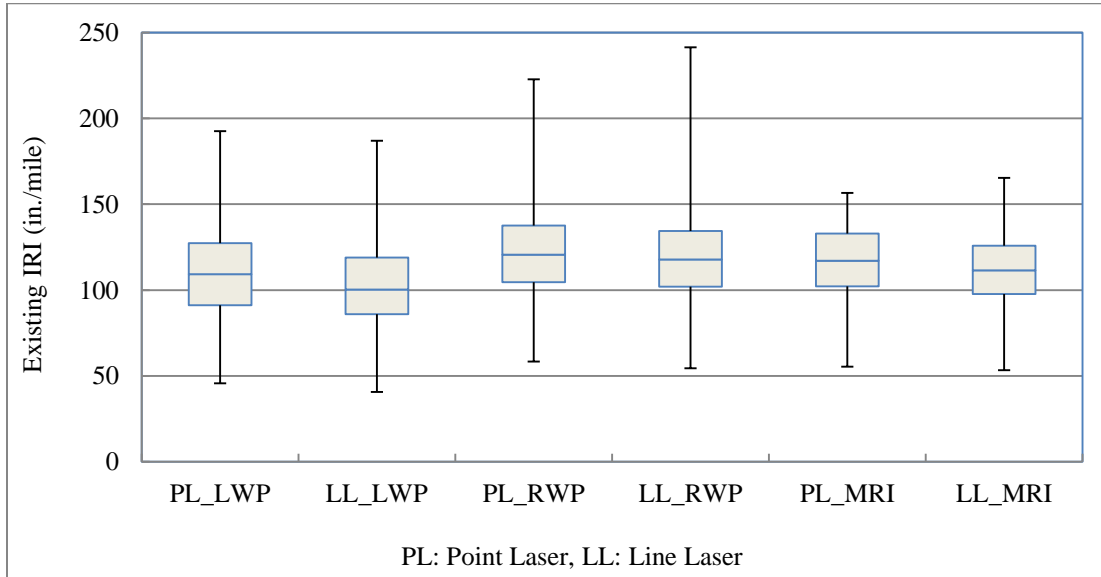
df = 359	LWP	RWP	MRI
t Stat	13.769	3.994	11.062
P(T<=t) one-tail	0.000	0.000	0.000
t Critical one-tail	1.650	1.650	1.650
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.968	1.968	1.968
Reject H_0 ?	Yes	Yes	Yes

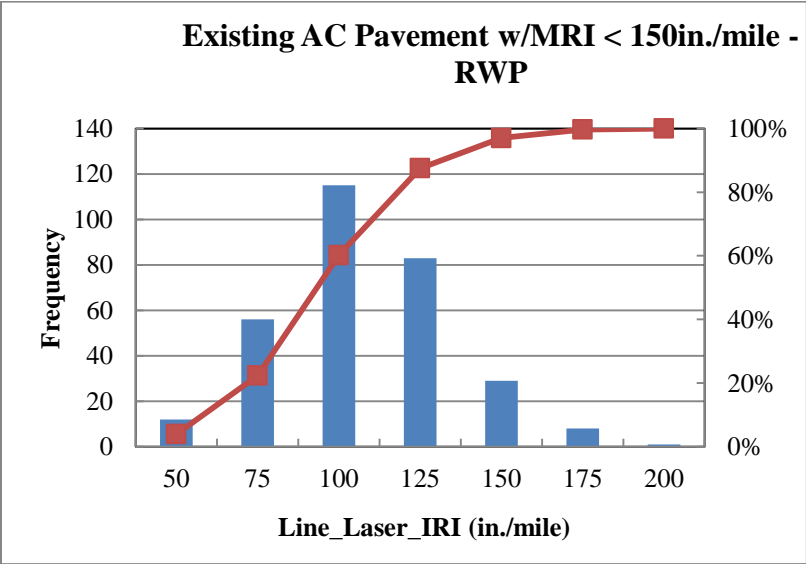
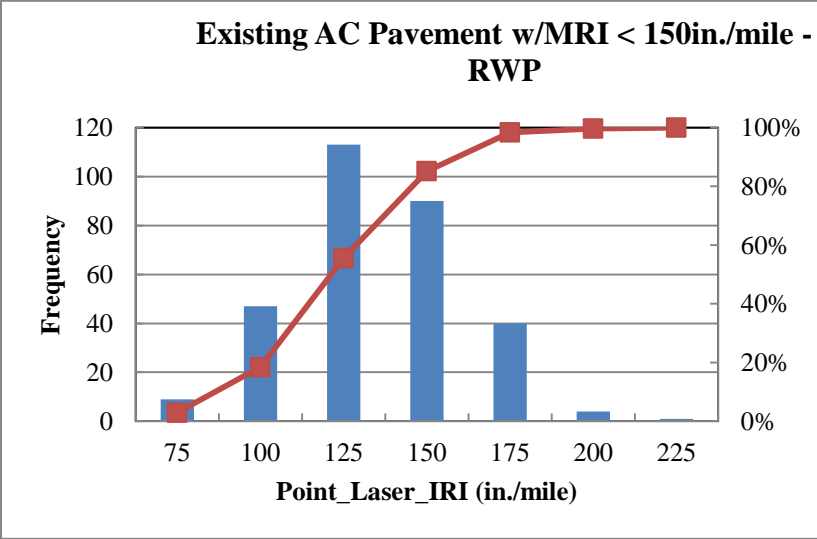
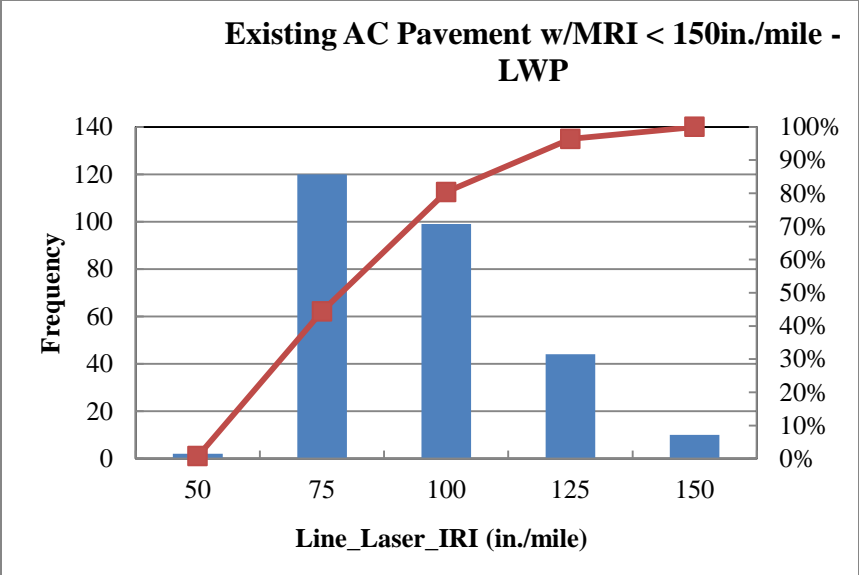
Existing AC pavement w/MRI < 150in./mile - F-test:

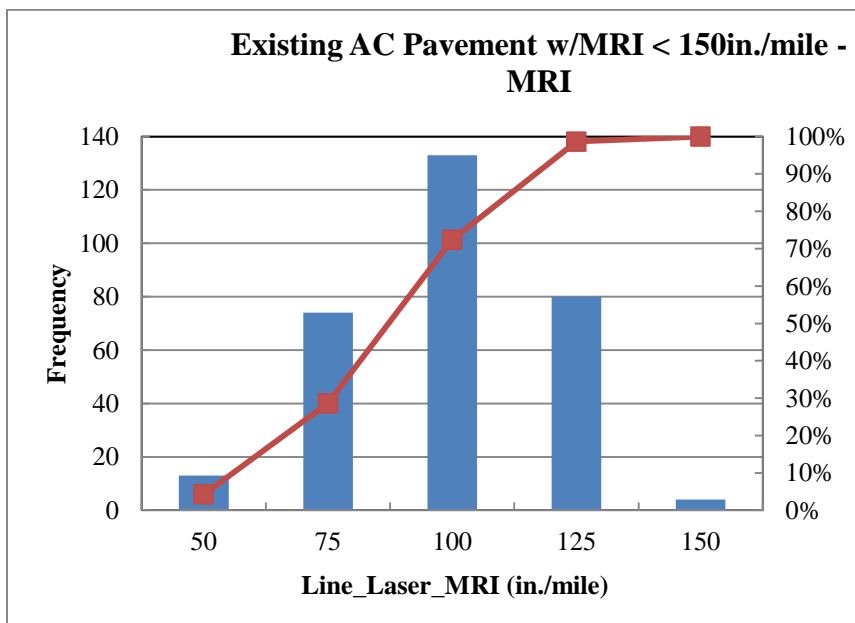
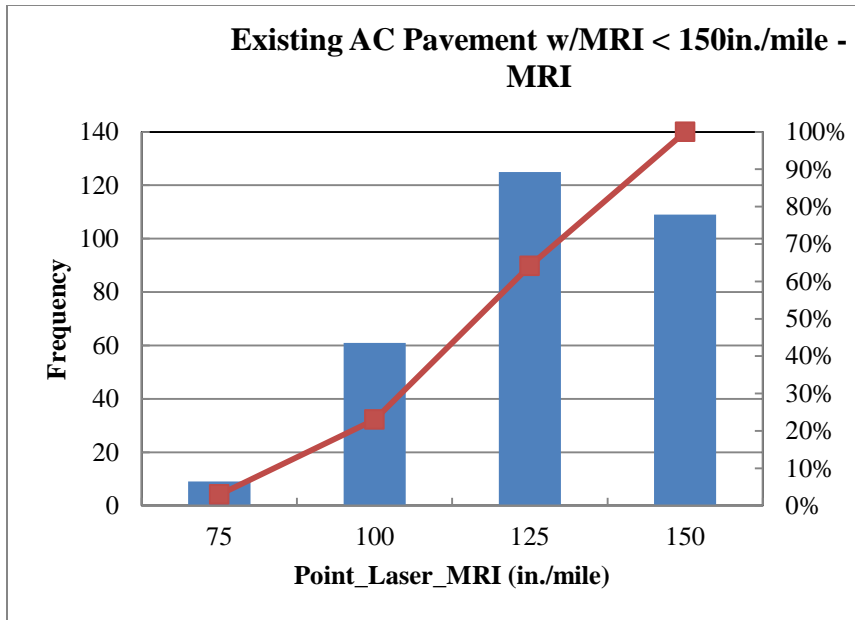
df = 359	LWP	RWP	MRI
F	1.116	1.047	1.059
P(F<=f) one-tail	0.170	0.345	0.310
F Critical one-tail	1.208	1.208	1.208
Reject H_0 ?	No	No	No

Existing AC pavement w/MRI < 166in./mile - IRI:

n = 307	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	109.81	122.11	115.96	102.55	119.38	110.97
Median (in./mile)	109.32	120.54	117.09	100.23	117.73	111.48
Standard Deviation	24.75	25.75	20.78	23.43	26.34	20.19
Minimum (in./mile)	45.67	58.29	55.34	45.67	54.40	53.29
Maximum (in./mile)	167.11	210.98	149.80	167.11	204.59	153.72

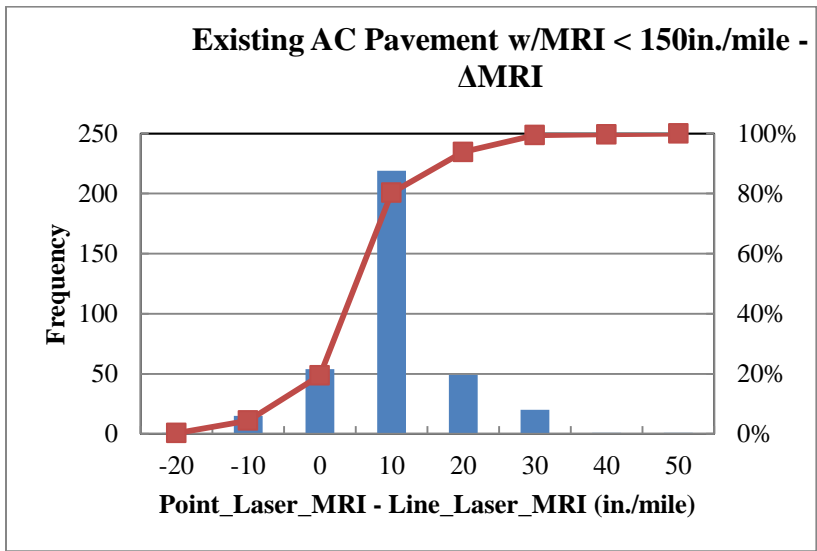
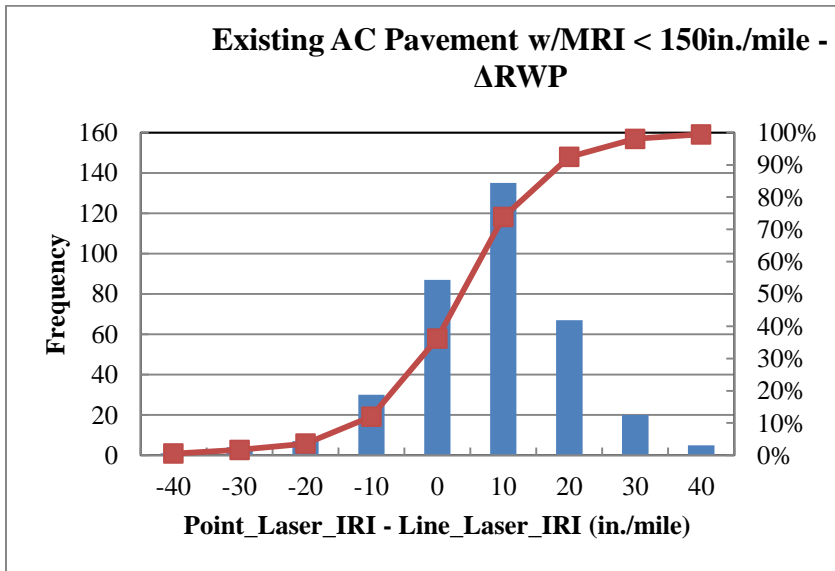
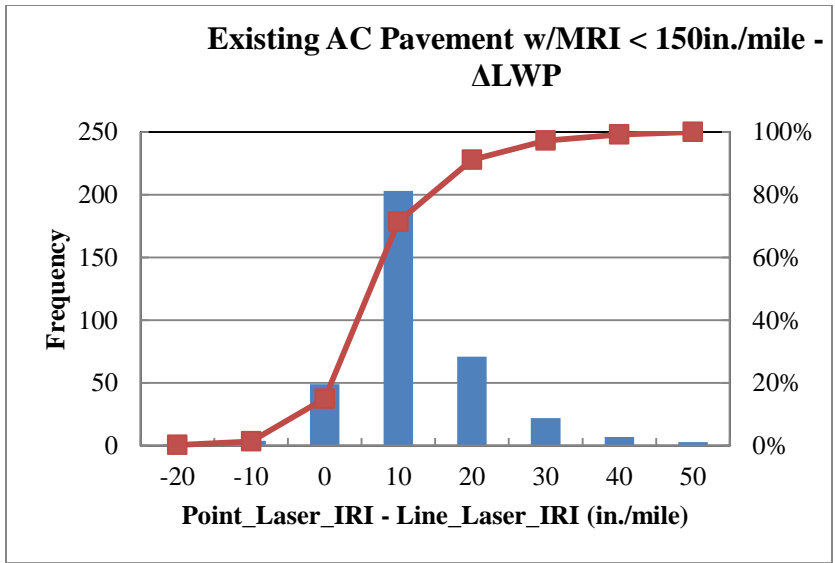






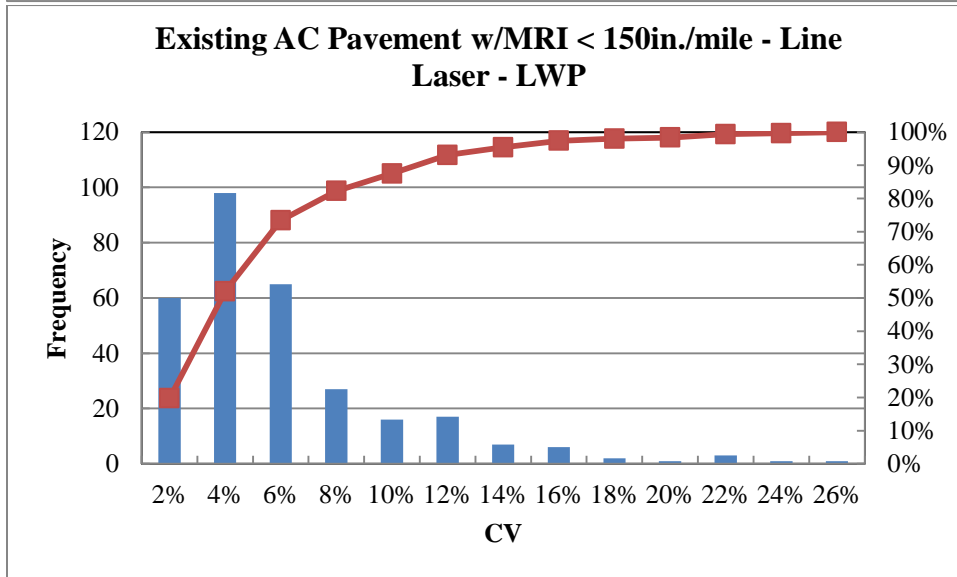
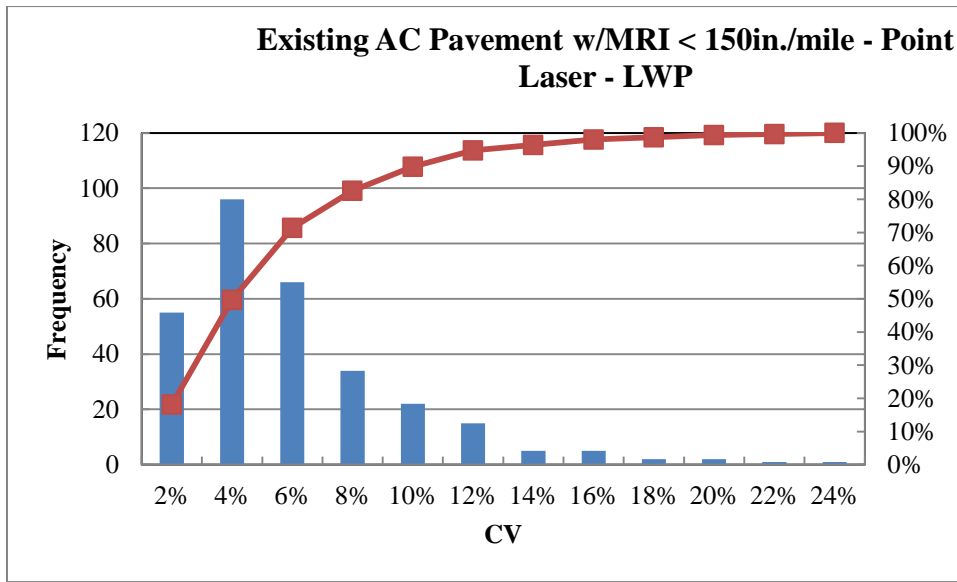
Existing AC pavement w/MRI < 150in./mile - (Point Laser IRI – Line Laser IRI):

n = 304	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	7.26	2.73	7.26
Median (in./mile)	5.96	2.81	5.96
Standard Deviation	9.20	11.91	9.20
Minimum (in./mile)	-29.70	-41.22	-29.70
Maximum (in./mile)	47.85	60.55	47.85

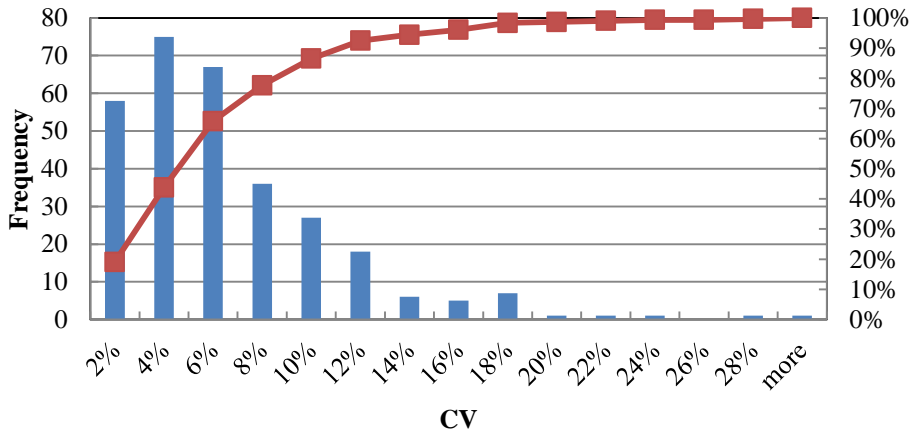


Existing AC pavement w/MRI < 150in./mile – Coefficient of Variation:

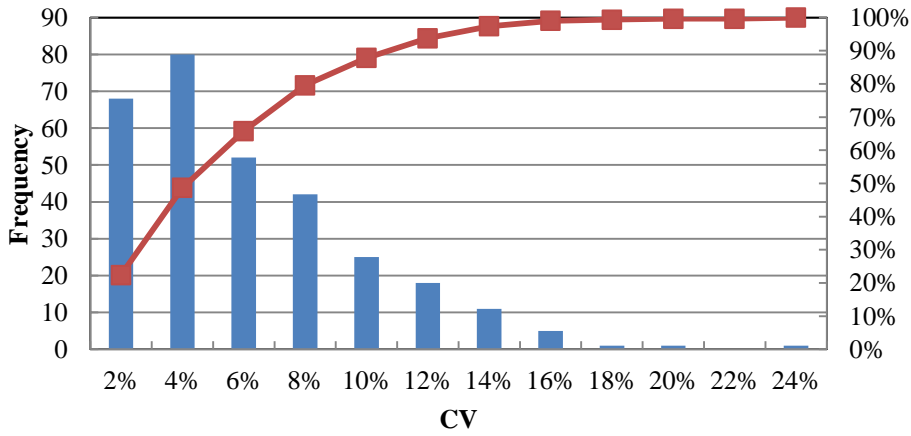
n = 304	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	5.02%	5.62%	5.02%	5.14%
Median	4.03%	4.59%	3.75%	4.09%
Standard Deviation	3.77%	4.58%	4.20%	3.77%
Minimum	0.15%	0.30%	0.19%	0.15%
Maximum	23.74%	36.08%	24.92%	22.27%

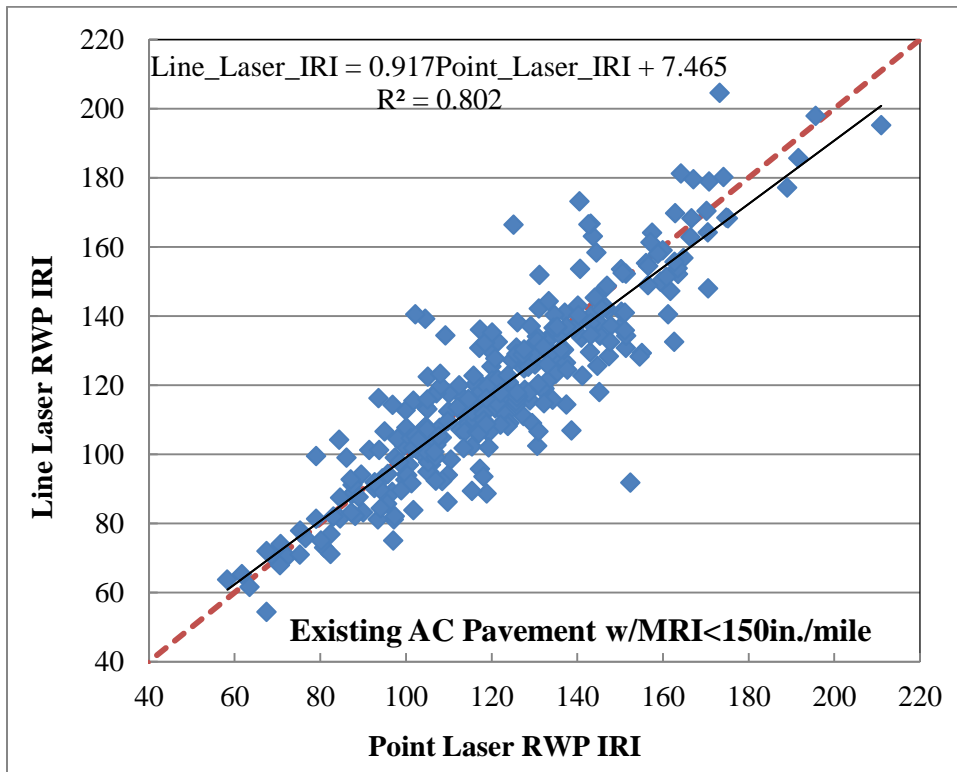
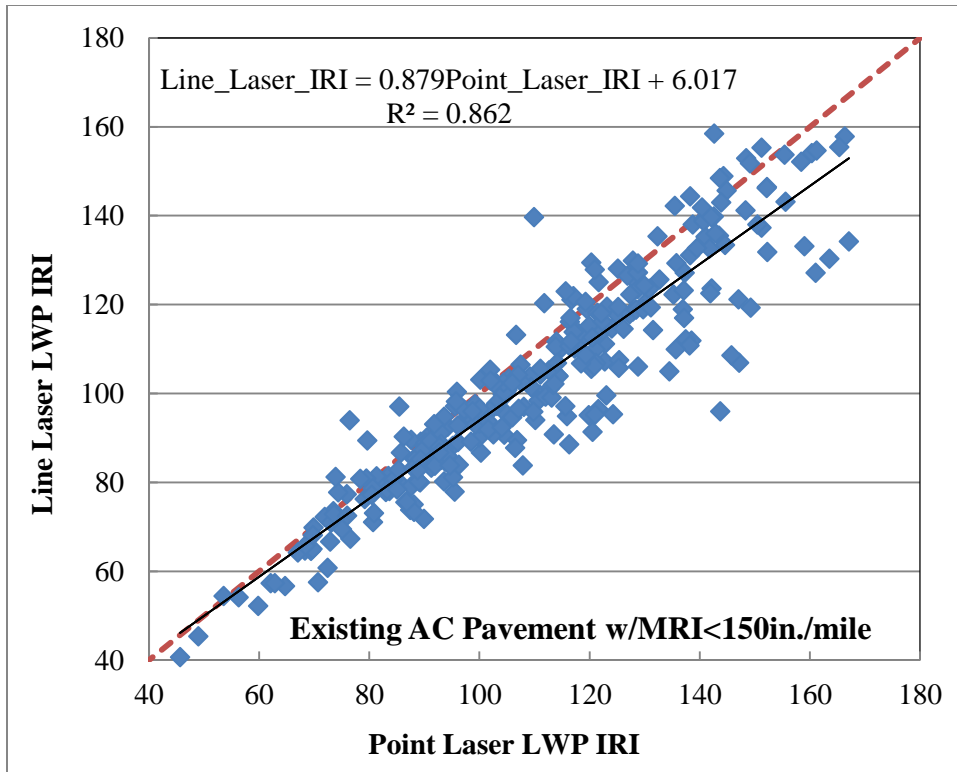


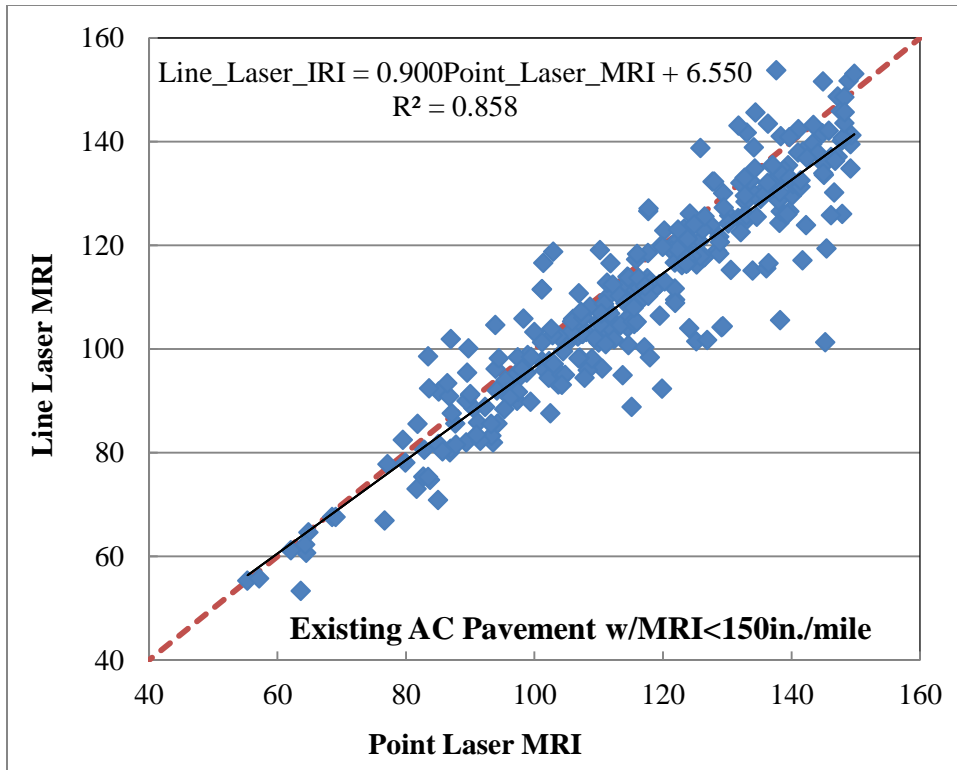
Existing AC Pavement w/MRI < 150in./mile - Point Laser - RWP



Existing AC Pavement w/MRI < 150in./mile - Line Laser - RWP







Newly Overlaid AC pavement - All Data - Paired t-test:

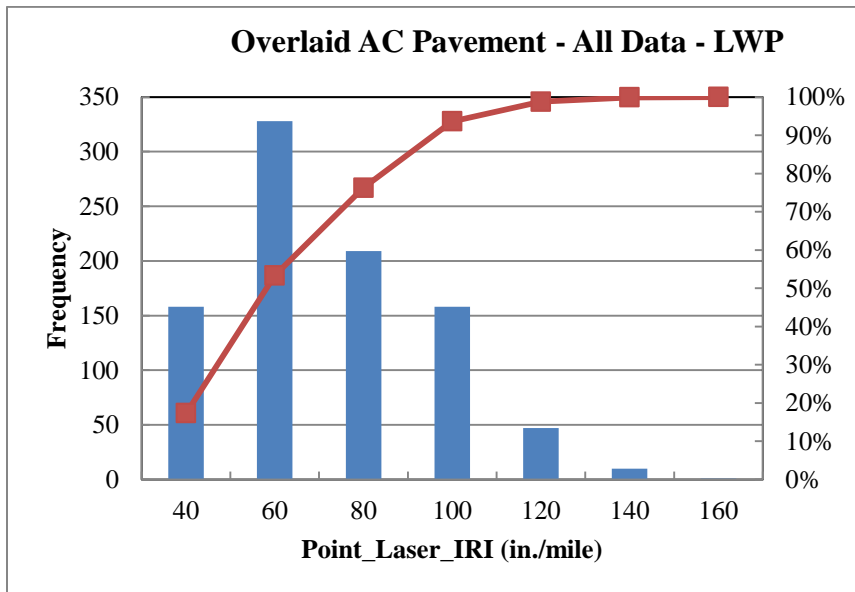
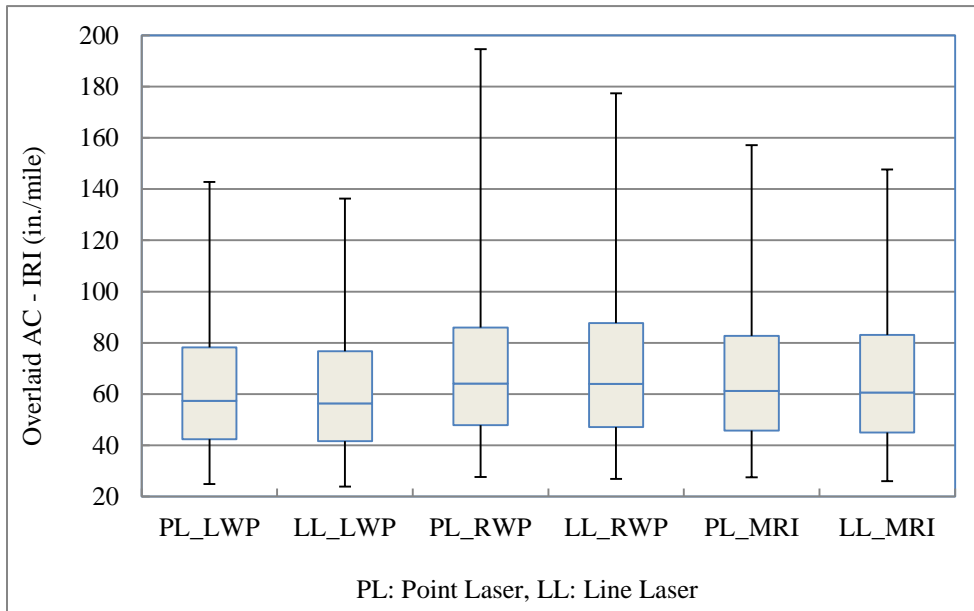
df = 913	LWP	RWP	MRI
t Stat	11.055	-3.543	3.392
P(T<=t) one-tail	0.000	0.000	0.000
t Critical one-tail	1.646	1.646	1.646
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.962	1.962	1.962
Reject H_0 ?	Yes	Yes	Yes

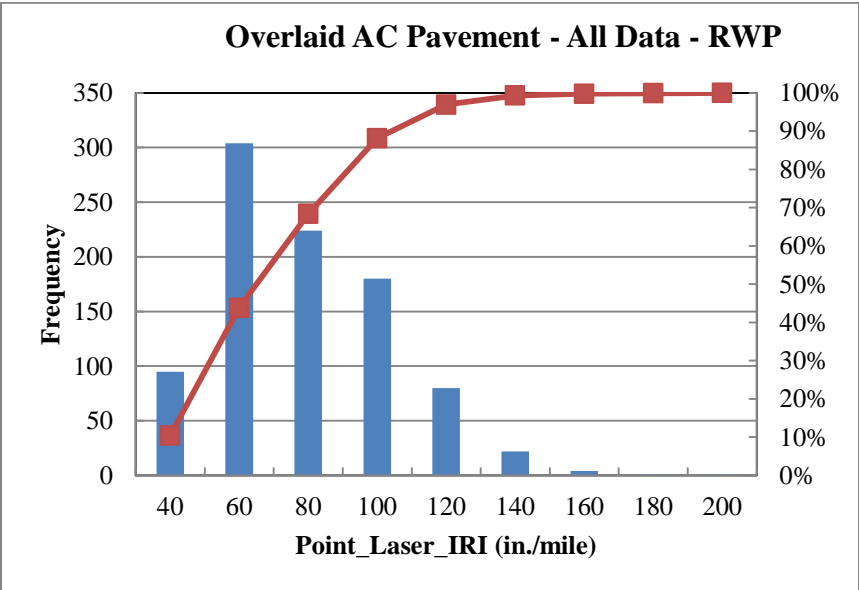
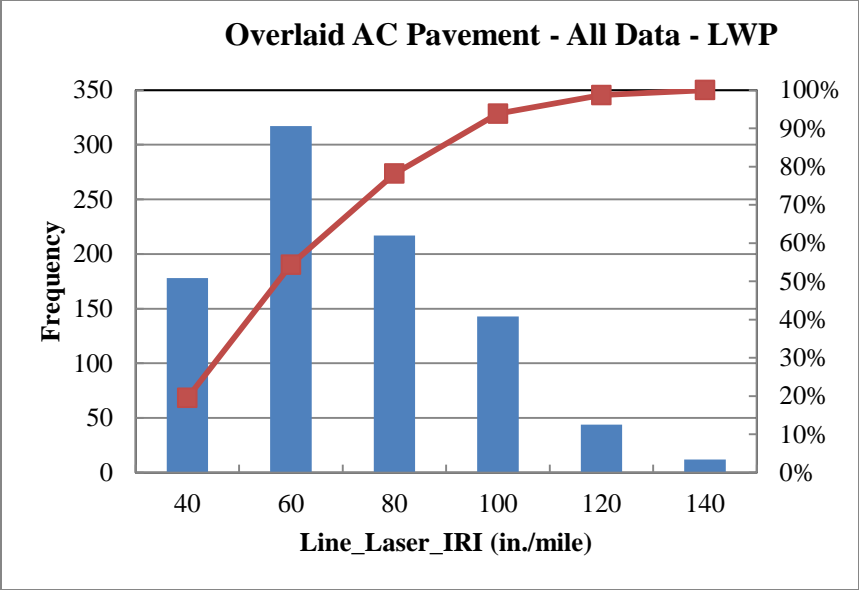
Newly Overlaid AC pavement - All Data - F-test:

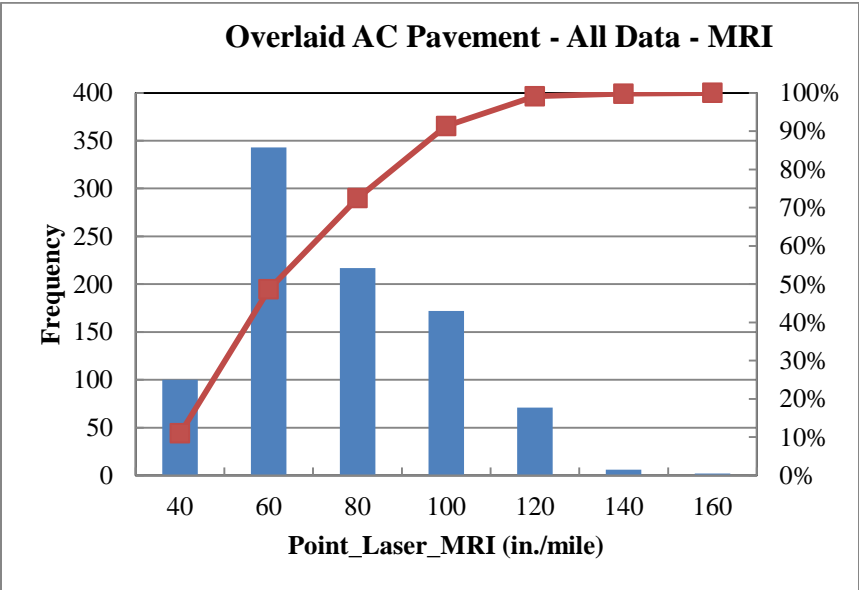
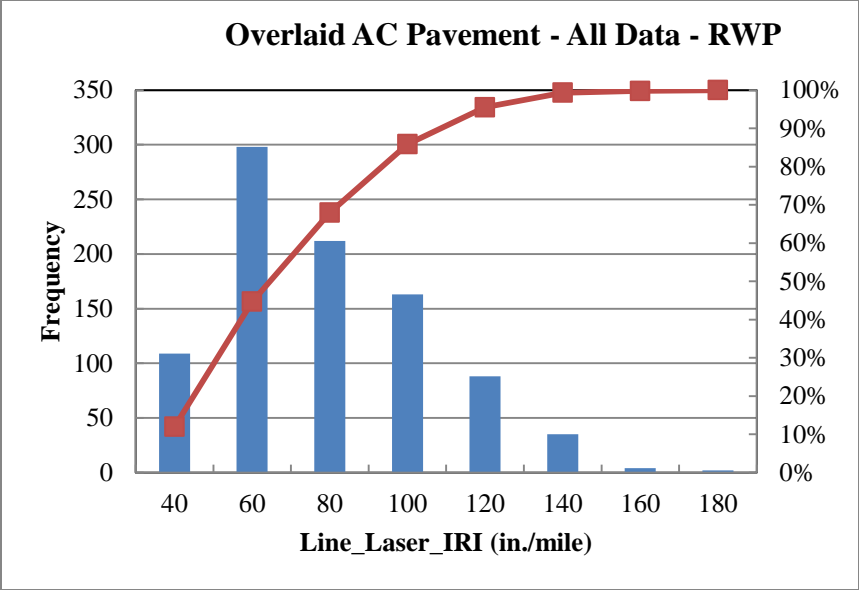
df = 913	LWP	RWP	MRI
F	1.001	1.118	1.004
P(F<=f) one-tail	0.496	0.046	0.190
F Critical one-tail	1.115	1.115	1.115
Reject H_0 ?	No	No	No

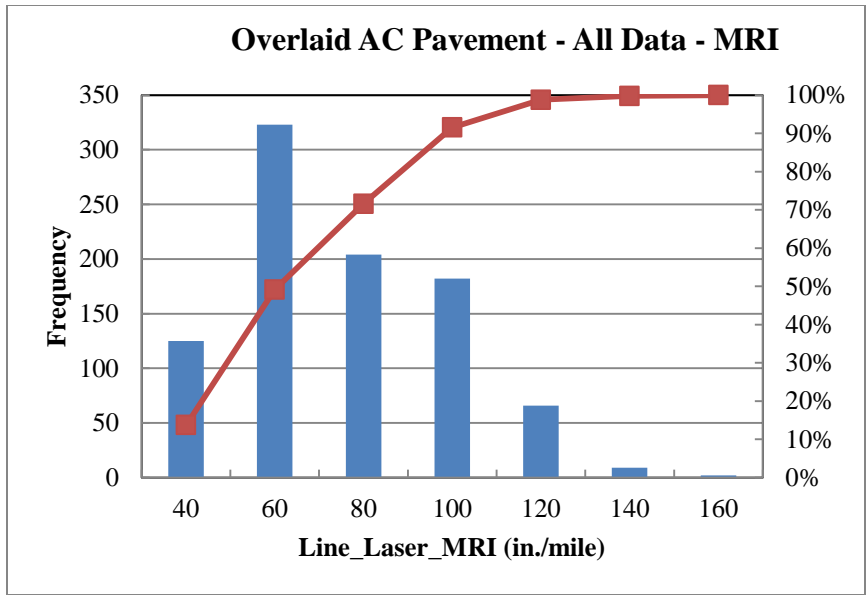
Newly Overlaid AC pavement - All Data - IRI:

n = 914	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	62.35	68.63	65.49	61.35	69.09	65.22
Median (in./mile)	57.39	64.13	61.28	56.33	64.01	60.58
Standard Deviation	22.82	25.05	22.88	22.73	26.49	23.50
Minimum (in./mile)	24.92	27.69	27.50	24.92	27.69	25.96
Maximum (in./mile)	142.76	194.60	157.18	142.76	194.60	147.68



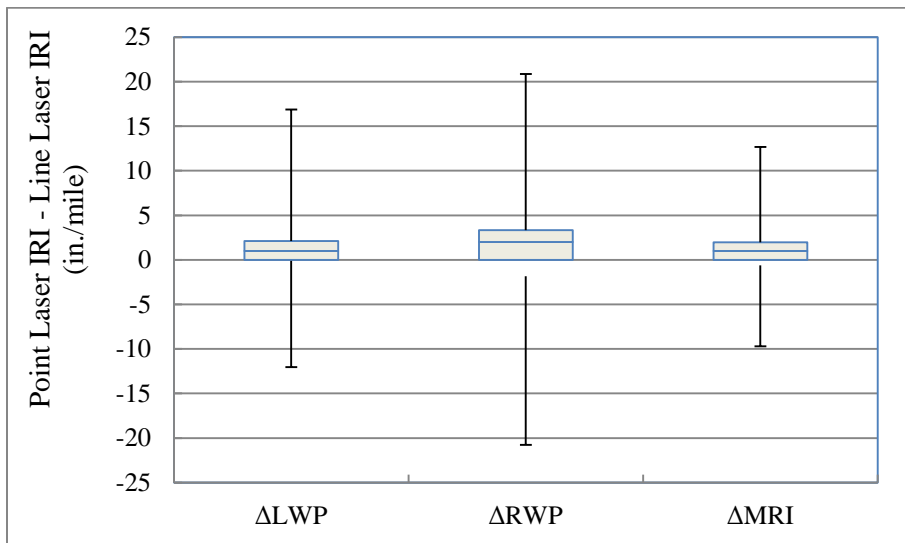


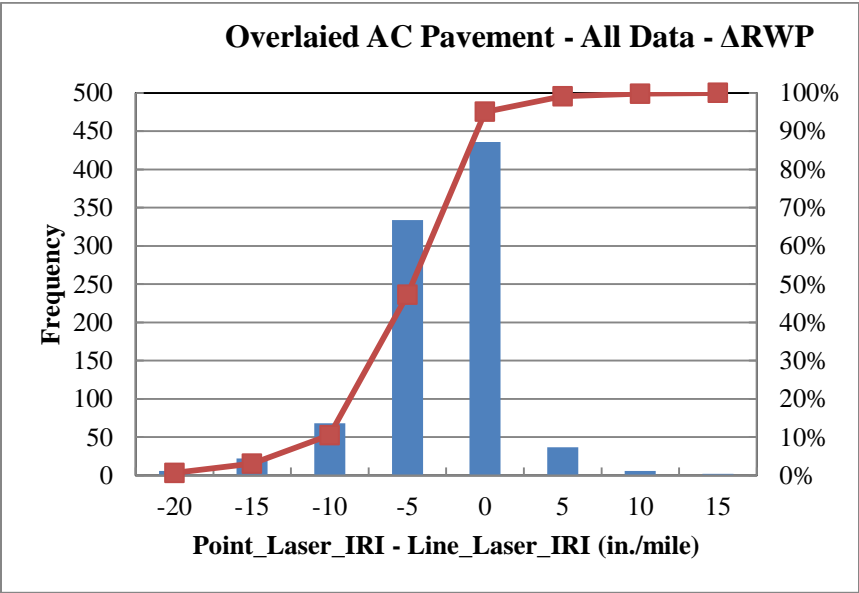
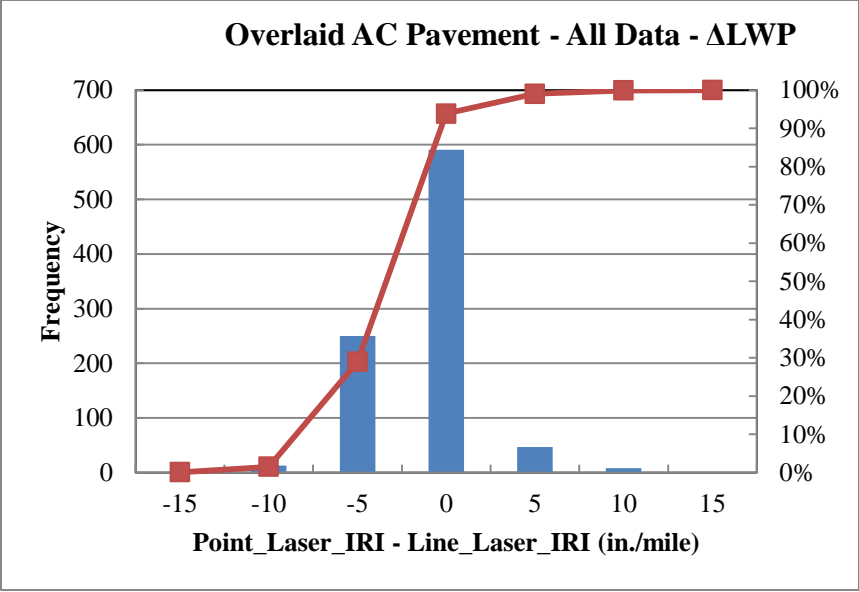


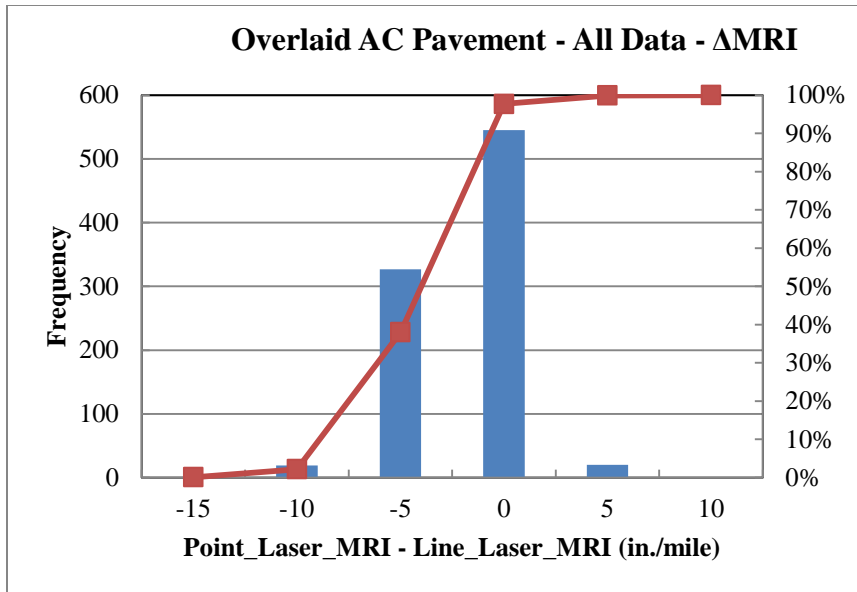


Newly Overlaid AC pavement - All Data - (Point Laser IRI – Line Laser IRI):

n = 914	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	1.00	-0.46	0.27
Median (in./mile)	0.87	0.15	0.37
Standard Deviation	2.61	4.03	2.18
Minimum (in./mile)	-12.04	-20.78	-9.72
Maximum (in./mile)	16.75	19.02	12.05

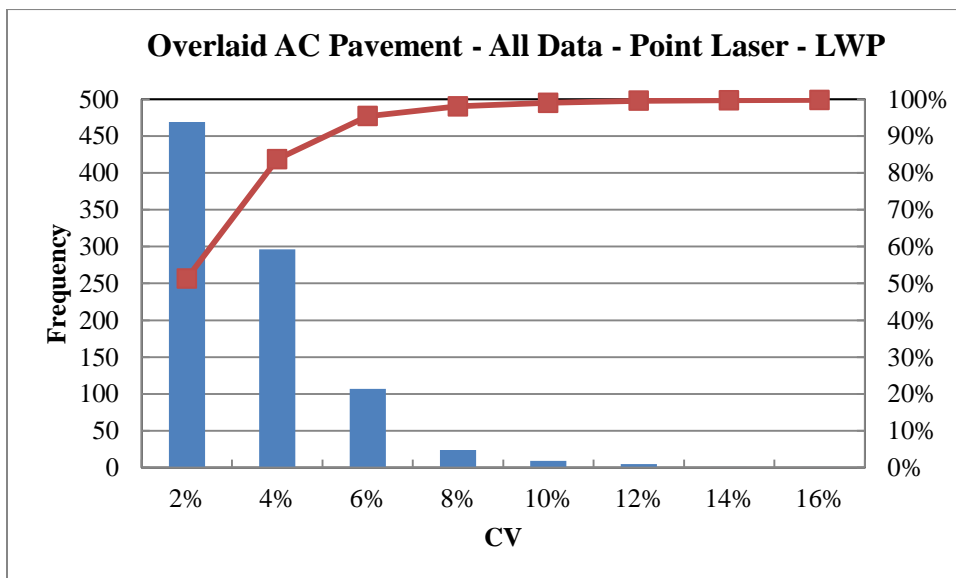


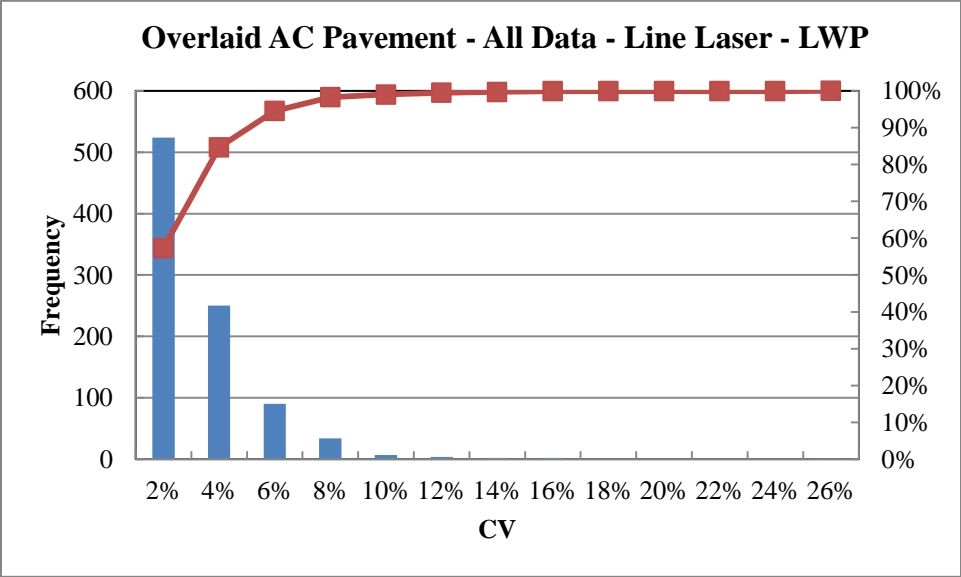
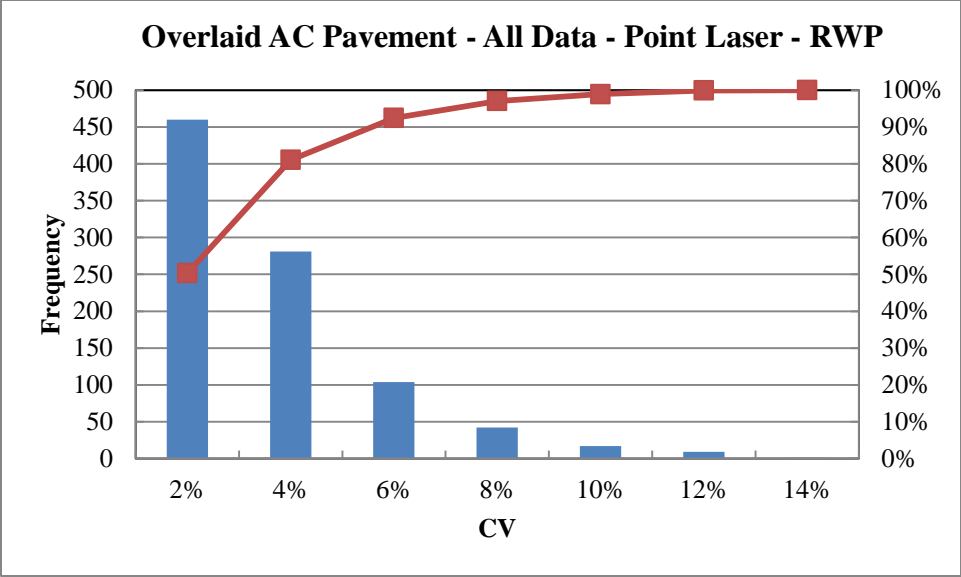


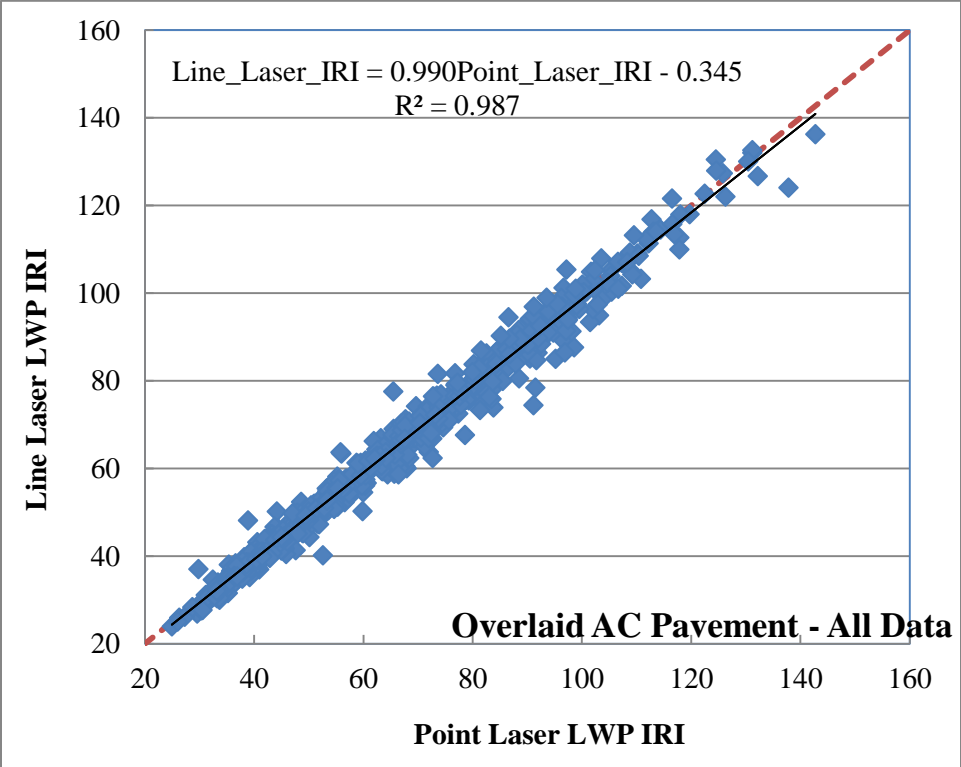
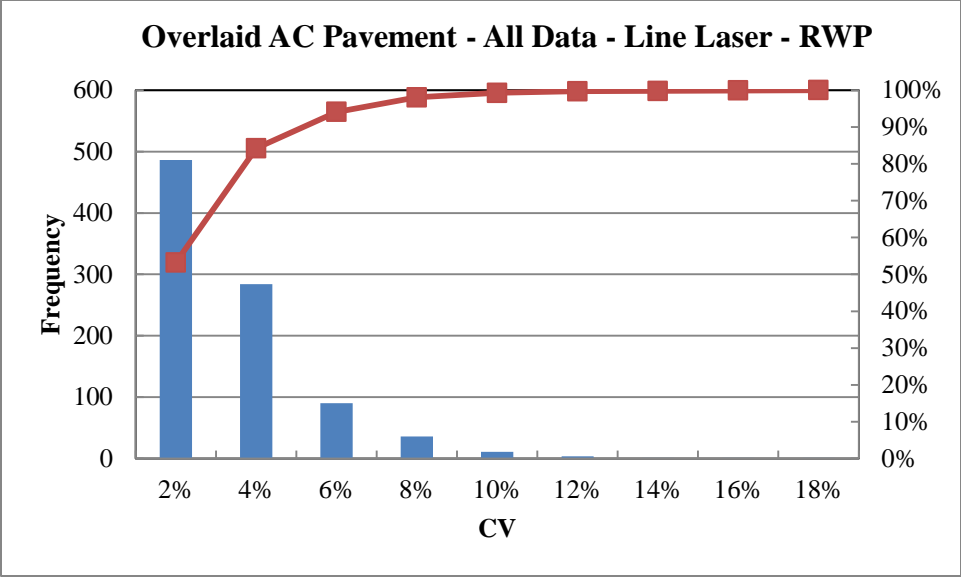


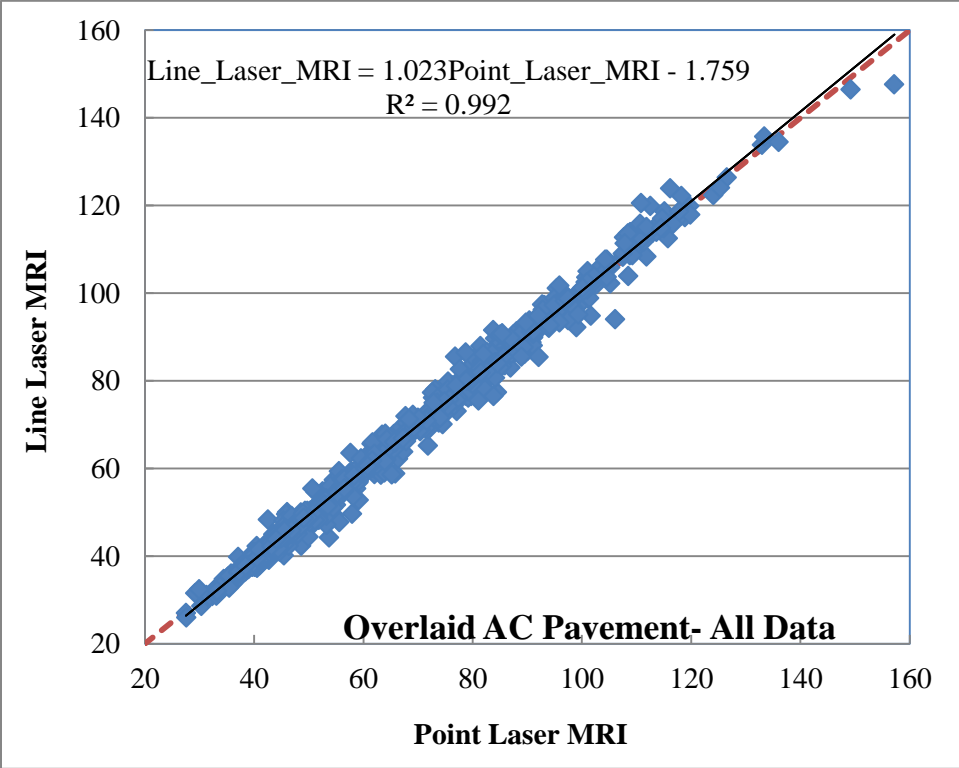
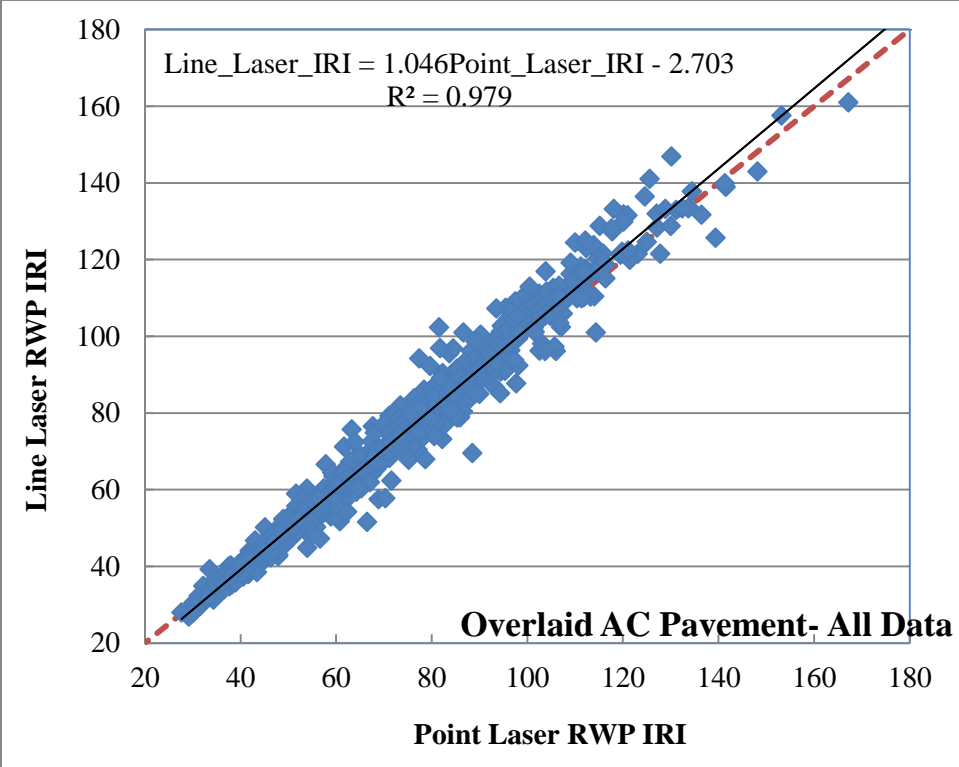
Overlaid AC pavement - All Data - Coefficient of Variation:

n = 914	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	2.46%	2.62%	2.33%	2.39%
Median	1.96%	1.98%	1.72%	1.88%
Standard Deviation	2.09%	2.05%	2.11%	1.97%
Minimum	0.04%	0.04%	0.04%	0.10%
Maximum	25.57%	13.14%	25.68%	16.96%









For overlaid pavement w/MRI < 110in/mile

Newly Overlaid AC pavement w/MRI < 110in/mile - Paired t-test:

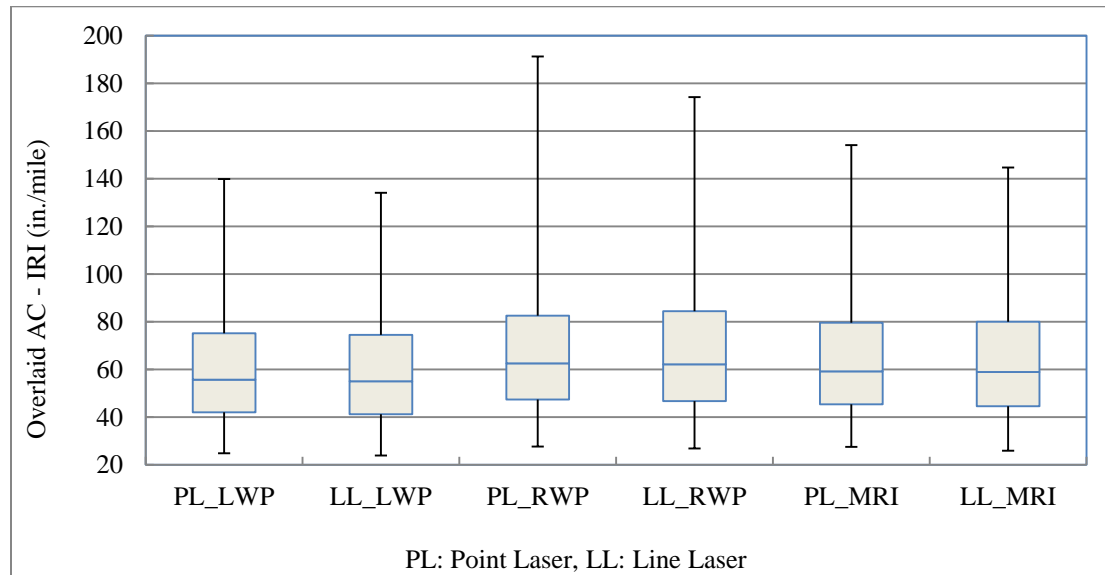
df = 871	LWP	RWP	MRI
t Stat	11.597	-2.318	4.949
P(T<=t) one-tail	0.000	0.010	0.000
t Critical one-tail	1.647	1.647	1.647
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.963	1.963	1.963
Reject H_0 ?	Yes	Yes	Yes

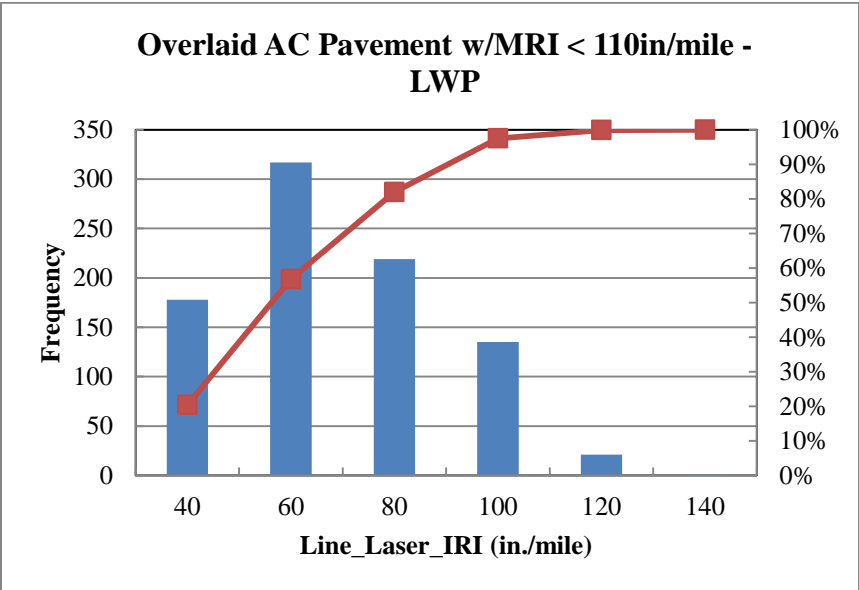
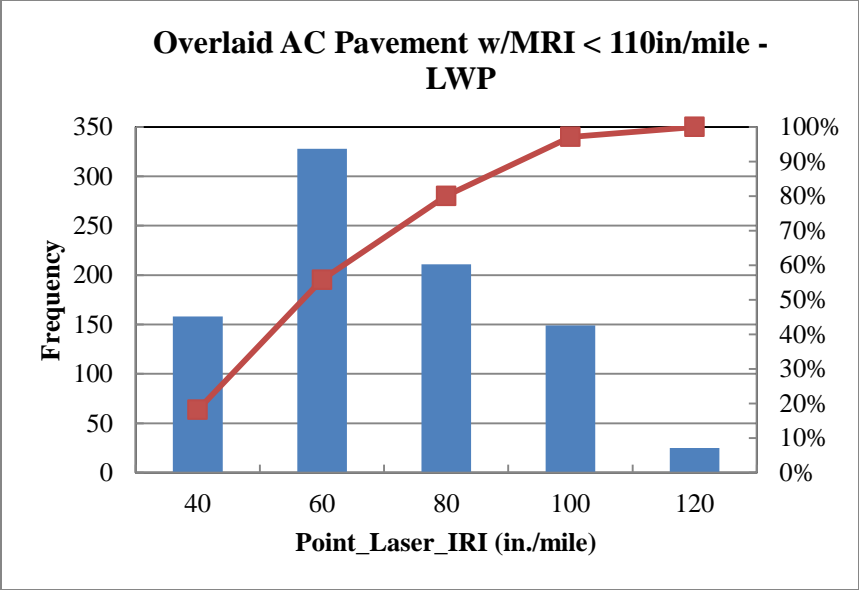
Newly Overlaid AC pavement w/MRI < 110in/mile - F-test:

df = 871	LWP	RWP	MRI
F	1.006	1.005	1.006
P(F<=f) one-tail	0.464	0.036	0.208
F Critical one-tail	1.118	1.118	1.118
Reject H_0 ?	No	No	No

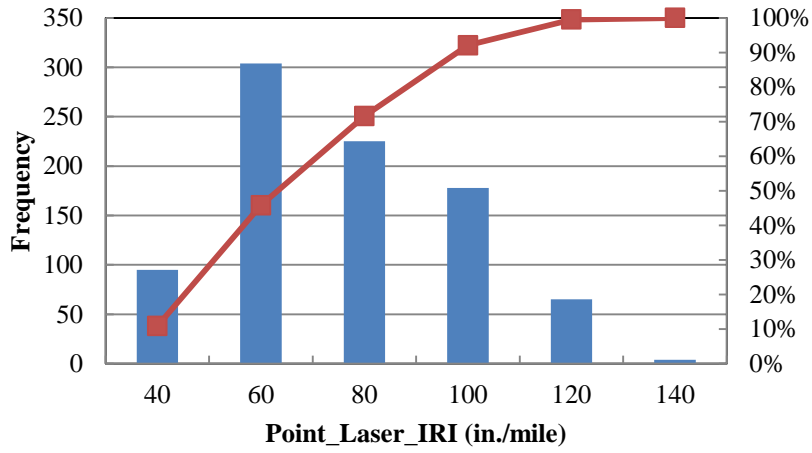
Newly Overlaid AC pavement w/MRI < 110in/mile - IRI:

n = 871	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	59.95	65.89	62.92	58.96	66.19	62.57
Median (in./mile)	55.66	62.55	59.19	55.01	62.17	58.88
Standard Deviation	20.36	21.95	20.09	20.29	23.33	20.66
Minimum (in./mile)	24.92	27.69	27.50	24.92	27.69	25.96
Maximum (in./mile)	118.02	139.43	109.23	118.02	139.43	109.06

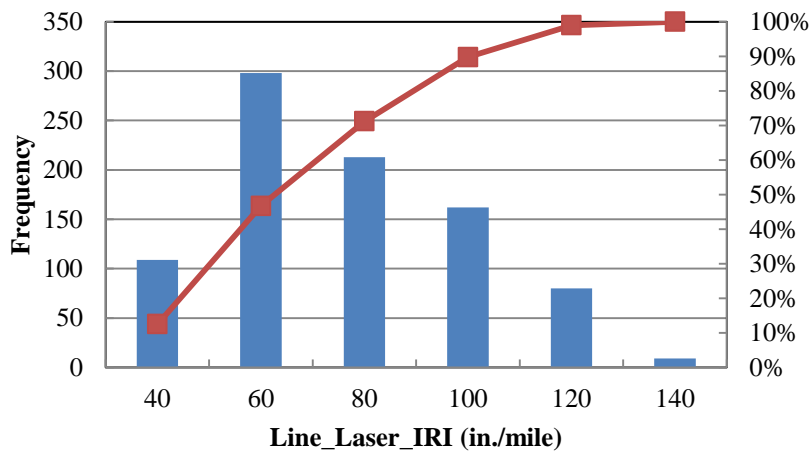


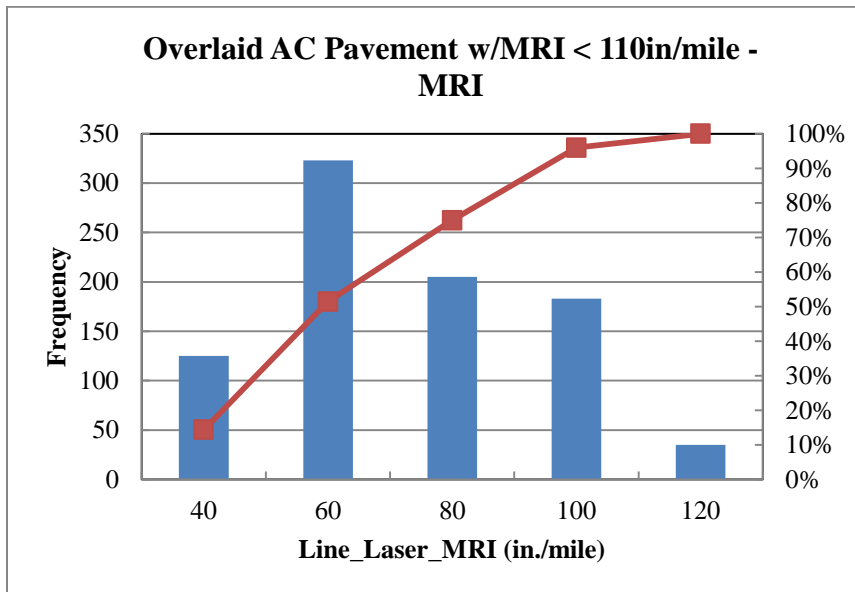
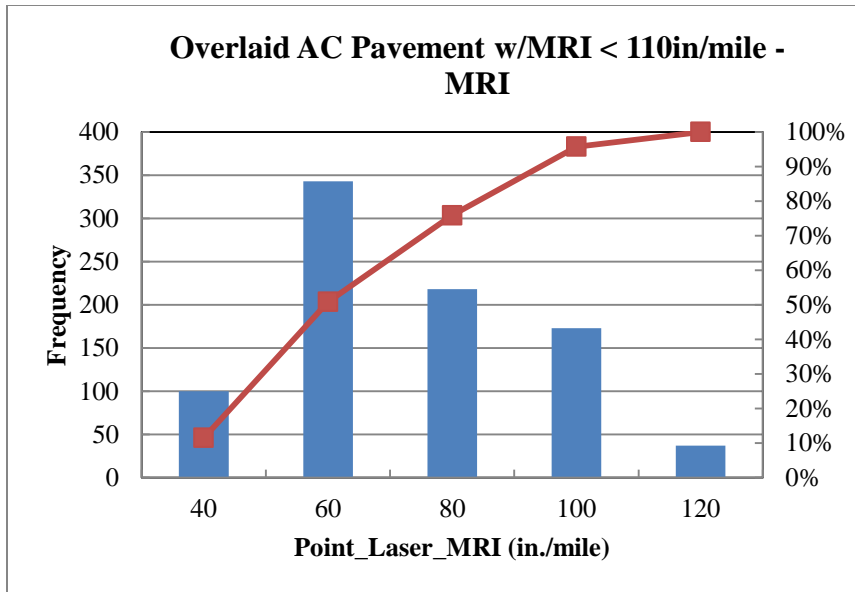


Overlaid AC Pavement w/MRI < 110in/mile - RWP



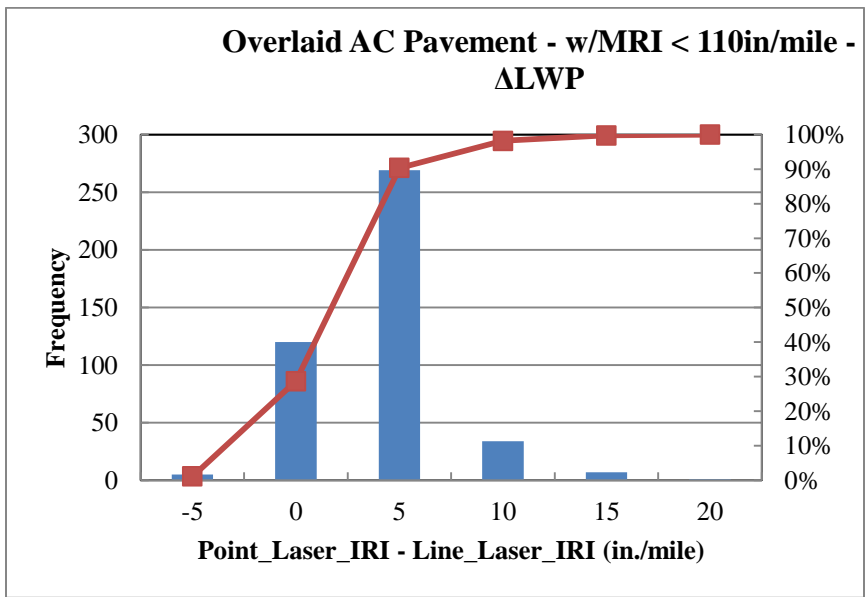
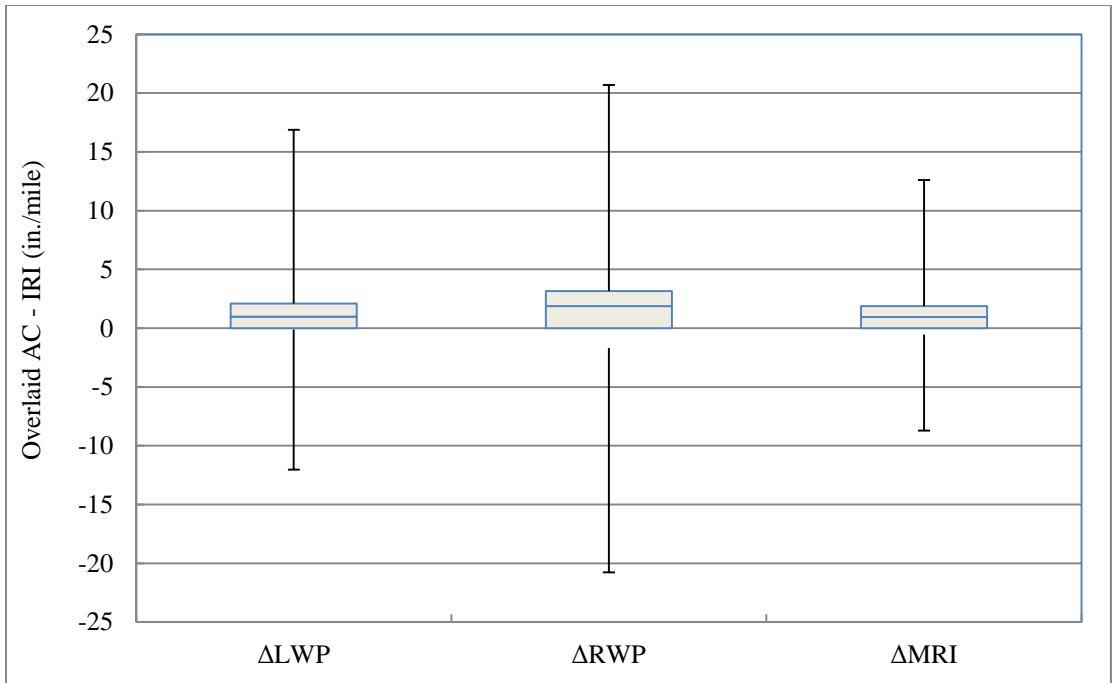
Overlaid AC Pavement w/MRI < 110in/mile - RWP

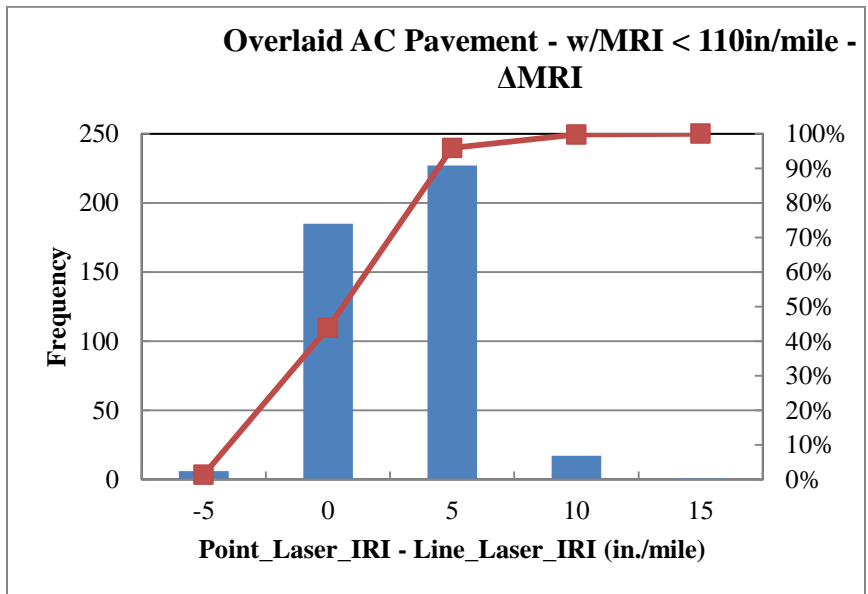
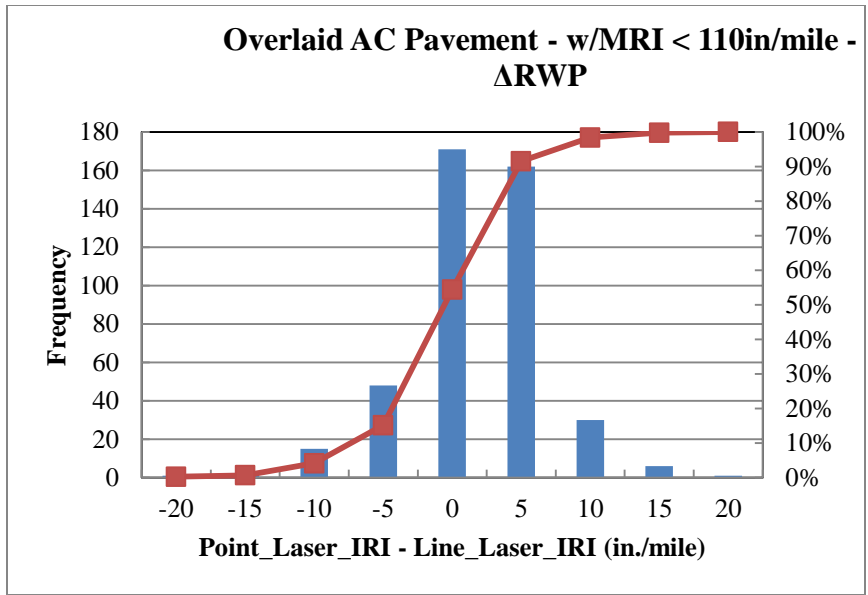




Newly Overlaid AC pavement - w/MRI < 110in/mile - (Point Laser IRI – Line Laser IRI):

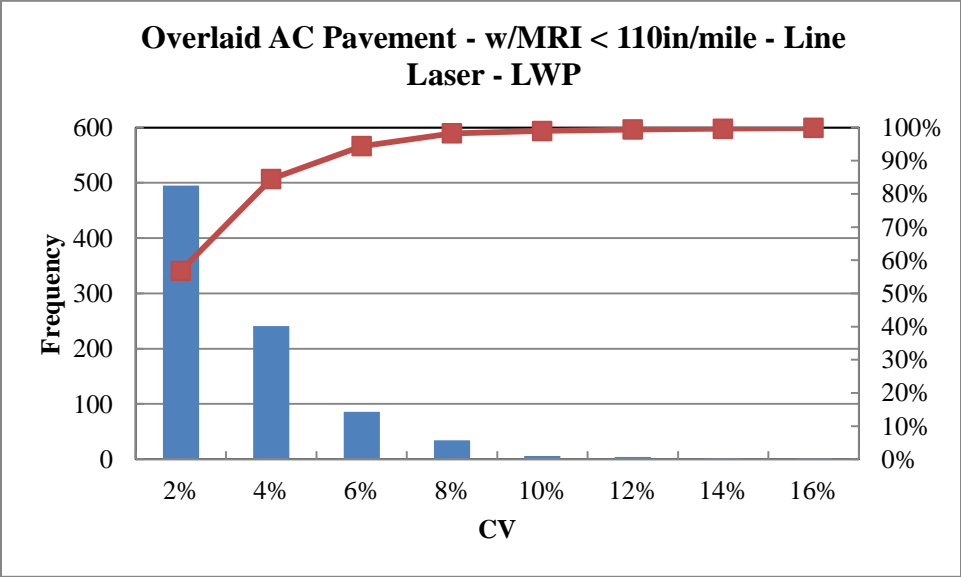
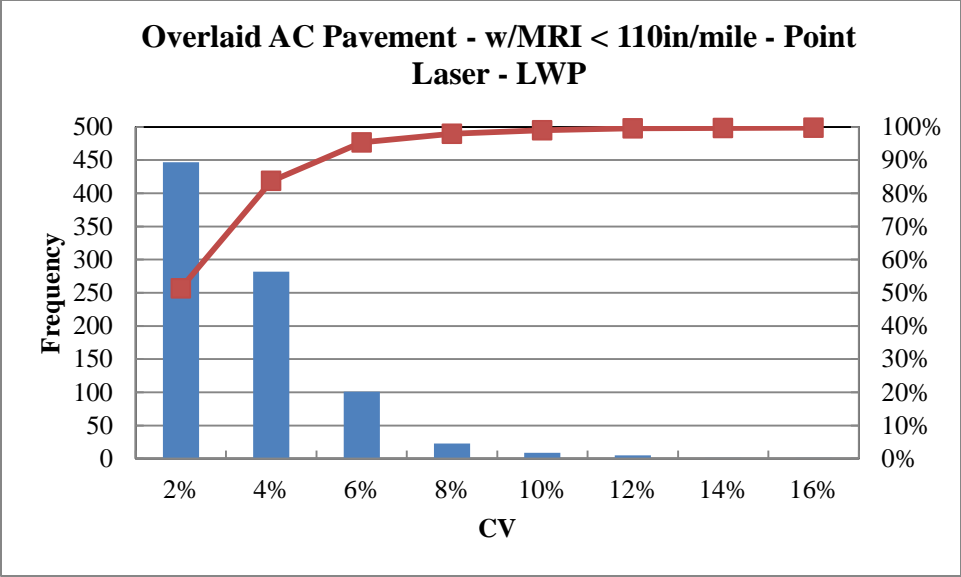
n = 871	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	0.99	-0.30	0.35
Median (in./mile)	0.87	0.19	0.42
Standard Deviation	2.53	3.78	2.08
Minimum (in./mile)	-12.04	-20.78	-8.70
Maximum (in./mile)	16.75	19.02	12.05

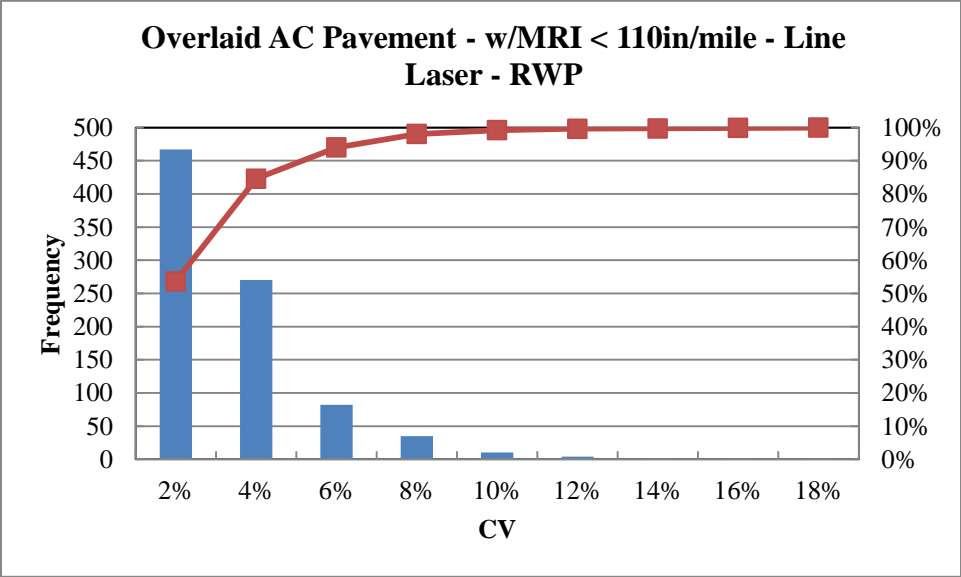
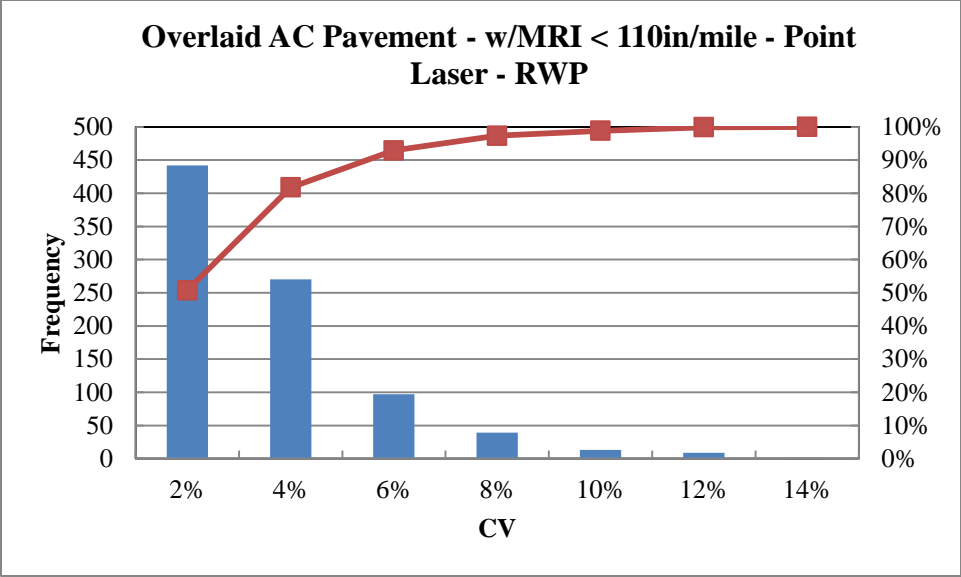


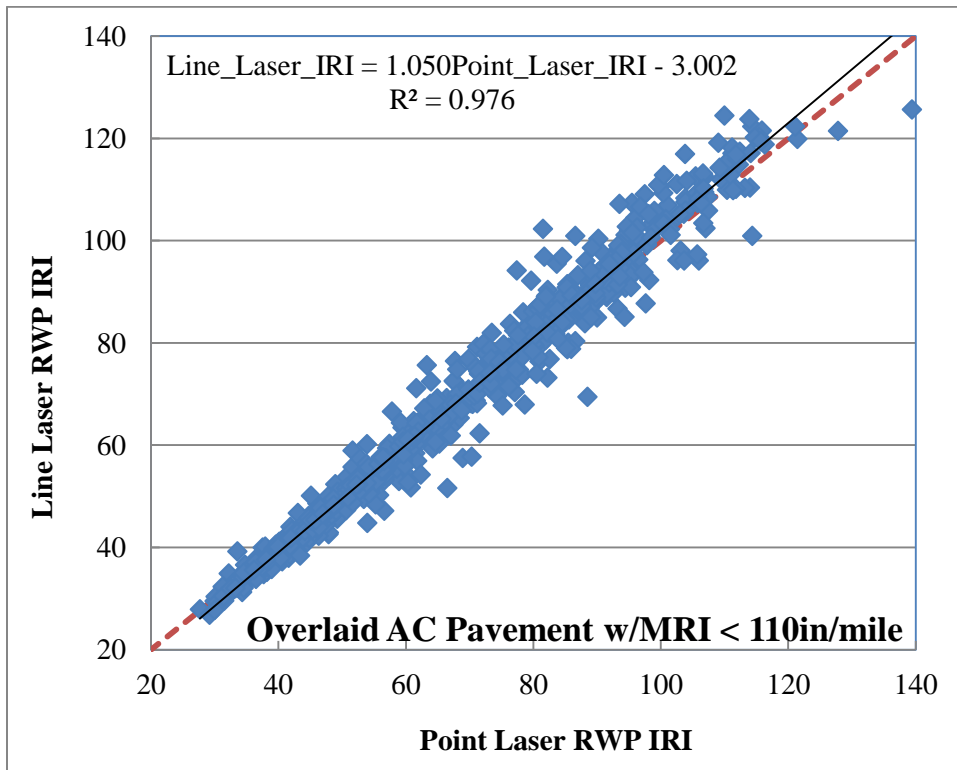
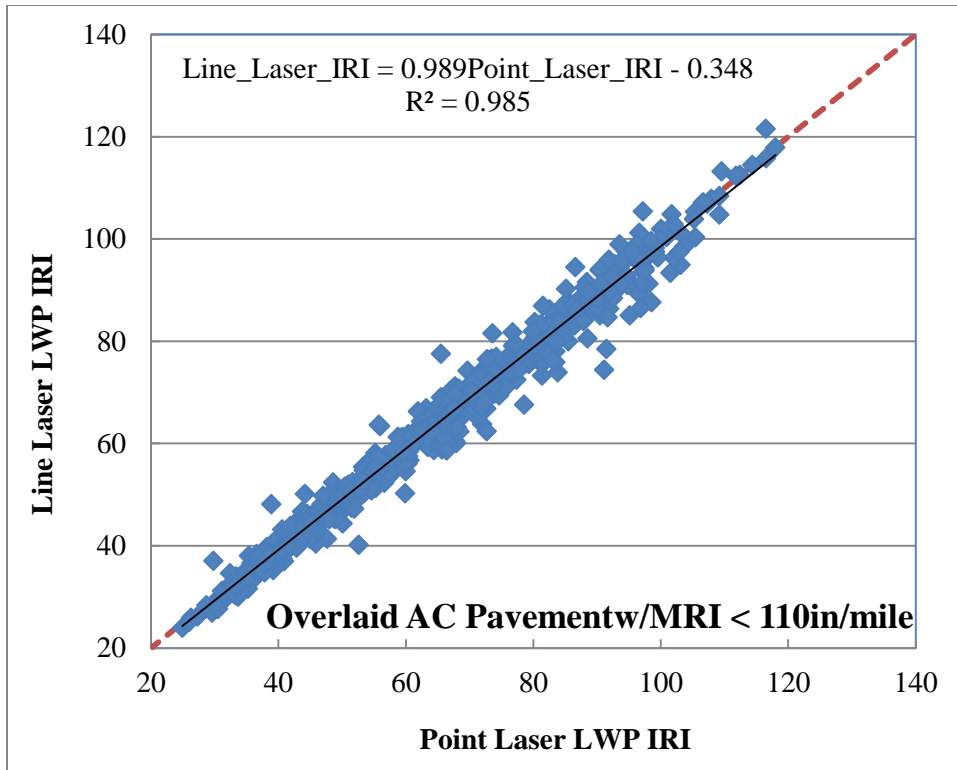


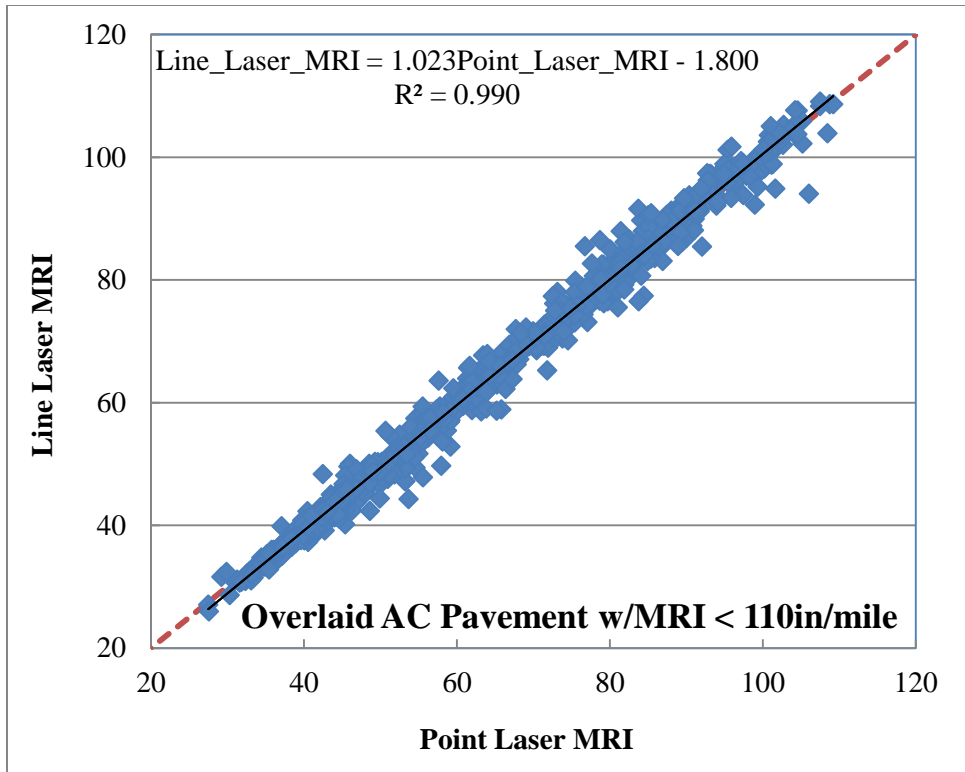
Overlaid AC pavement - w/MRI < 110in/mile - Coefficient of Variation:

n = 871	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	2.47%	2.59%	2.35%	2.38%
Median	1.95%	1.97%	1.74%	1.87%
Standard Deviation	2.12%	2.03%	2.13%	1.97%
Minimum	0.04%	0.04%	0.04%	0.10%
Maximum	25.57%	13.14%	25.68%	16.96%









For overlaid pavement w/MRI < 80in/mile

Newly Overlaid AC pavement - w/MRI < 80in/mile -paired t-test:

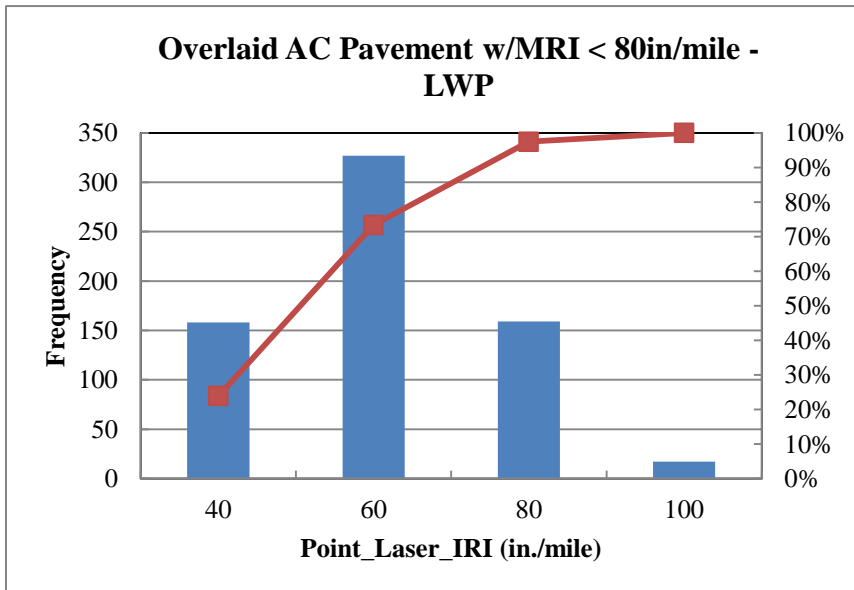
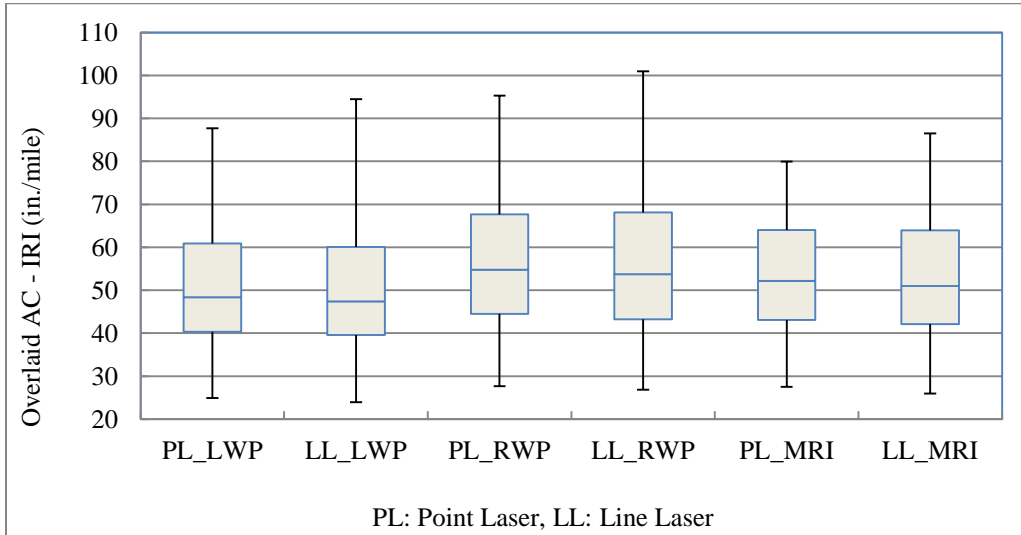
df = 660	LWP	RWP	MRI
t Stat	10.672	2.089	7.913
P(T<=t) one-tail	0.000	0.019	0.000
t Critical one-tail	1.647	1.647	1.647
P(T<=t) two-tail	0.000	0.037	0.000
t Critical two-tail	1.964	1.964	1.964
Reject <i>H</i> ₀ ?	Yes	Yes	Yes

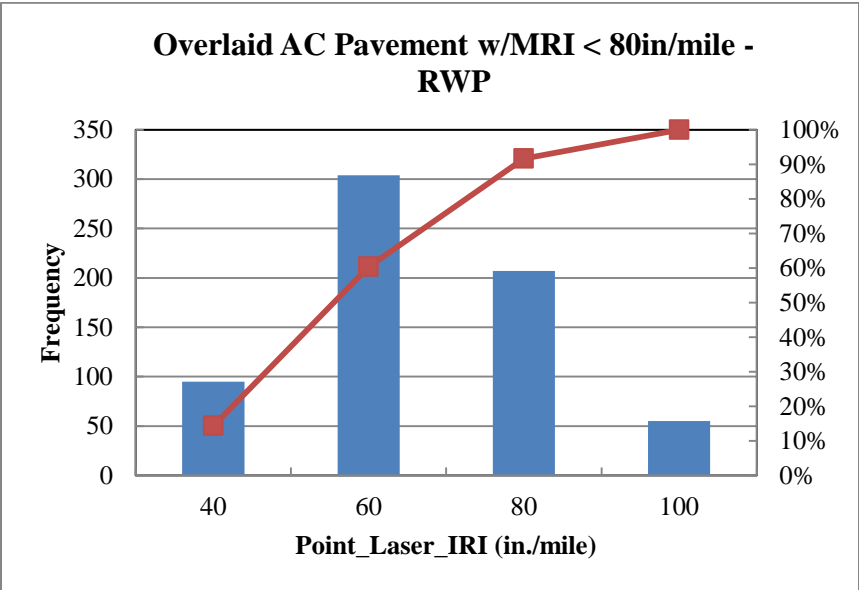
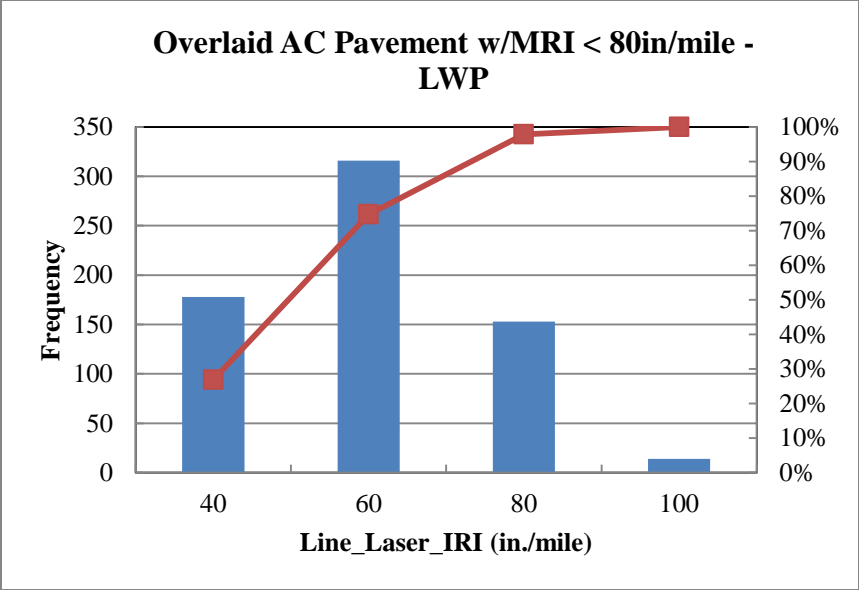
Newly Overlaid AC pavement - w/MRI < 80in/mile - F-test:

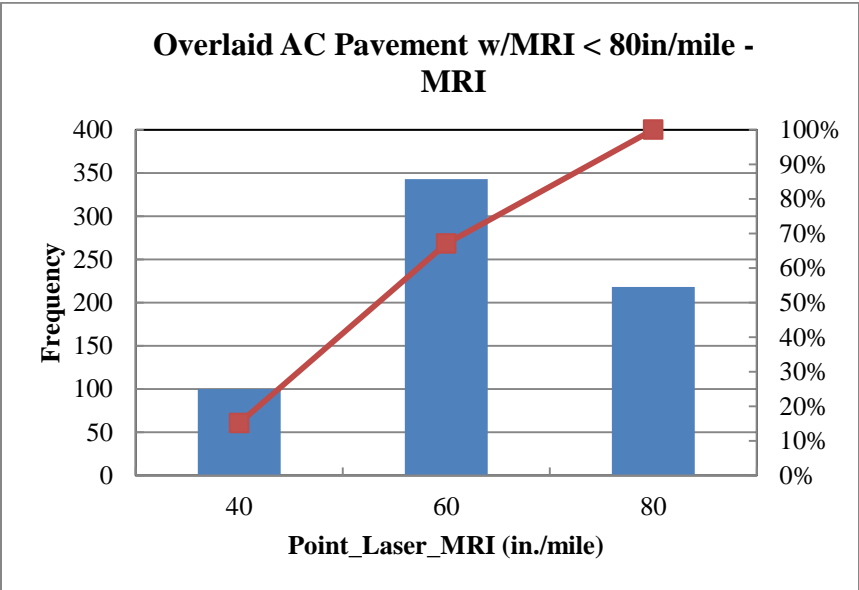
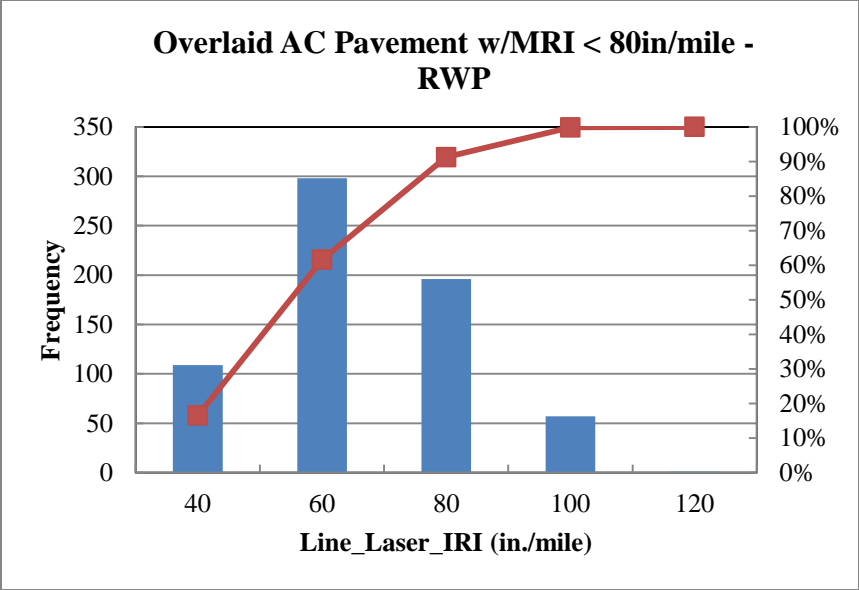
df = 660	LWP	RWP	MRI
F	1.001	1.004	1.011
P(F<=f) one-tail	0.496	0.058	0.190
F Critical one-tail	1.115	1.137	1.137
Reject <i>H</i> ₀ ?	No	No	No

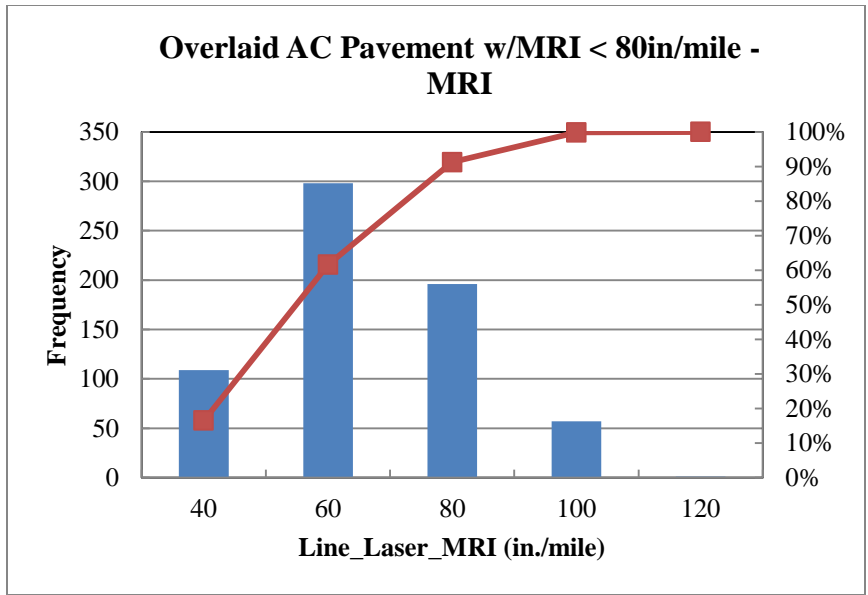
Newly Overlaid AC pavement - w/MRI < 80in/mile - All Data - IRI:

n = 661	Point Laser IRI			Line Laser IRI		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	51.22	56.57	53.90	50.34	56.32	53.33
Median (in./mile)	48.37	54.77	52.18	47.43	53.76	51.01
Standard Deviation	13.76	15.16	13.29	13.86	16.12	13.76
Minimum (in./mile)	24.92	27.69	27.50	24.92	27.69	25.96
Maximum (in./mile)	87.67	95.31	79.97	87.67	95.31	86.48



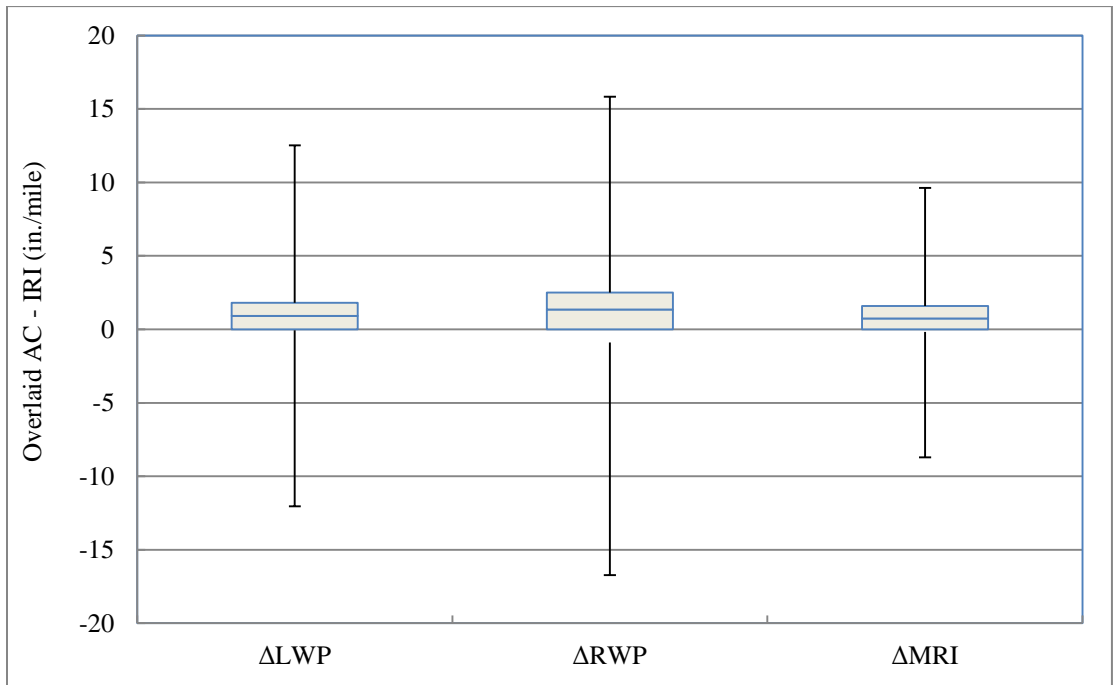


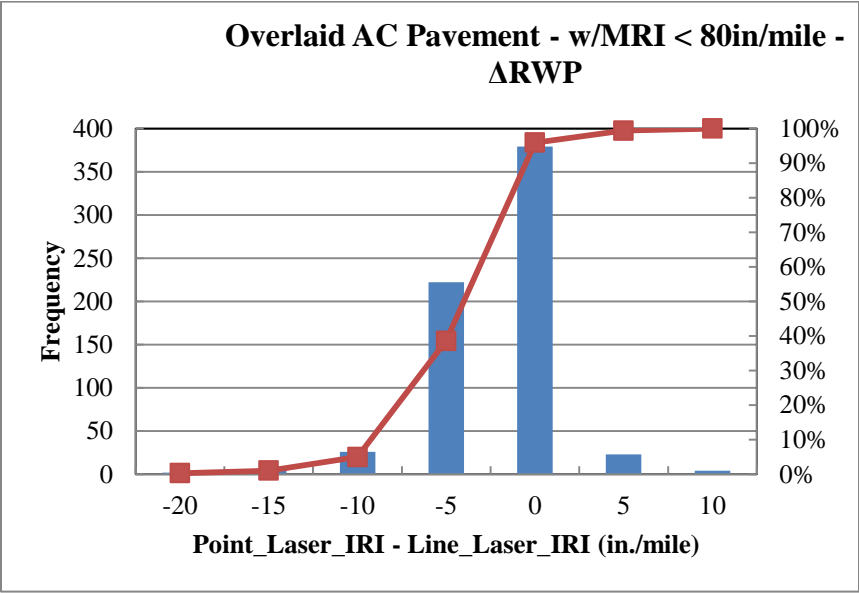
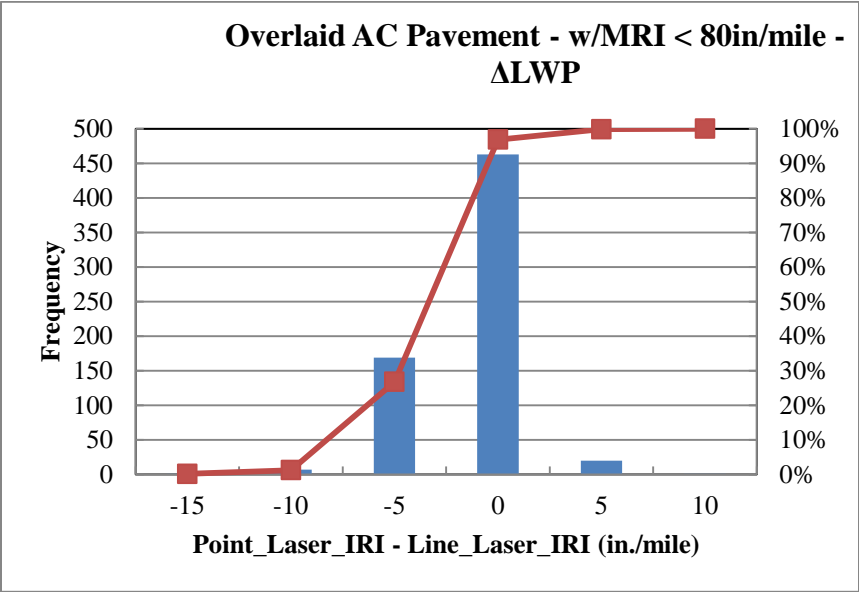


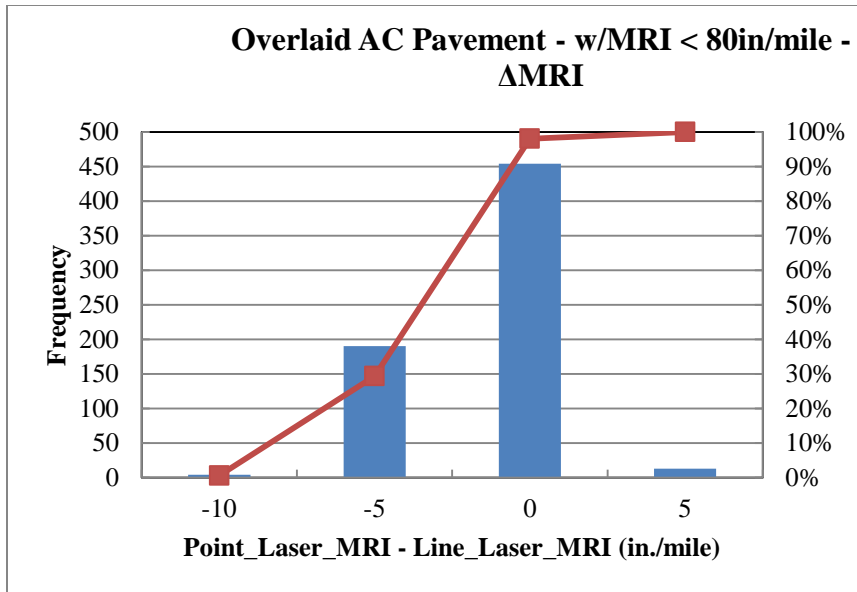


Newly Overlaid AC pavement – w/MRI < 80in./mile - (Point Laser IRI – Line Laser IRI):

n = 661	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	0.88	0.25	0.57
Median (in./mile)	0.86	0.47	0.58
Standard Deviation	2.12	3.11	1.84
Minimum (in./mile)	-12.04	-16.73	-8.70
Maximum (in./mile)	12.46	14.94	9.46

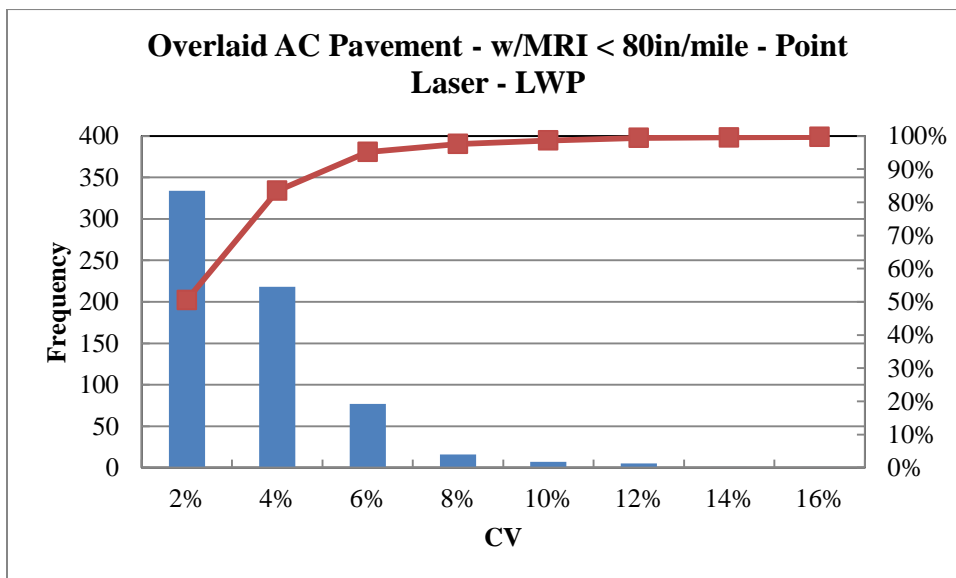


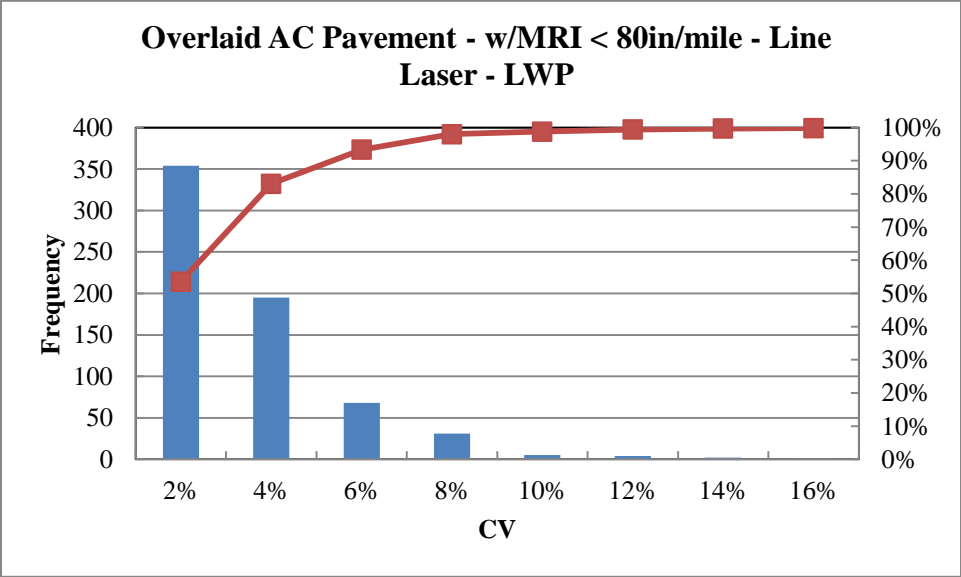
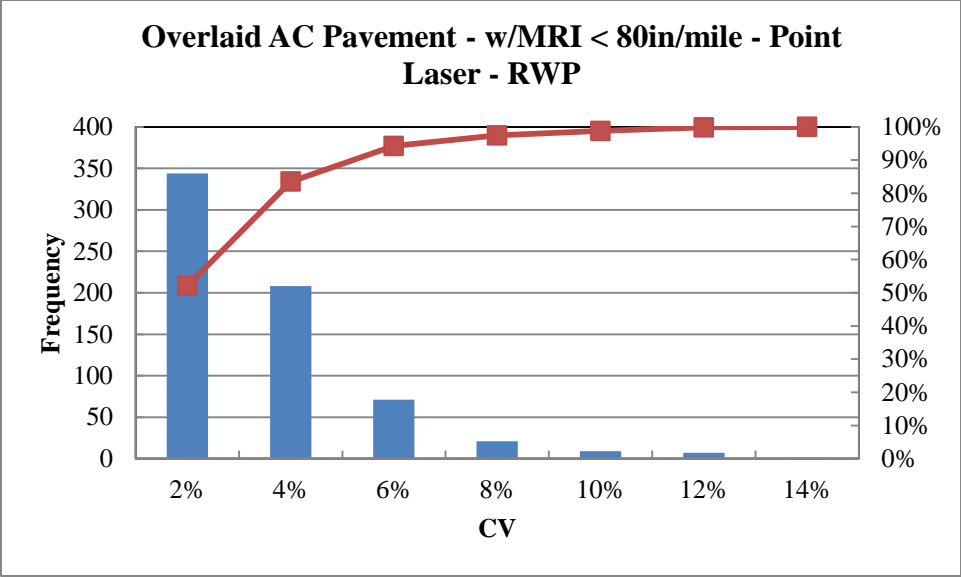


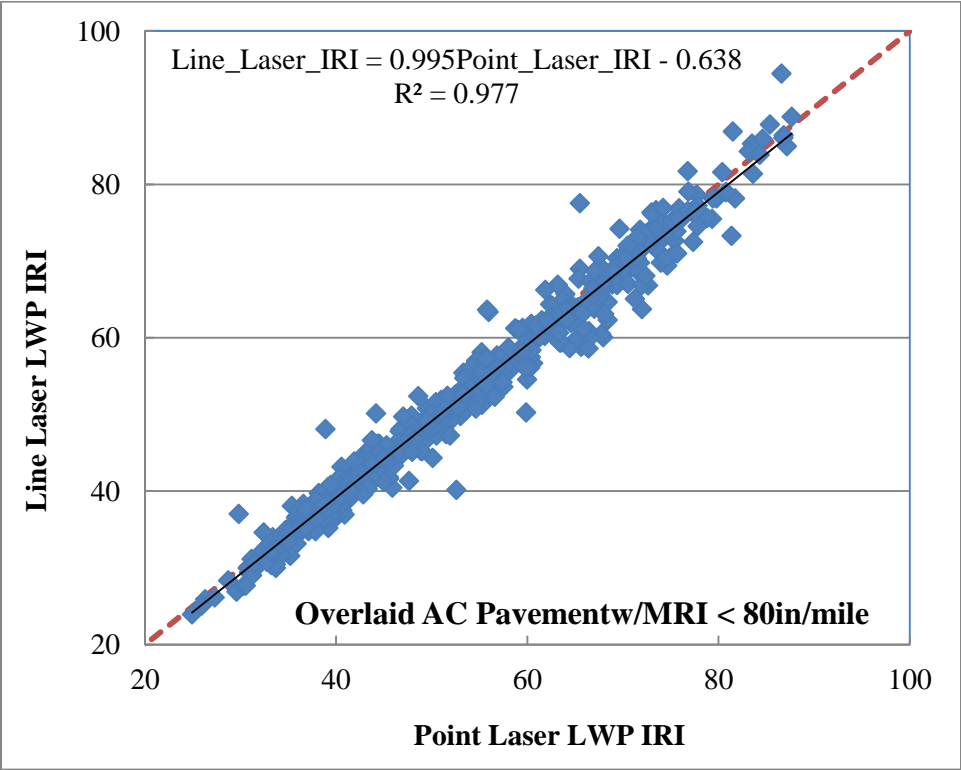
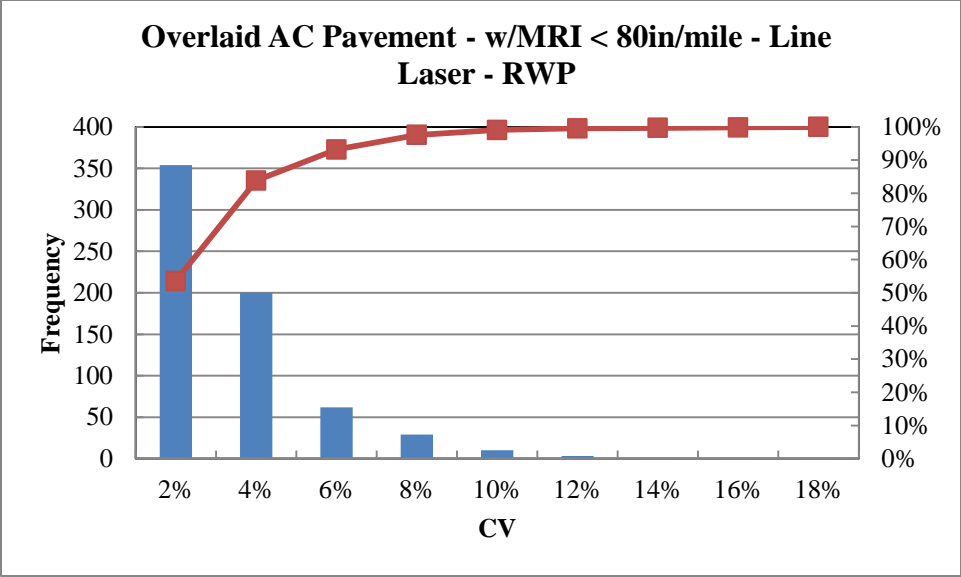


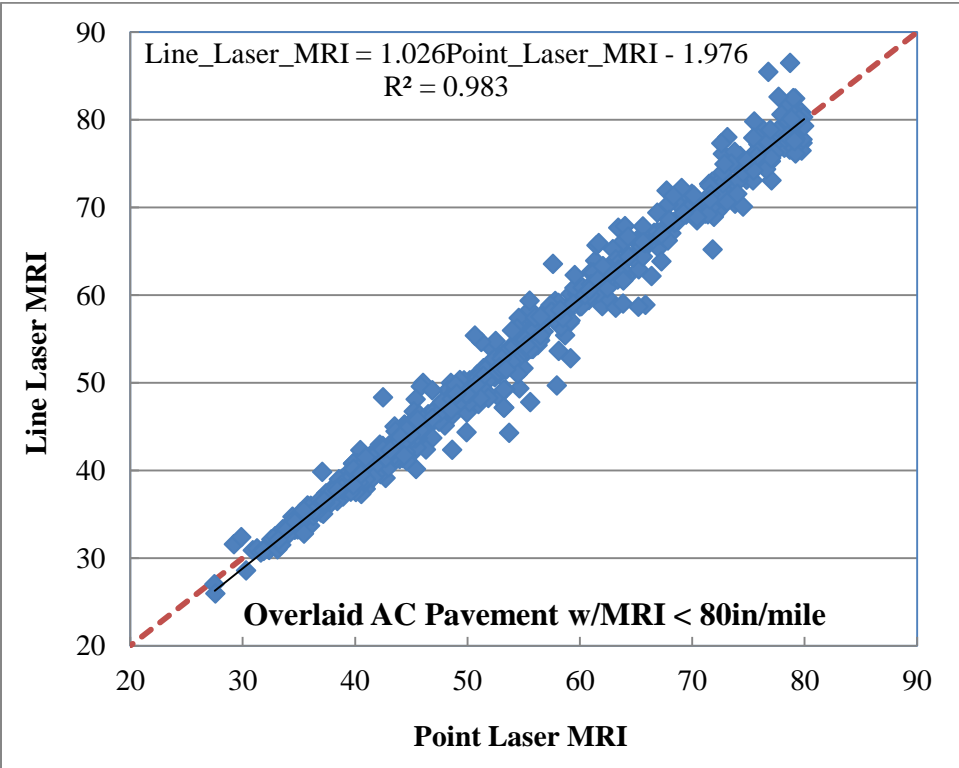
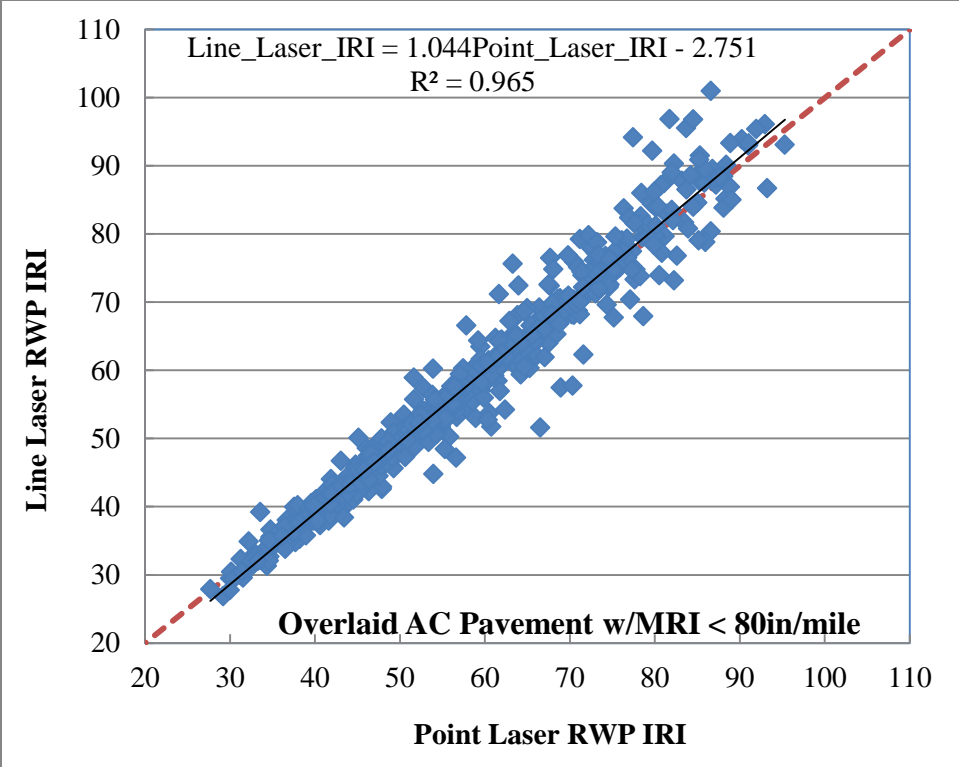
Overlaid AC pavement - w/MRI < 80in/mile - Coefficient of Variation:

n = 661	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	2.53%	2.50%	2.49%	2.44%
Median	1.98%	1.90%	1.86%	1.88%
Standard Deviation	2.25%	1.97%	2.22%	2.06%
Minimum	0.04%	0.04%	0.06%	0.10%
Maximum	25.57%	13.14%	25.68%	16.96%









For OGFC:

OGFC - Paired t-test:

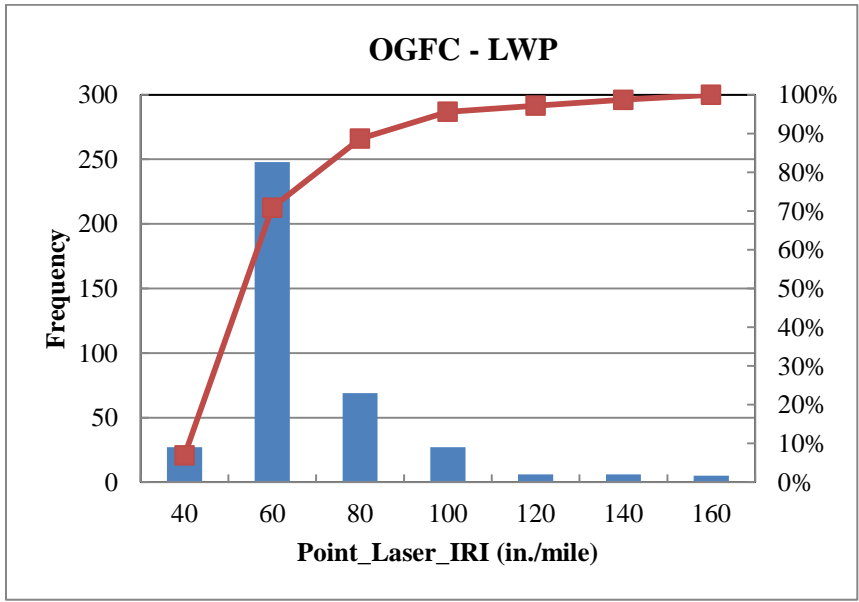
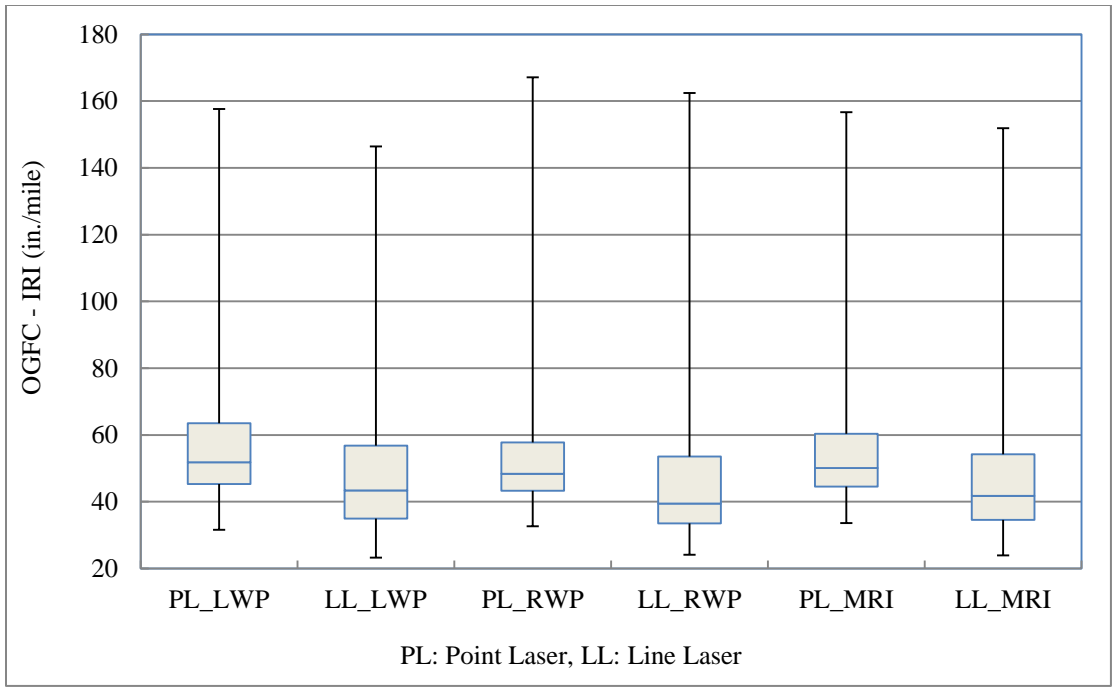
df = 387	LWP	RWP	MRI
t Stat	34.180	28.956	33.249
P(T<=t) one-tail	0.000	0.010	0.000
t Critical one-tail	1.649	1.649	1.649
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.966	1.966	1.966
Reject H_0 ?	Yes	Yes	Yes

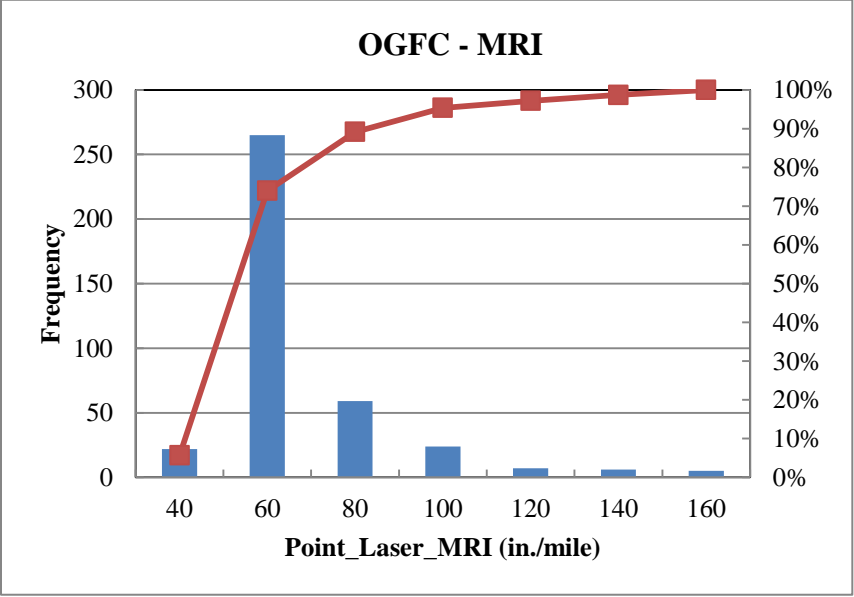
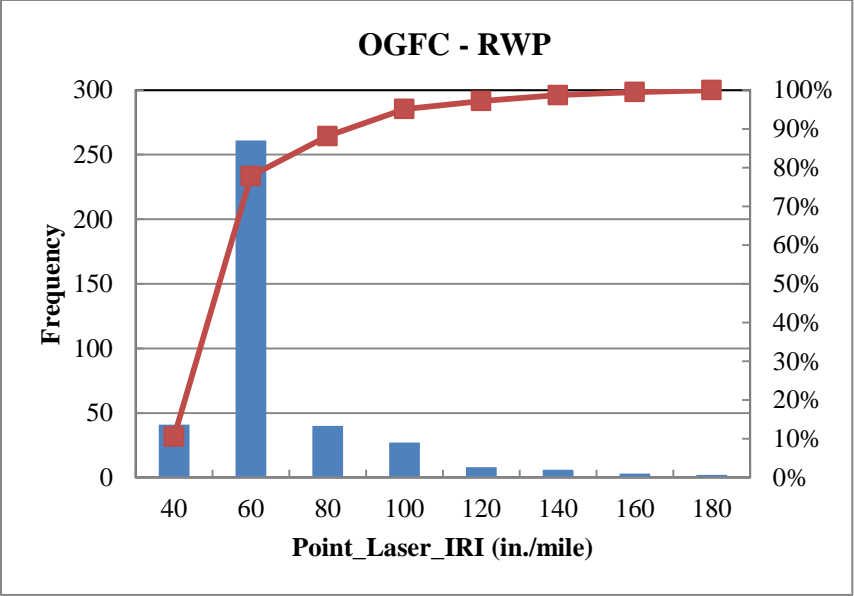
OGFC - F-test:

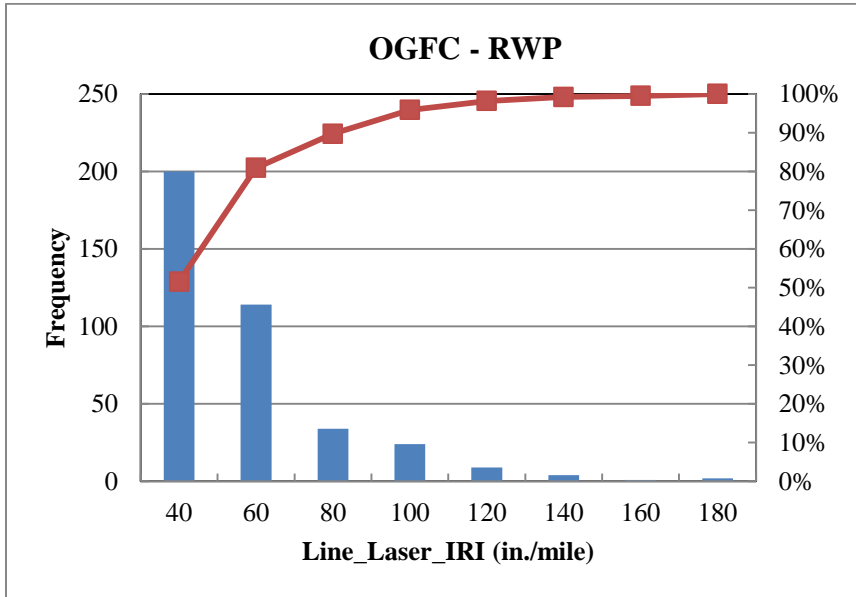
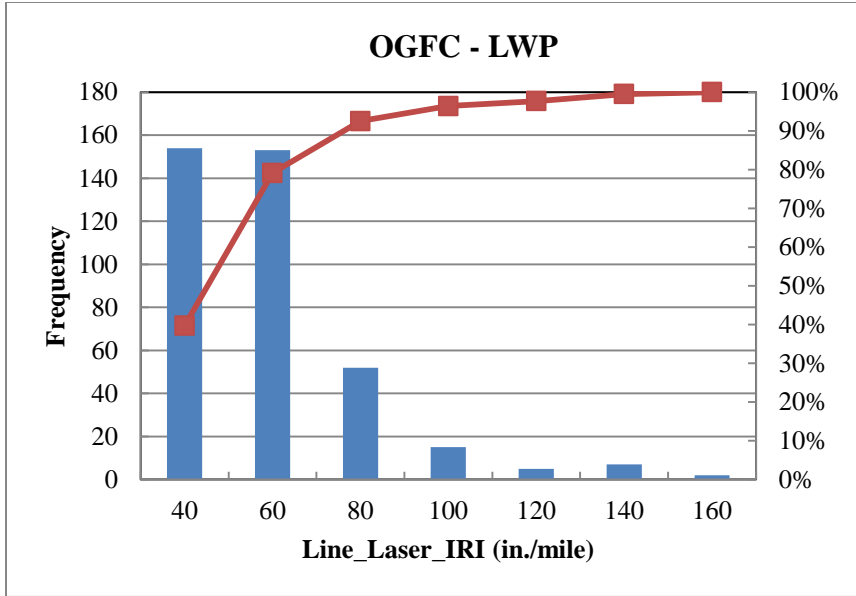
df = 387	LWP	RWP	MRI
F	1.0957	1.1402	1.1231
P(F<=f) one-tail	0.1846	0.0987	0.1269
F Critical one-tail	1.1823	1.1823	1.1823
Reject H_0 ?	No	No	No

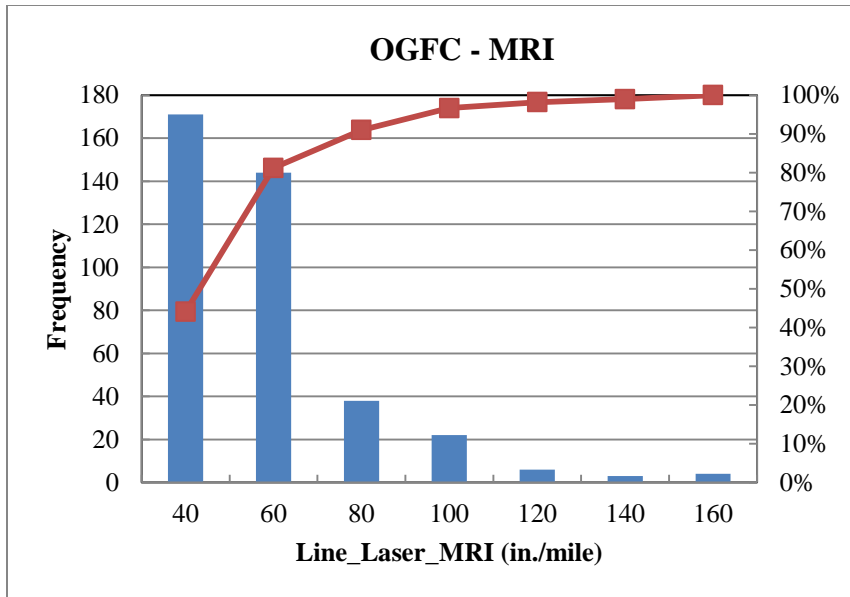
OGFC - IRI:

n = 388	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	57.81	55.46	56.63	49.62	47.76	48.69
Median (in./mile)	51.87	48.30	50.12	43.53	39.34	41.78
Standard Deviation	20.42	21.22	20.34	21.37	22.68	21.54
Minimum (in./mile)	31.64	32.70	33.58	31.64	32.70	23.90
Maximum (in./mile)	157.63	167.13	156.69	157.63	167.13	151.86



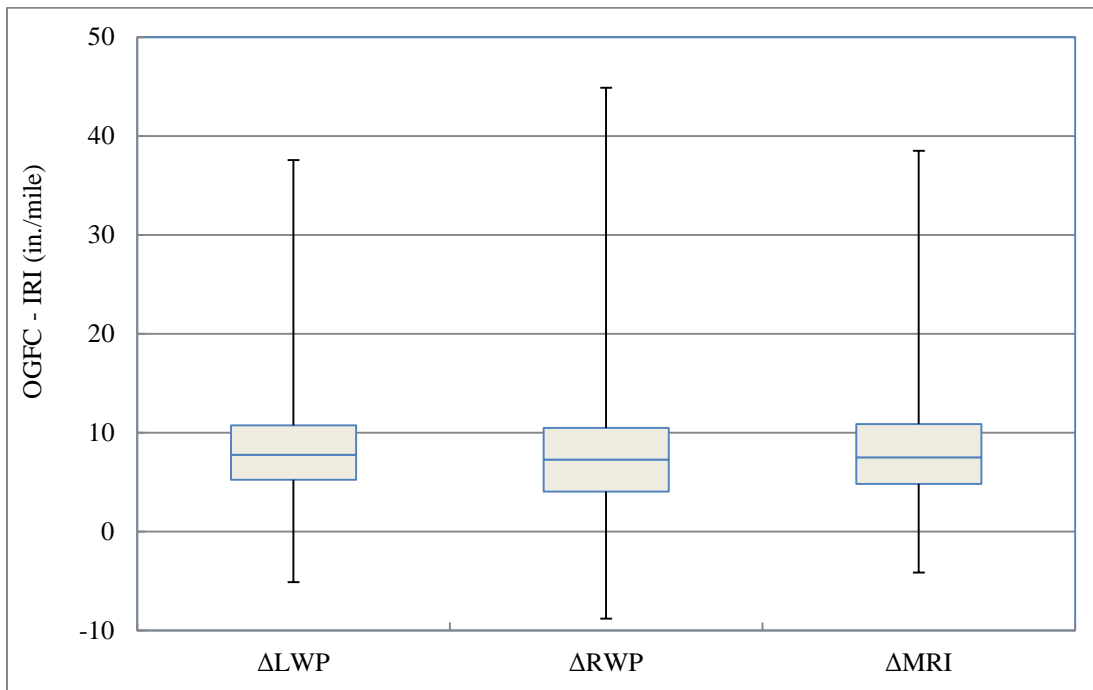


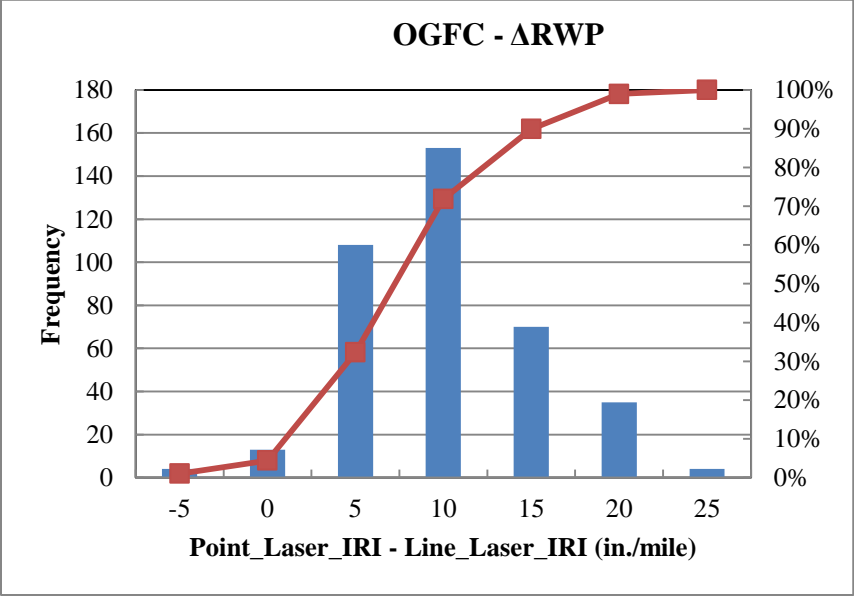
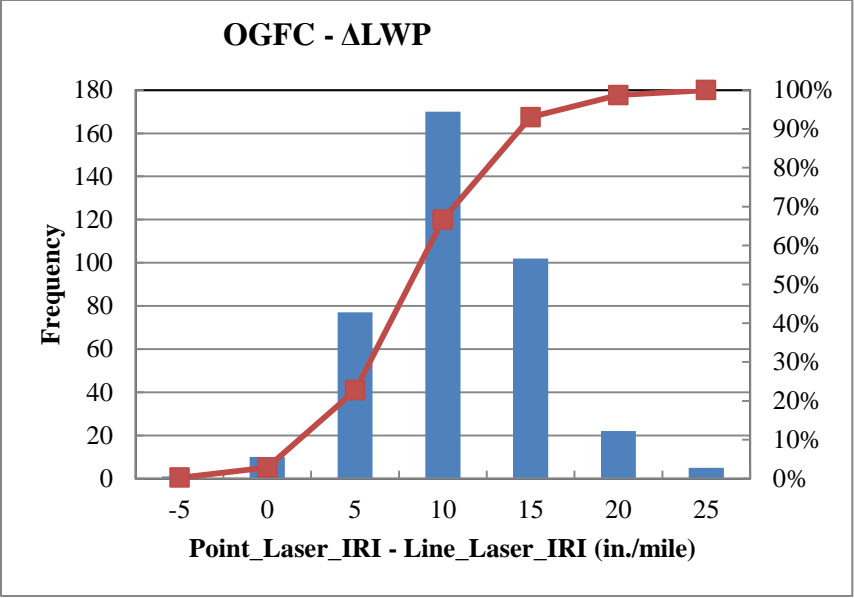


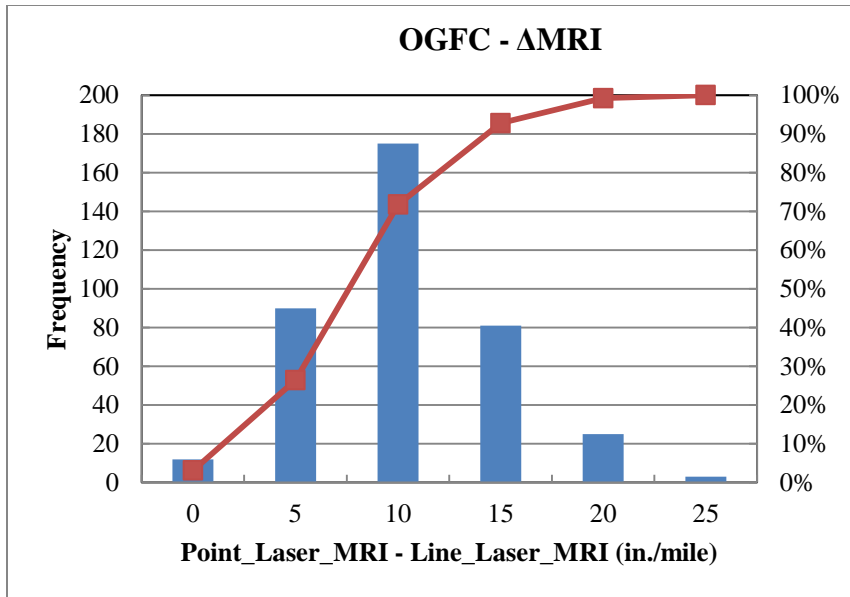


OGFC - (Point Laser IRI – Line Laser IRI):

n = 388	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	8.27	7.66	7.96
Median (in./mile)	7.77	7.28	7.49
Standard Deviation	4.76	5.21	4.72
Minimum (in./mile)	-5.13	-8.81	-4.14
Maximum (in./mile)	36.84	29.06	25.27

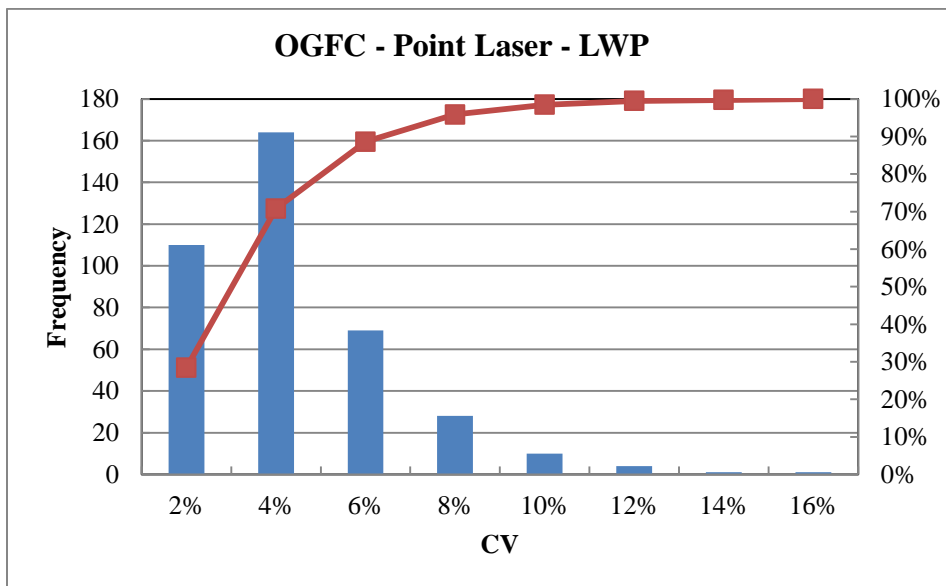


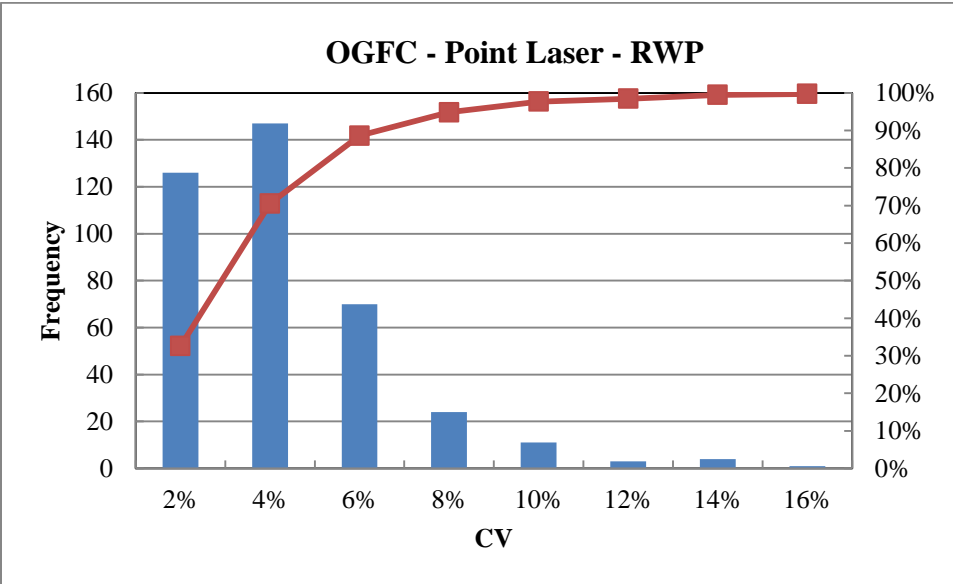
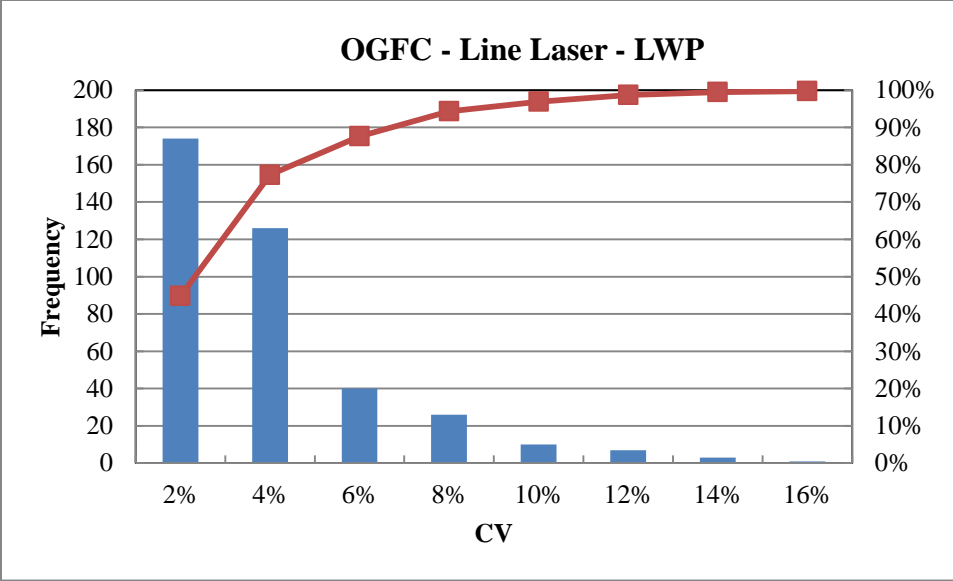


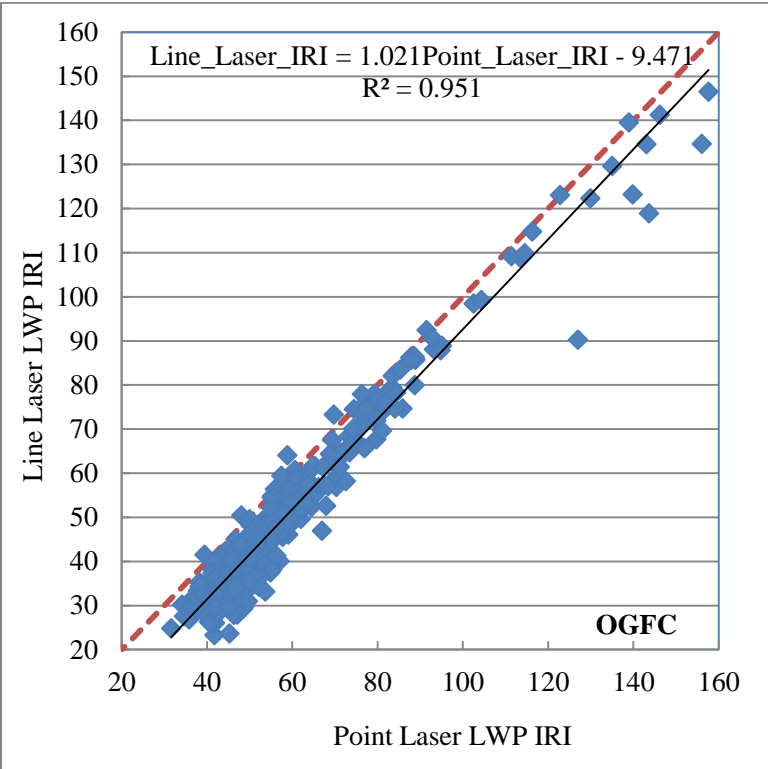
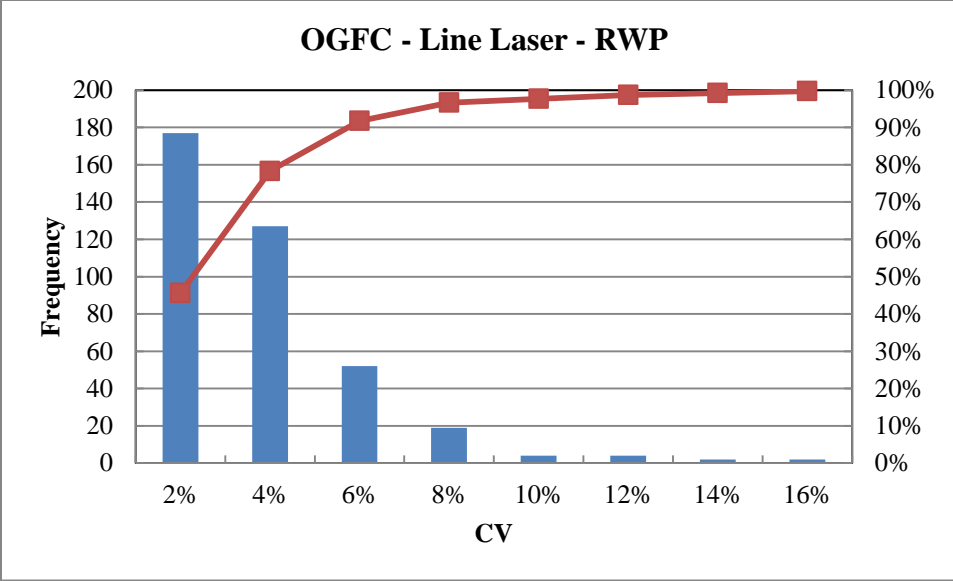


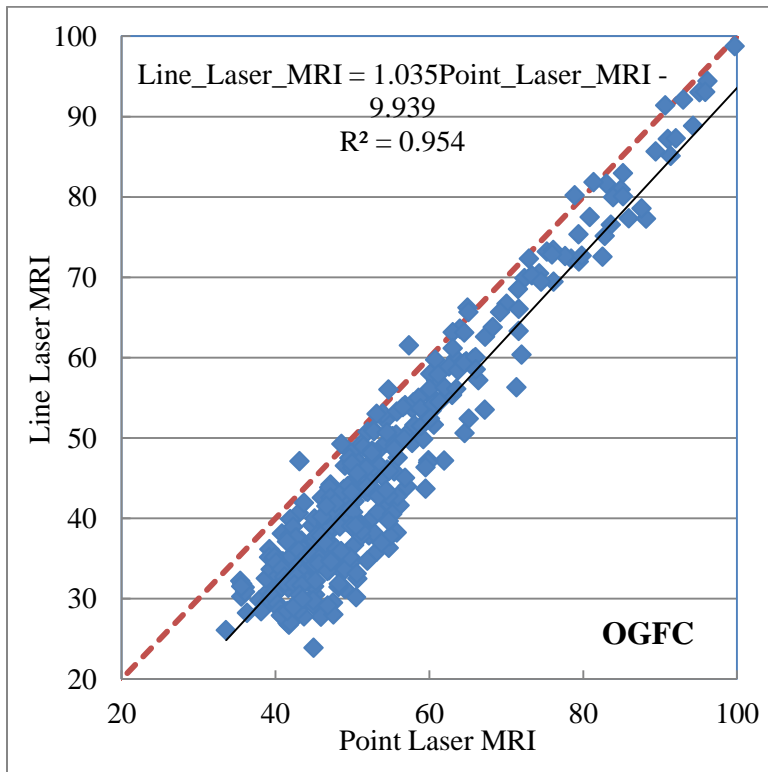
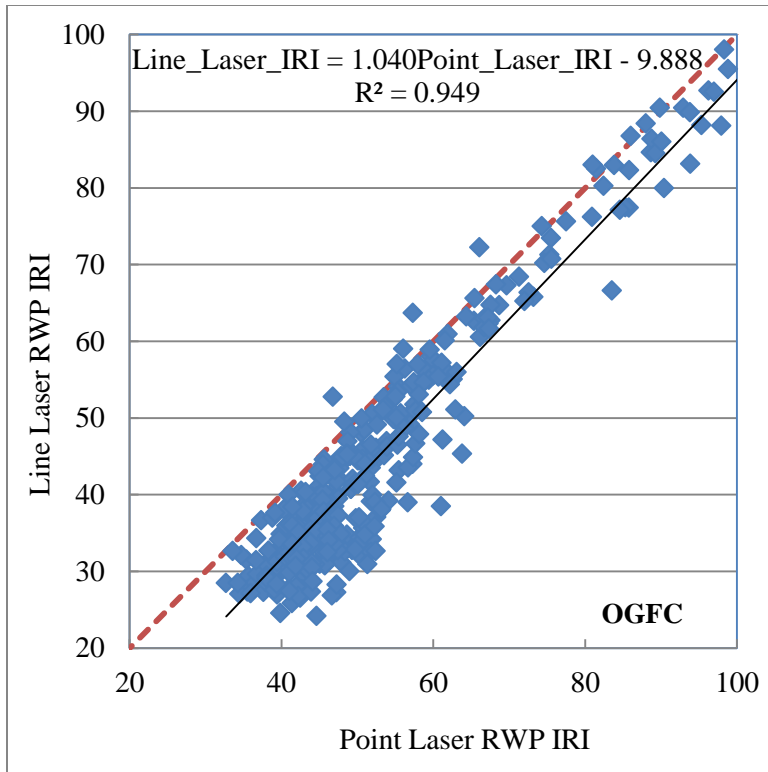
OGFC - Coefficient of Variation:

n = 388	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	2.53%	2.50%	2.49%	2.44%
Median	1.98%	1.90%	1.86%	1.88%
Standard Deviation	2.25%	1.97%	2.22%	2.06%
Minimum	0.04%	0.04%	0.06%	0.10%
Maximum	25.57%	13.14%	25.68%	16.96%









For OGFC w/MRI < 80in./mile:

OGFC w/MRI < 80in./mile - Paired t-test:

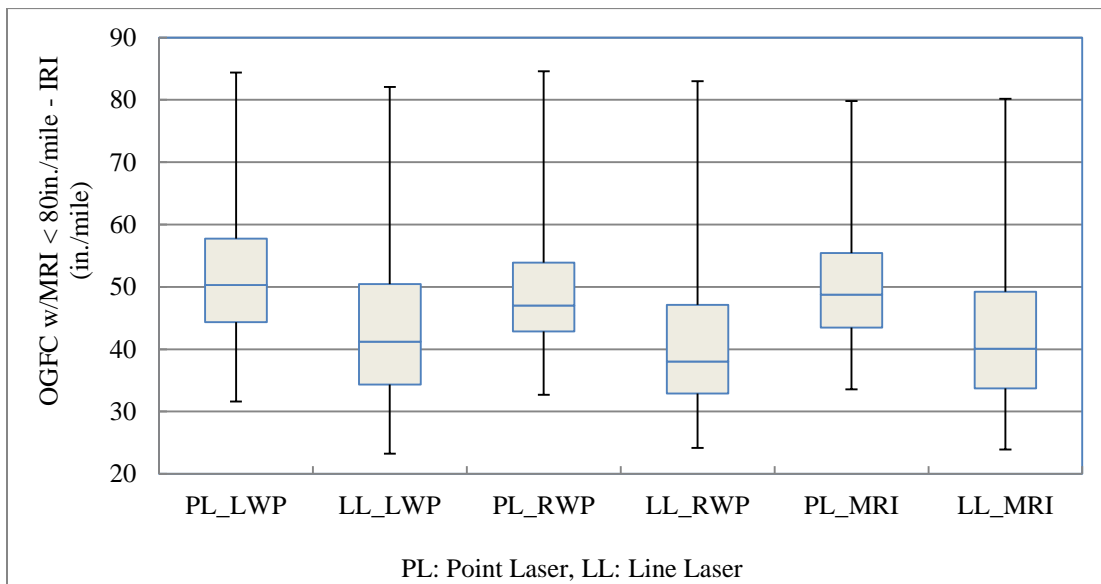
df = 345	LWP	RWP	MRI
t Stat	36.235	29.318	34.046
P(T<=t) one-tail	0.000	0.010	0.000
t Critical one-tail	1.649	1.649	1.649
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.967	1.967	1.967
Reject H_0 ?	Yes	Yes	Yes

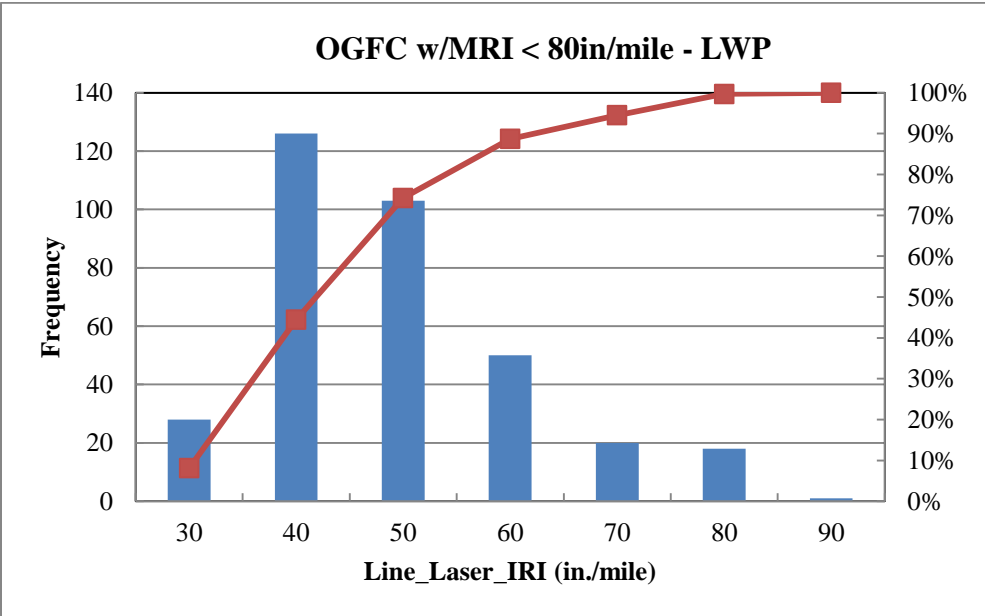
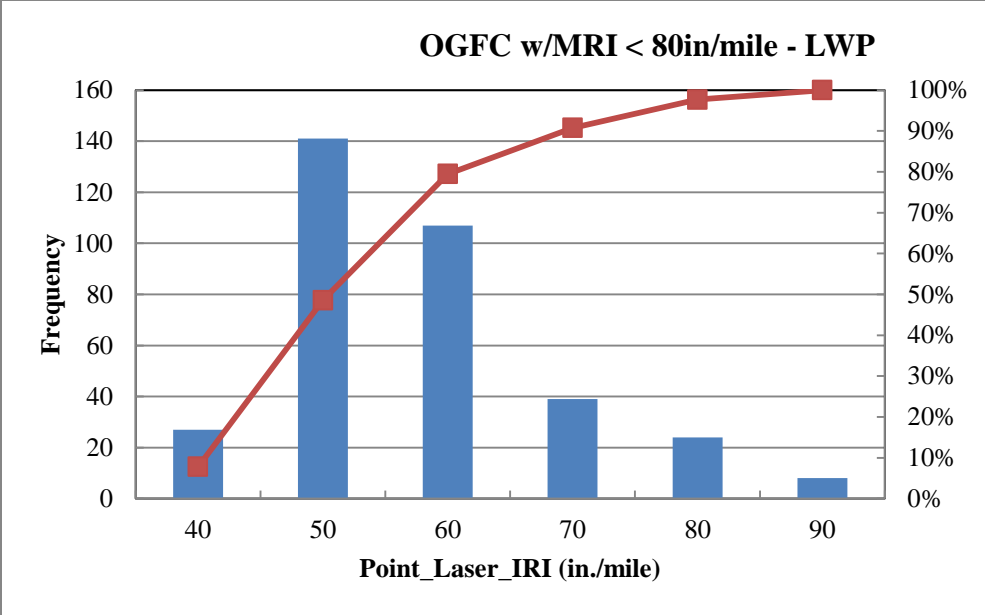
OGFC w/MRI < 80in./mile - F-test:

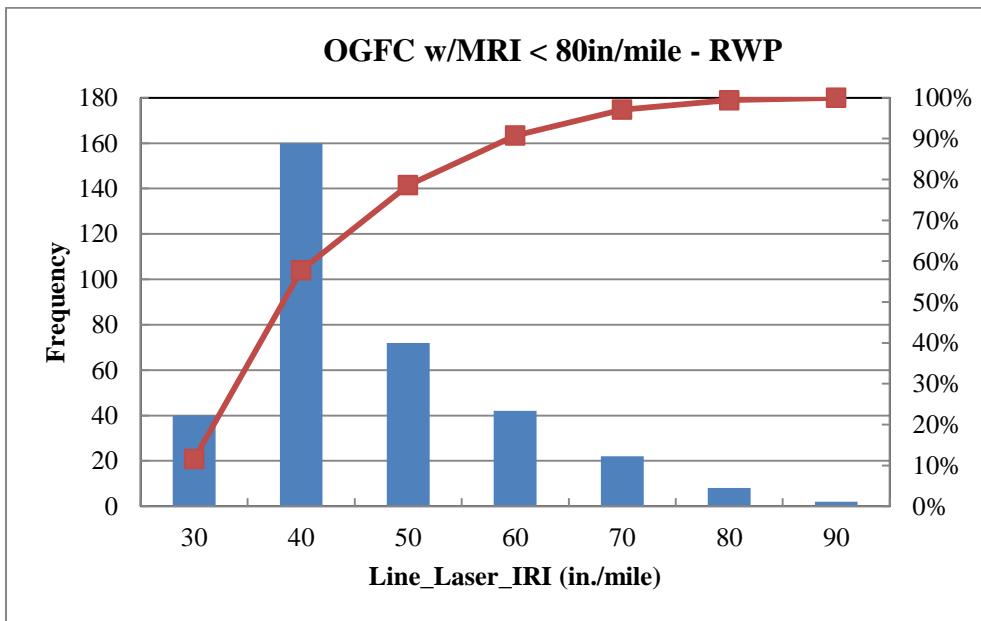
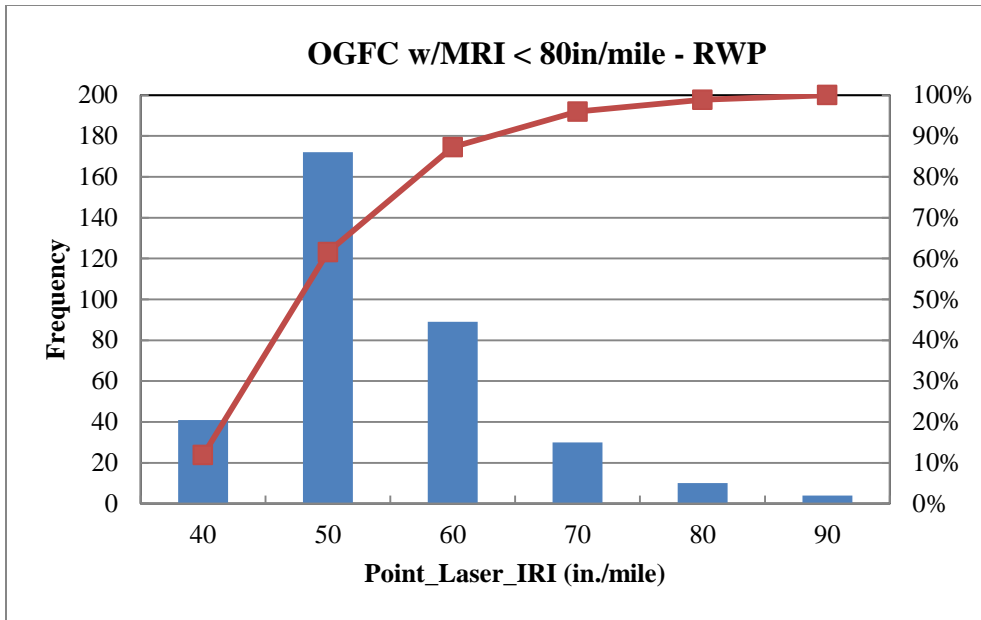
df = 345	LWP	RWP	MRI
F	1.313	1.496	1.428
P(F<=f) one-tail	0.006	0.000	0.000
F Critical one-tail	1.194	1.194	1.194
Reject H_0 ?	Yes	Yes	Yes

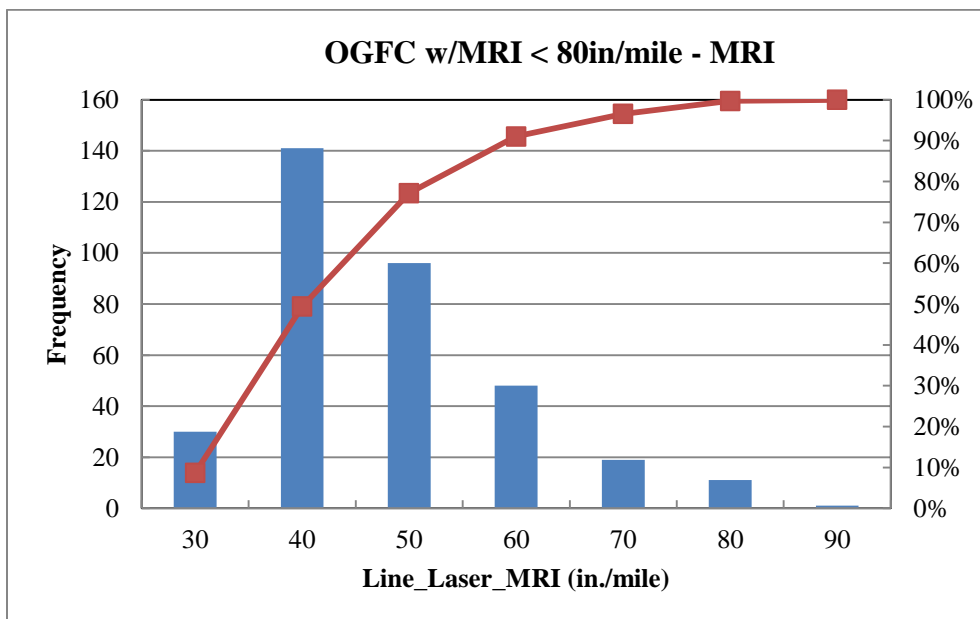
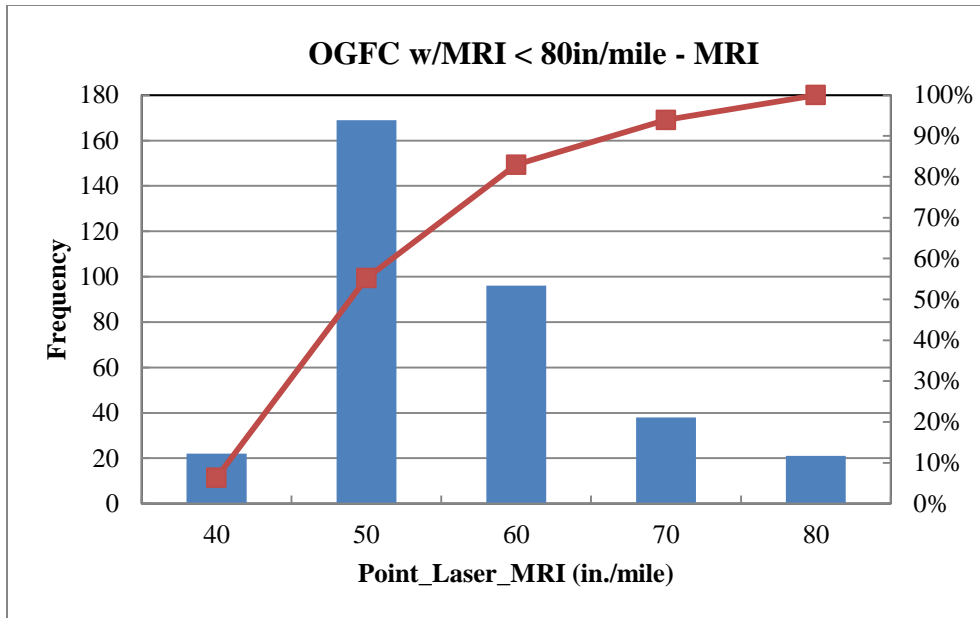
OGFC w/MRI < 80in./mile - IRI:

n = 346	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	52.40	49.33	50.86	43.94	41.43	42.68
Median (in./mile)	50.28	46.99	48.75	41.19	38.02	40.10
Standard Deviation	10.89	9.47	9.55	12.48	11.58	11.41
Minimum (in./mile)	31.64	32.70	33.58	31.64	32.70	23.90
Maximum (in./mile)	84.38	84.60	79.83	84.38	84.60	80.18



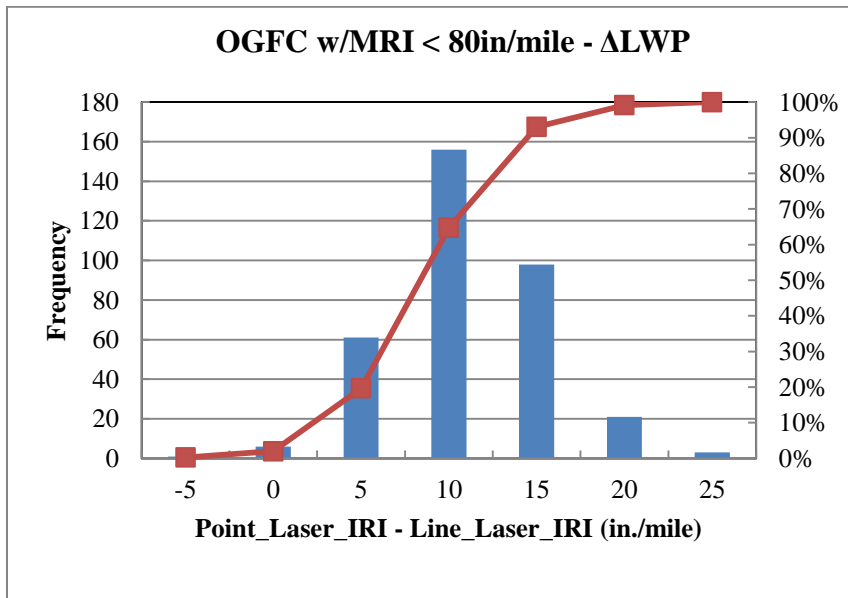
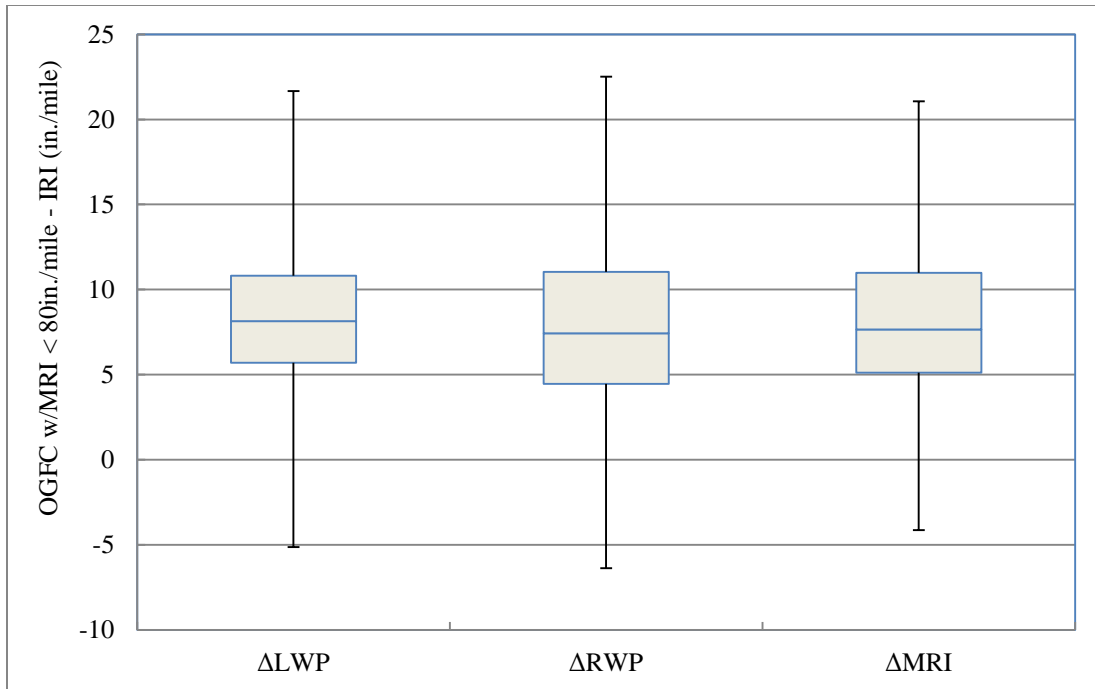


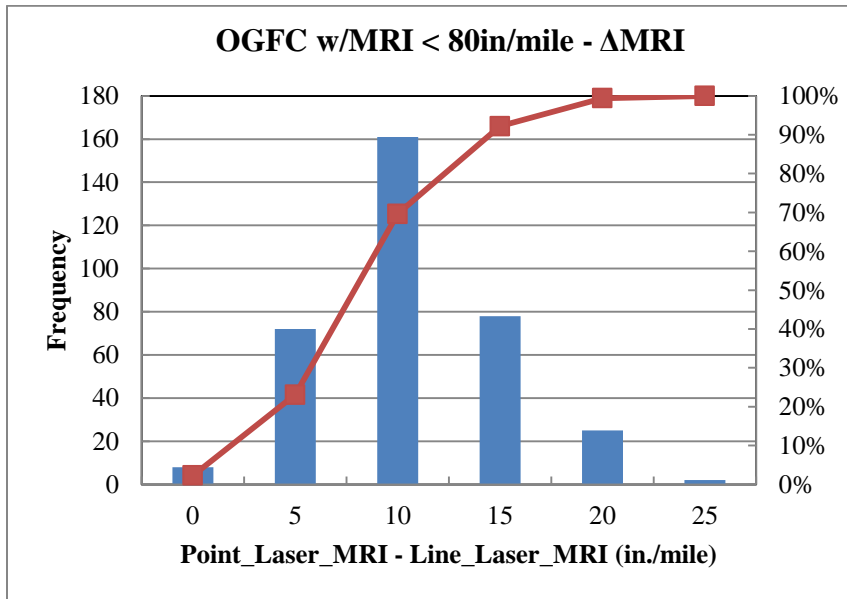
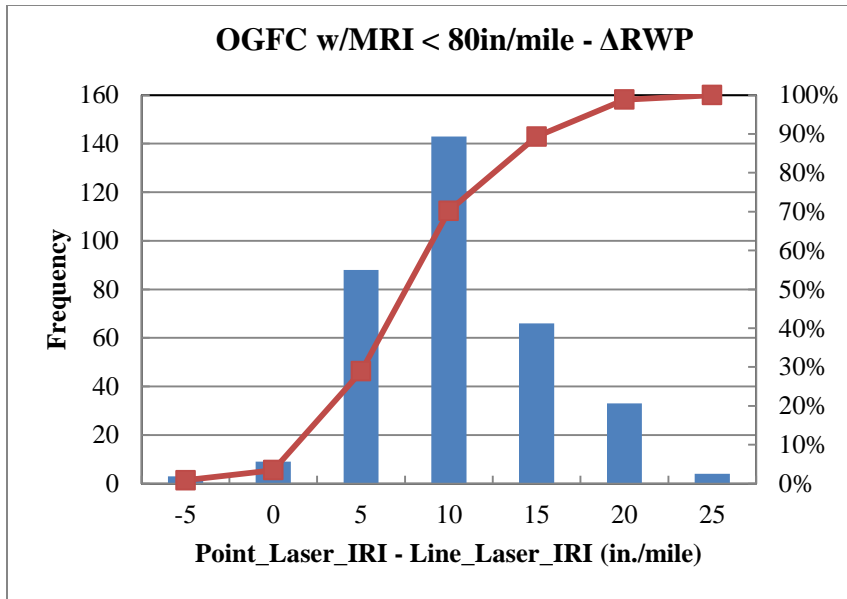




OGFC w/MRI < 80in/mile - (Point Laser IRI – Line Laser IRI):

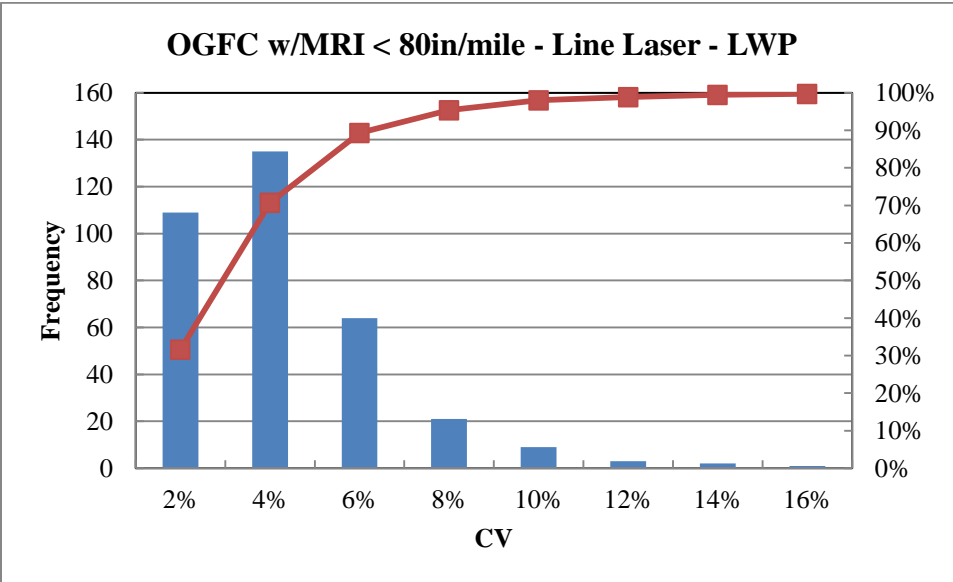
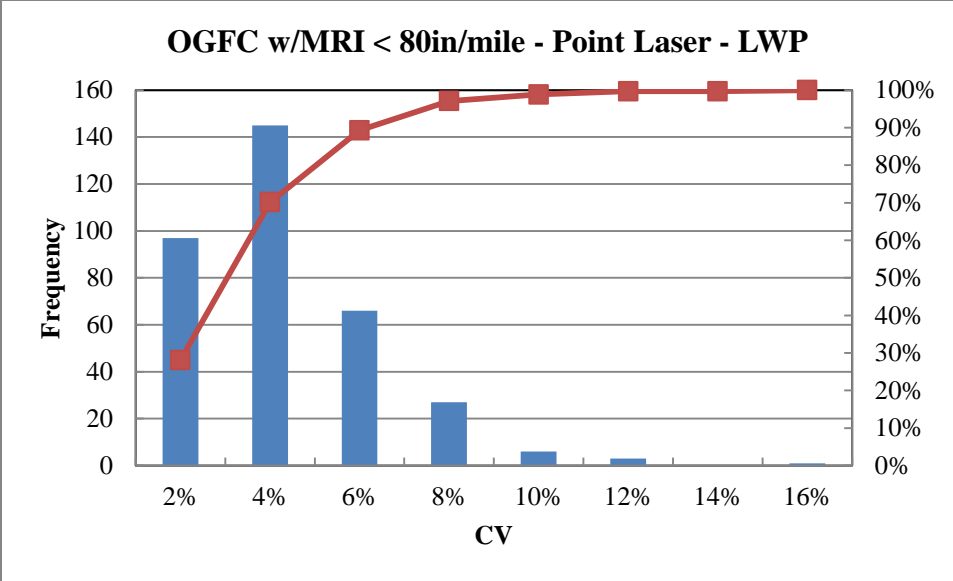
n = 346	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	8.46	7.90	8.18
Median (in./mile)	8.14	7.43	7.66
Standard Deviation	4.34	5.01	4.47
Minimum (in./mile)	-5.13	-6.37	-4.14
Maximum (in./mile)	21.66	22.52	21.06

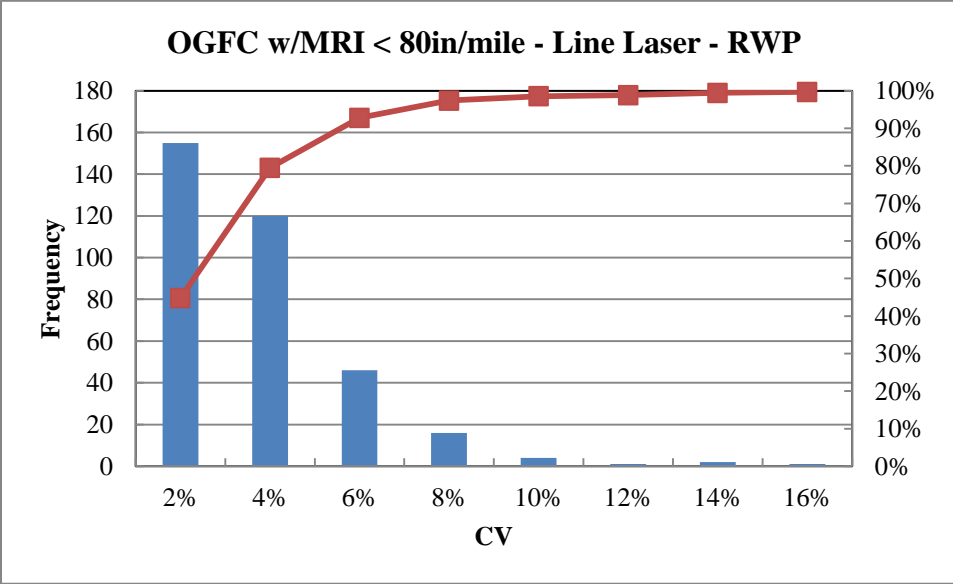
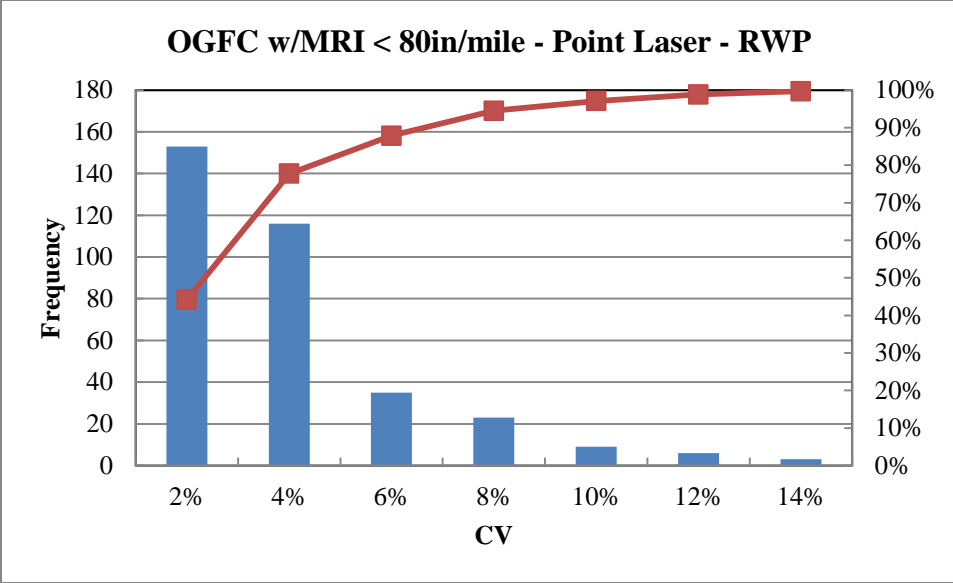


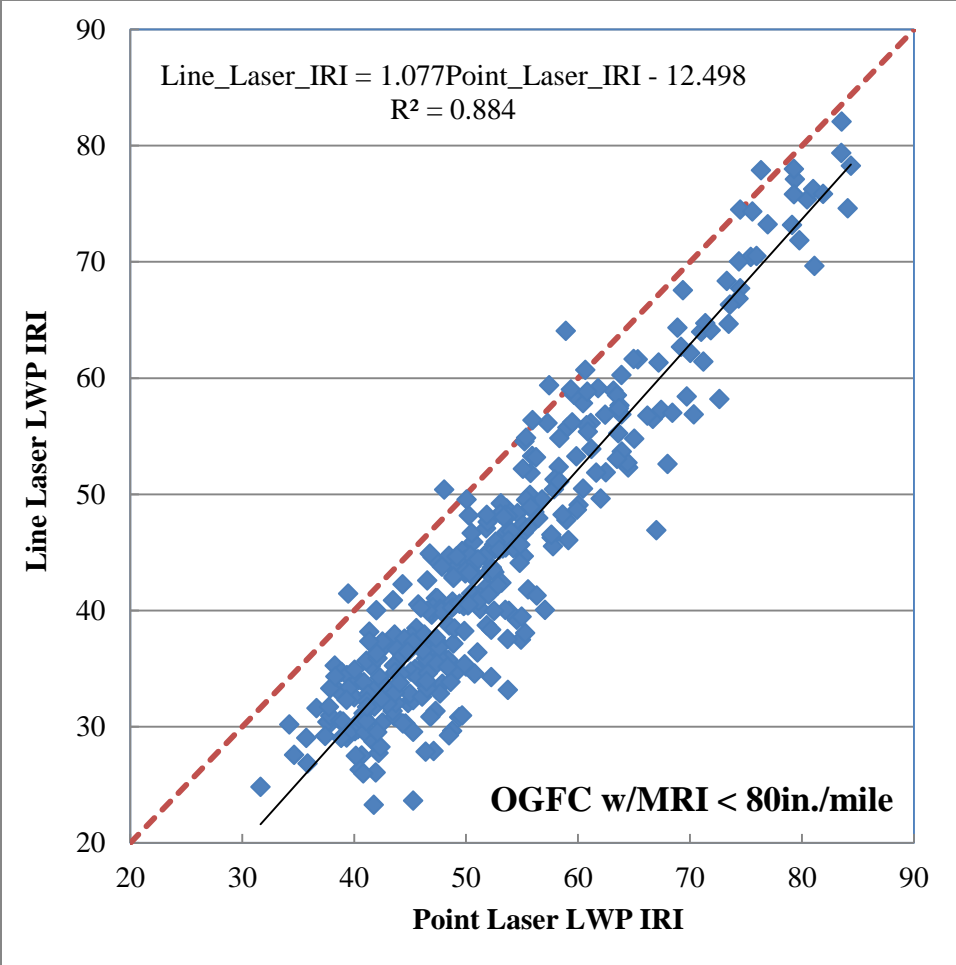


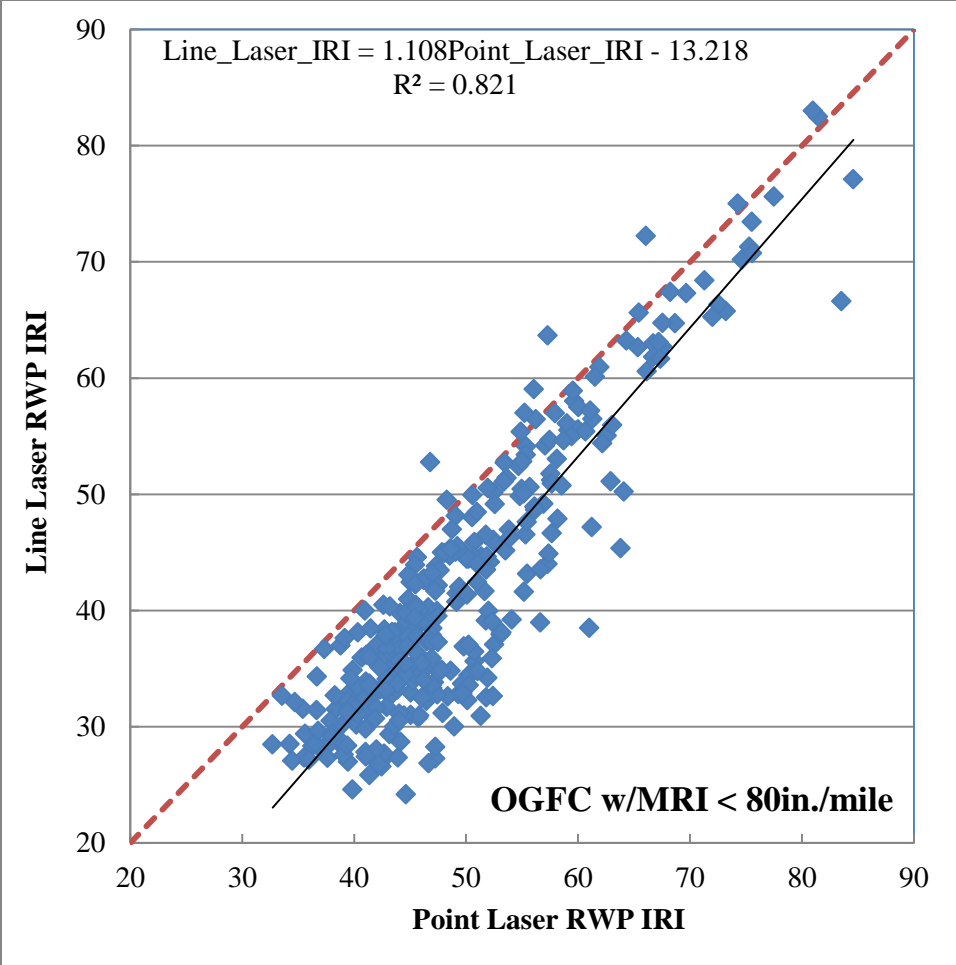
OGFC w/MRI < 80in/mile - Coefficient of Variation:

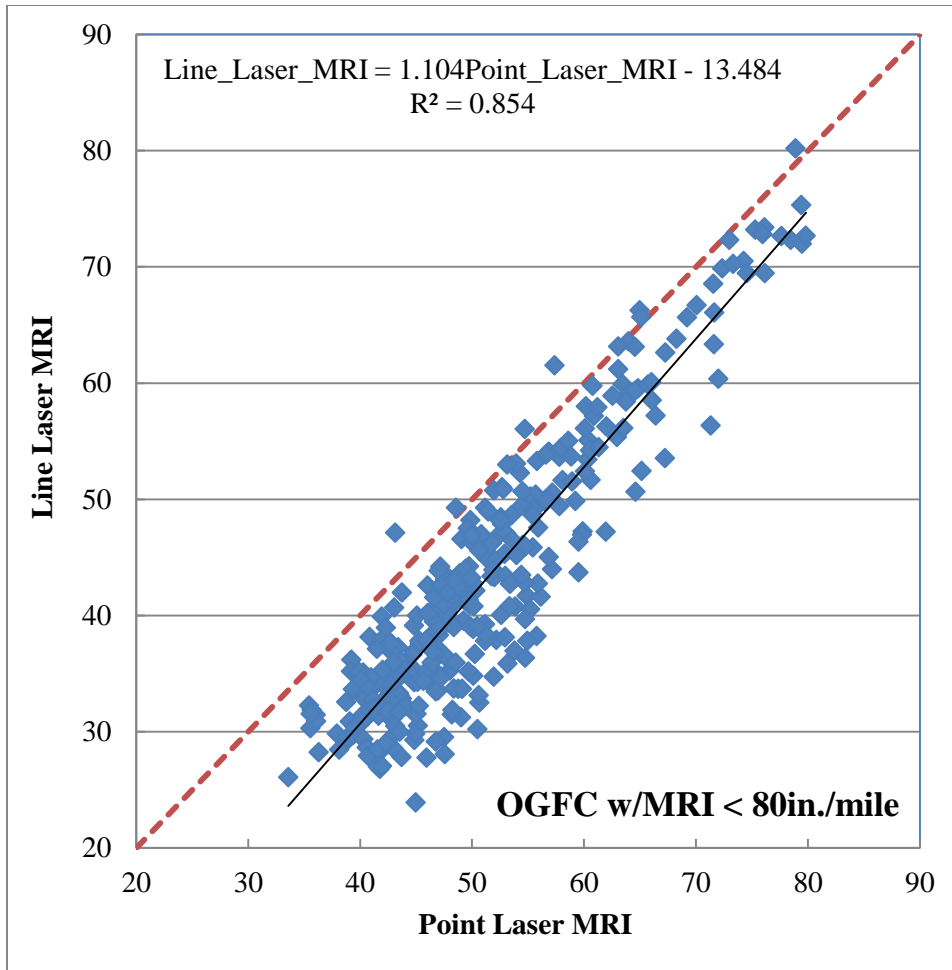
n = 346	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	3.45%	3.45%	3.05%	2.73%
Median	3.07%	2.86%	2.30%	2.14%
Standard Deviation	2.61%	2.78%	2.64%	2.43%
Minimum	0.07%	0.18%	0.12%	0.10%
Maximum	32.45%	29.87%	22.25%	23.96%











For PCC:

PCC - Paired t-test:

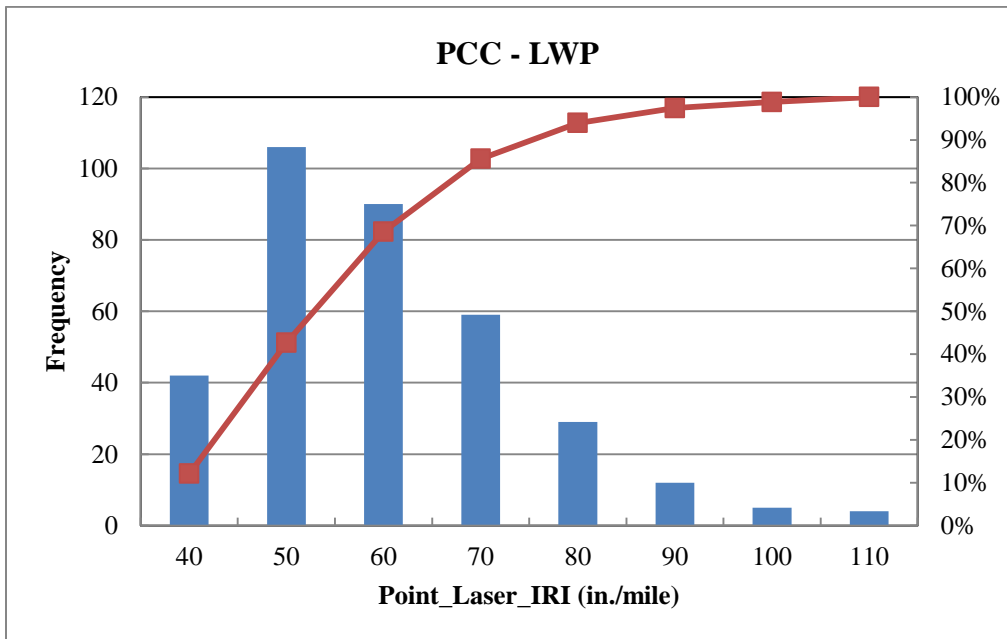
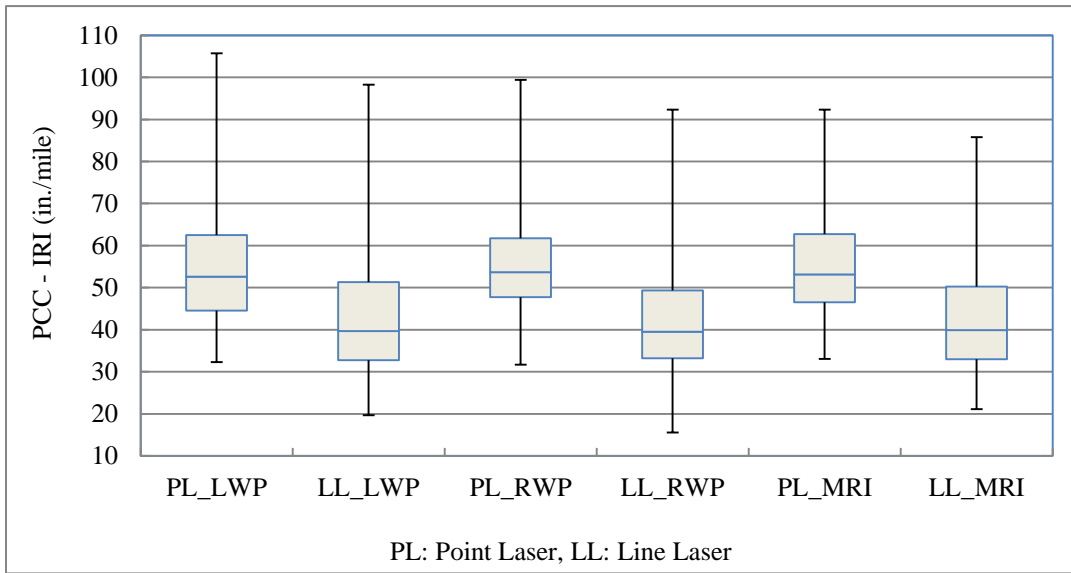
df = 346	LWP	RWP	MRI
t Stat	35.807	39.103	43.774
P(T<=t) one-tail	0.000	0.010	0.000
t Critical one-tail	1.649	1.649	1.649
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.967	1.967	1.967
Reject H_0 ?	Yes	Yes	Yes

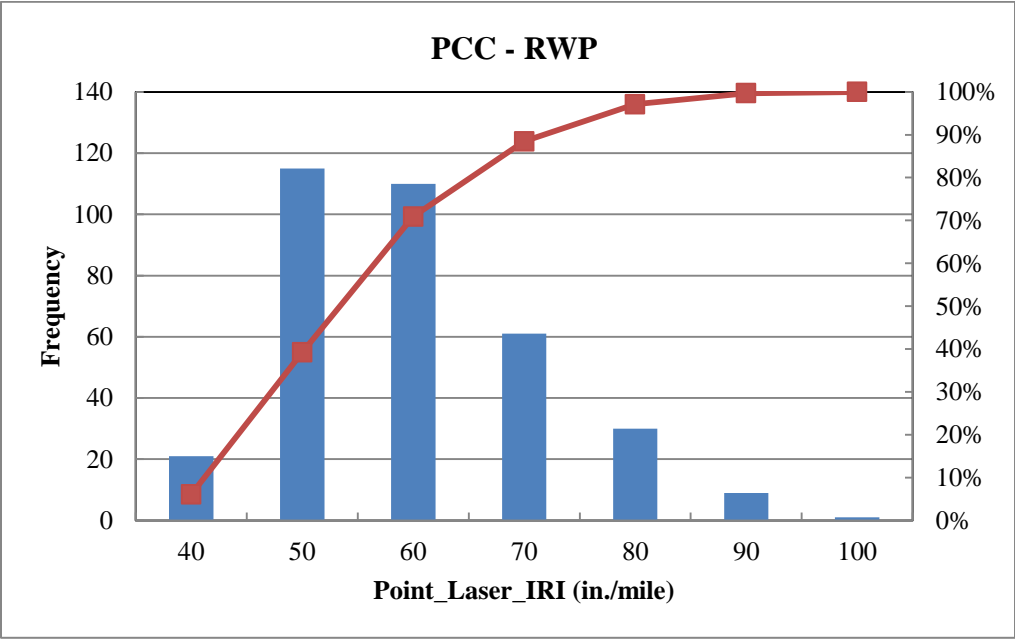
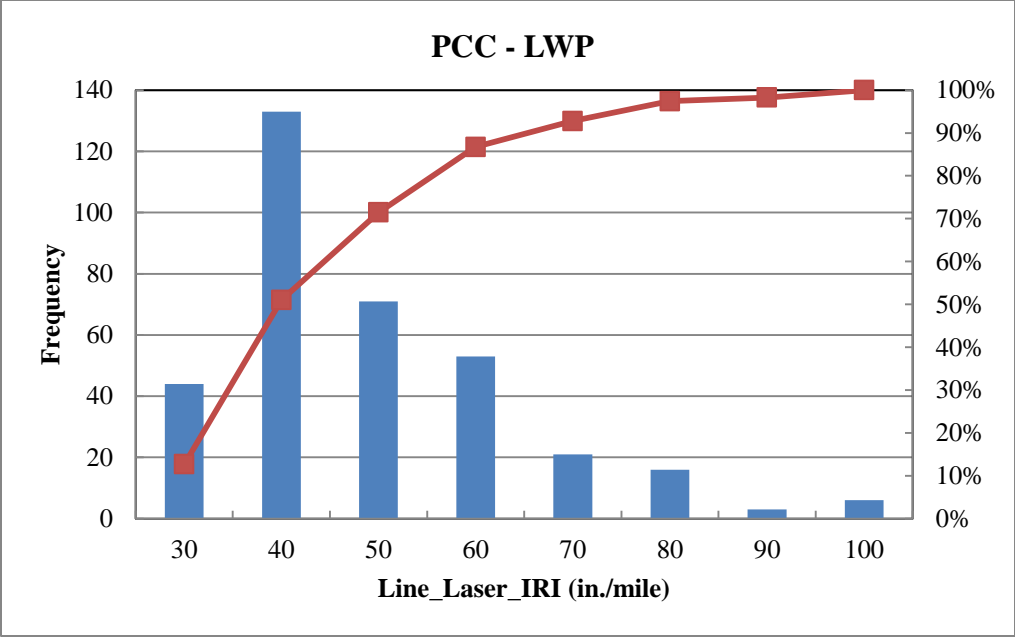
PCC - F-test:

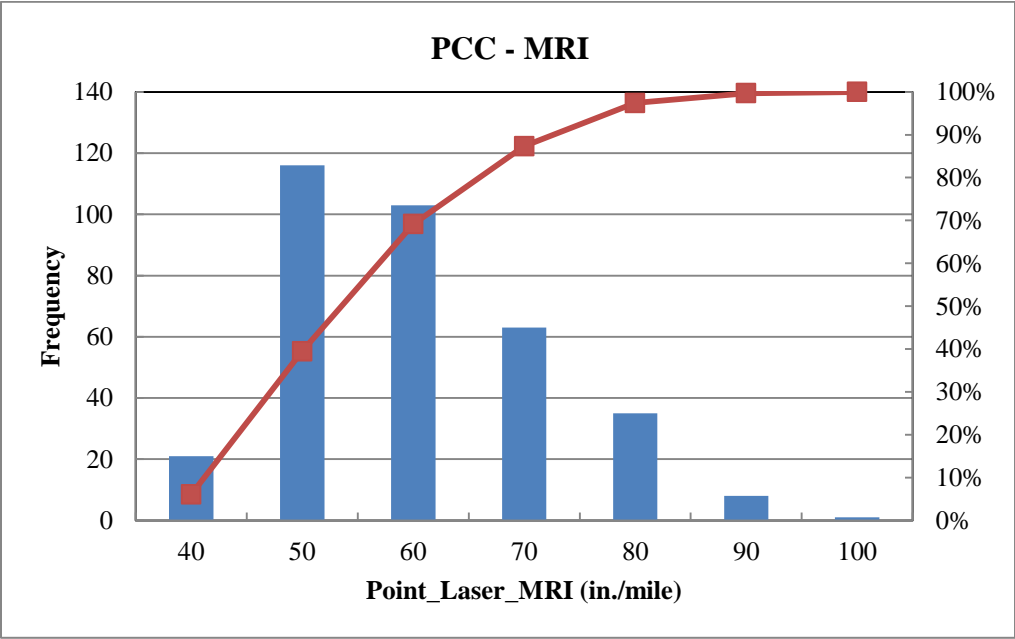
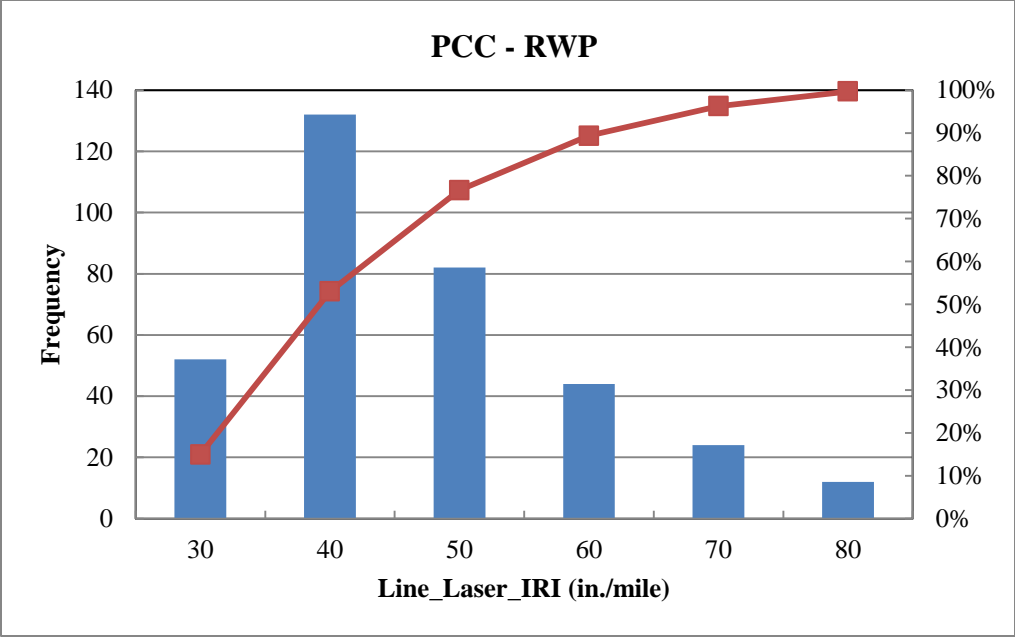
df = 346	LWP	RWP	MRI
F	1.152	1.300	1.223
P(F<=f) one-tail	0.095	0.007	0.031
F Critical one-tail	1.196	1.196	1.196
Reject H_0 ?	No	Yes	Yes

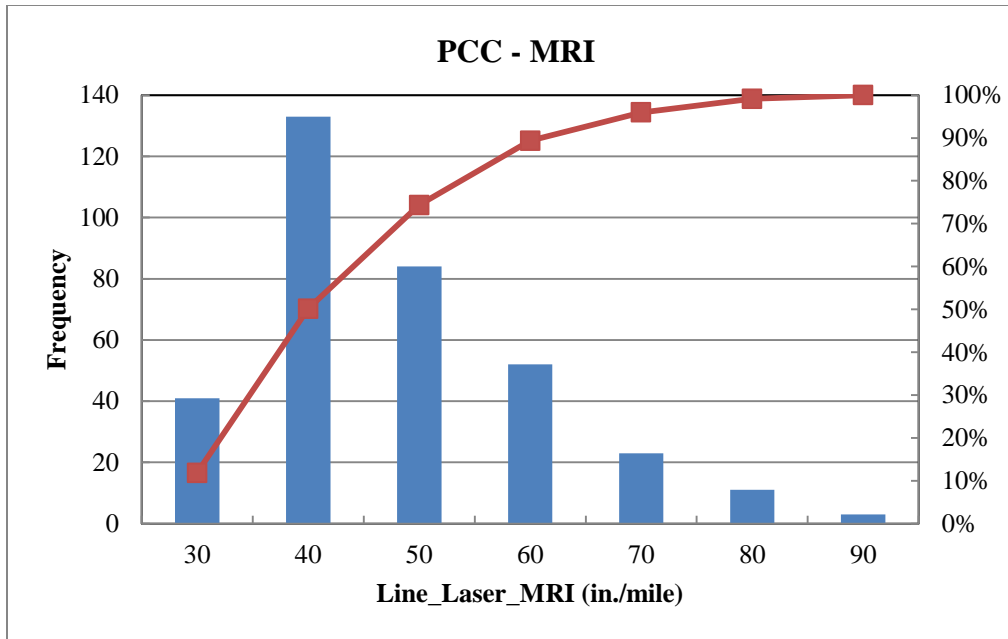
PCC - IRI:

n = 347	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	54.92	55.18	55.05	43.75	41.96	42.86
Median (in./mile)	52.58	53.65	53.12	39.71	39.55	39.92
Standard Deviation	13.92	11.18	11.40	14.93	12.75	12.60
Minimum (in./mile)	32.28	31.66	33.10	32.28	31.66	21.15
Maximum (in./mile)	105.72	99.38	92.35	105.72	99.38	85.82



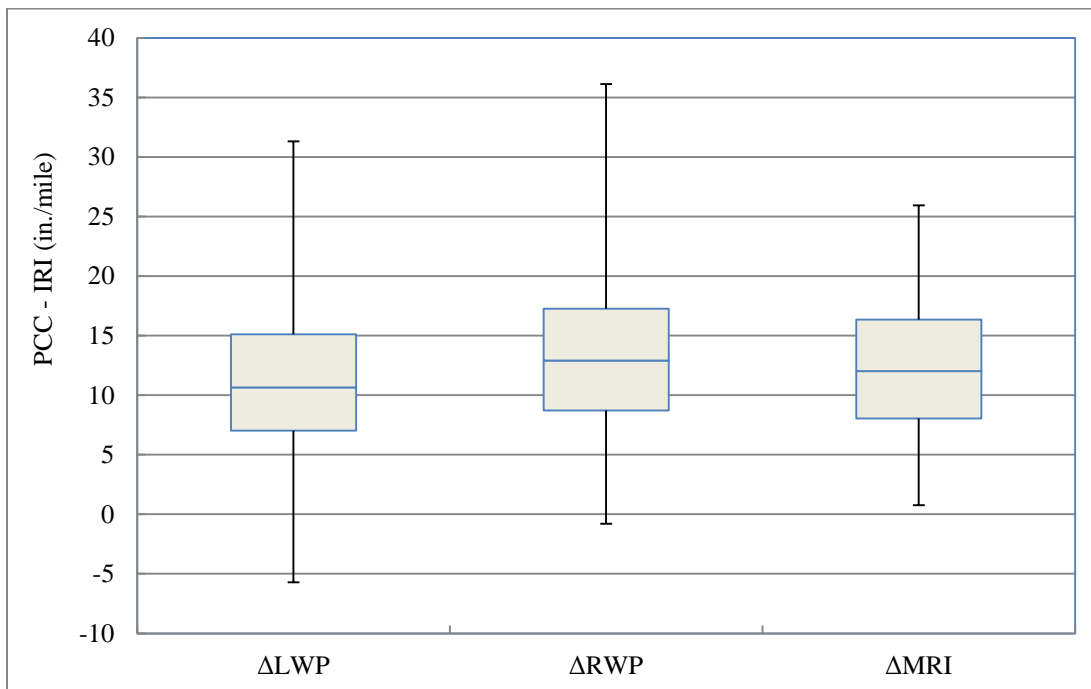


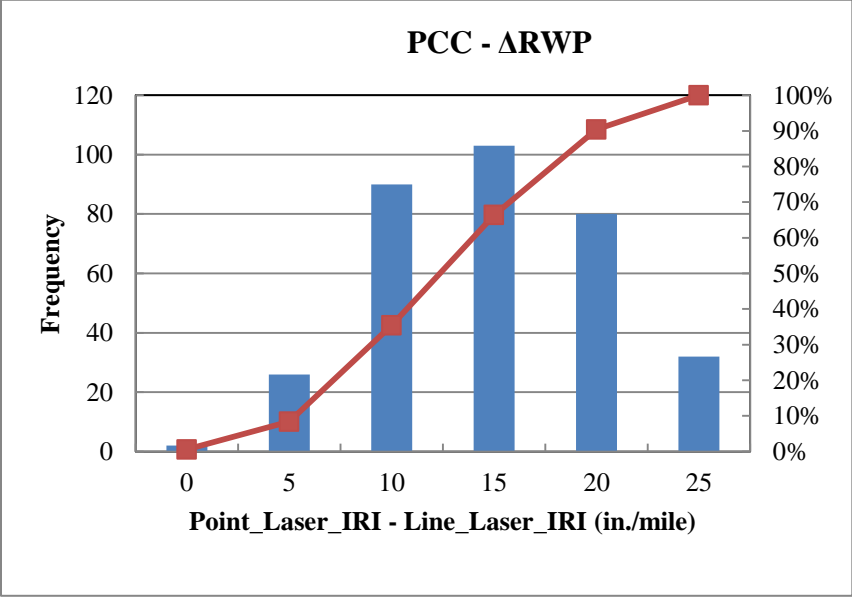
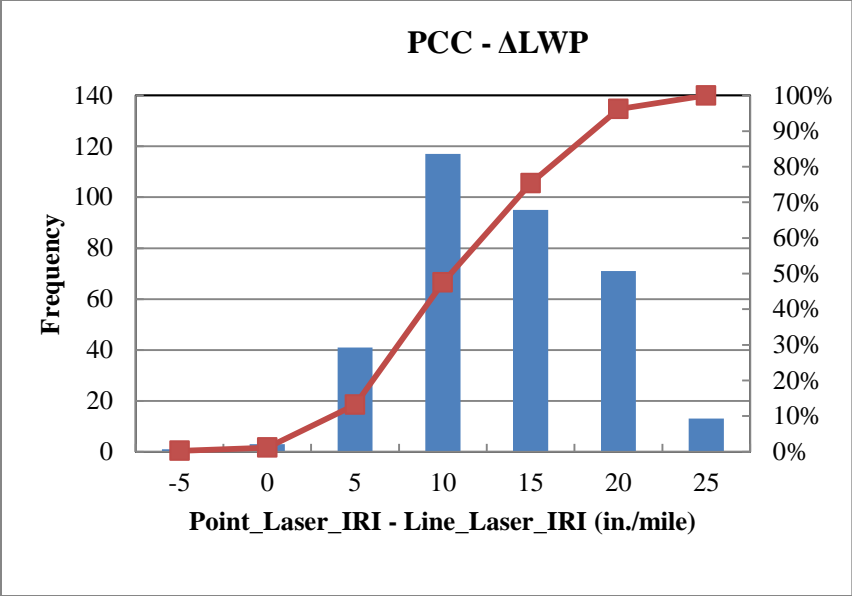


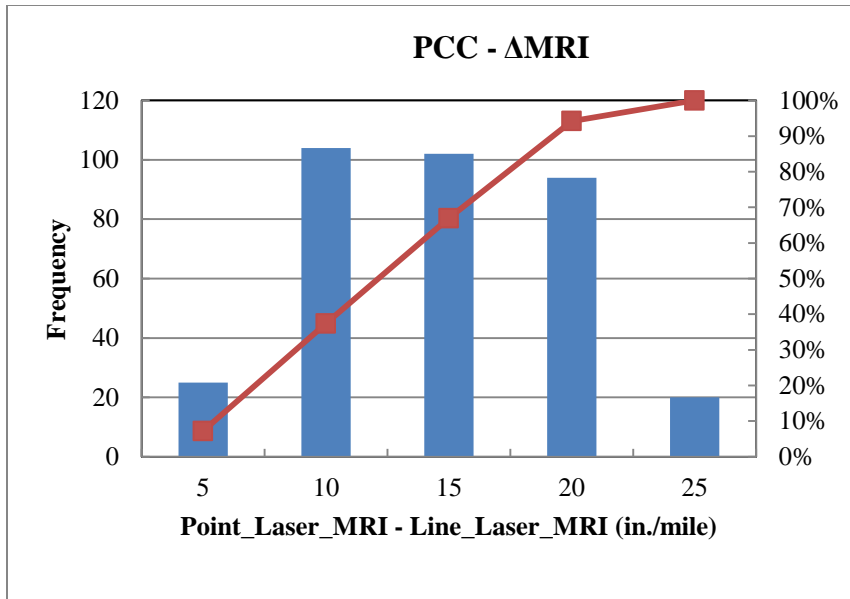


PCC - (Point Laser IRI – Line Laser IRI):

n = 347	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	11.17	13.21	12.19
Median (in./mile)	10.65	12.90	12.01
Standard Deviation	5.81	6.29	5.19
Minimum (in./mile)	-5.70	-0.81	0.75
Maximum (in./mile)	31.31	36.12	25.93

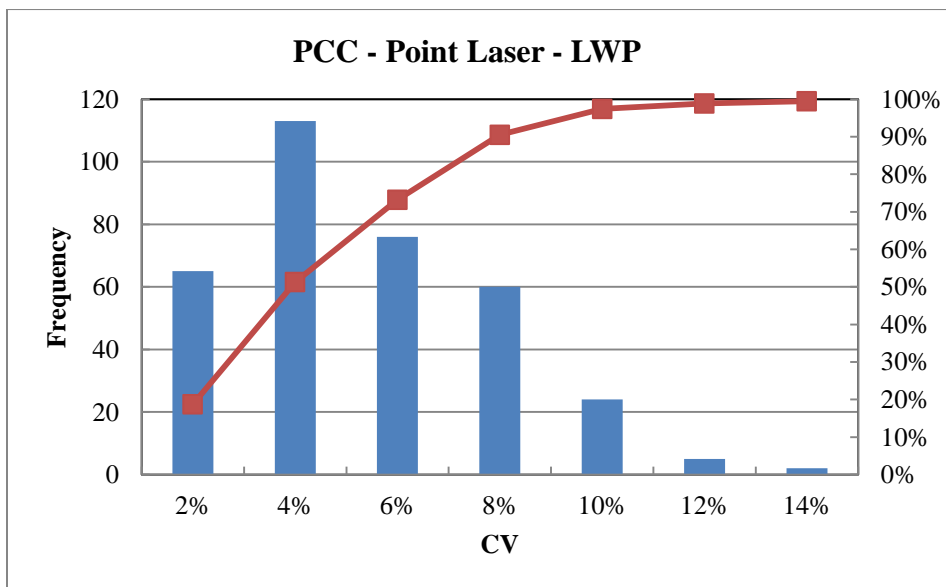


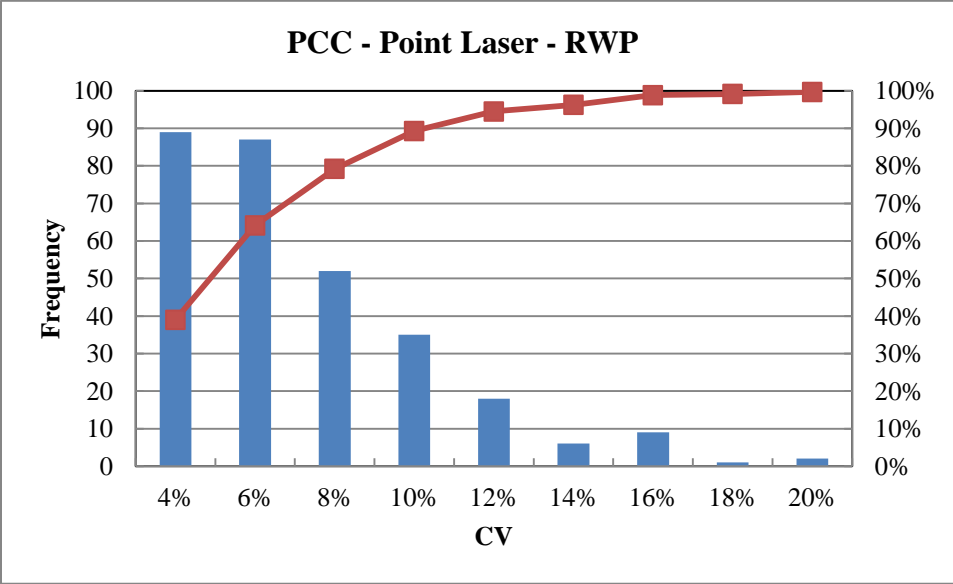
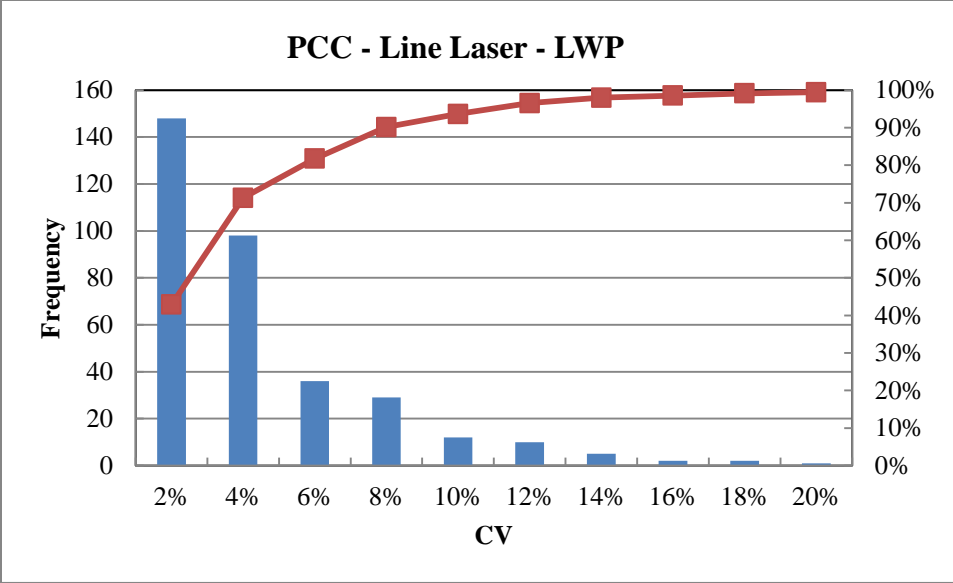


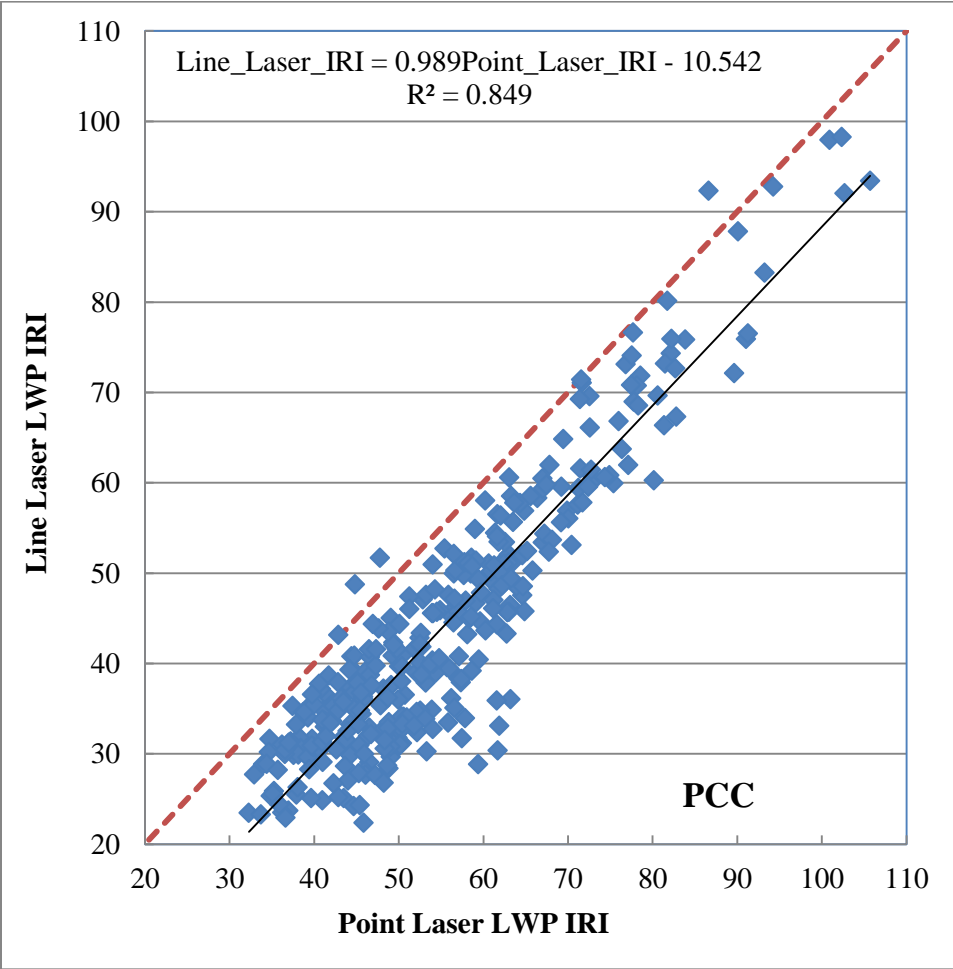
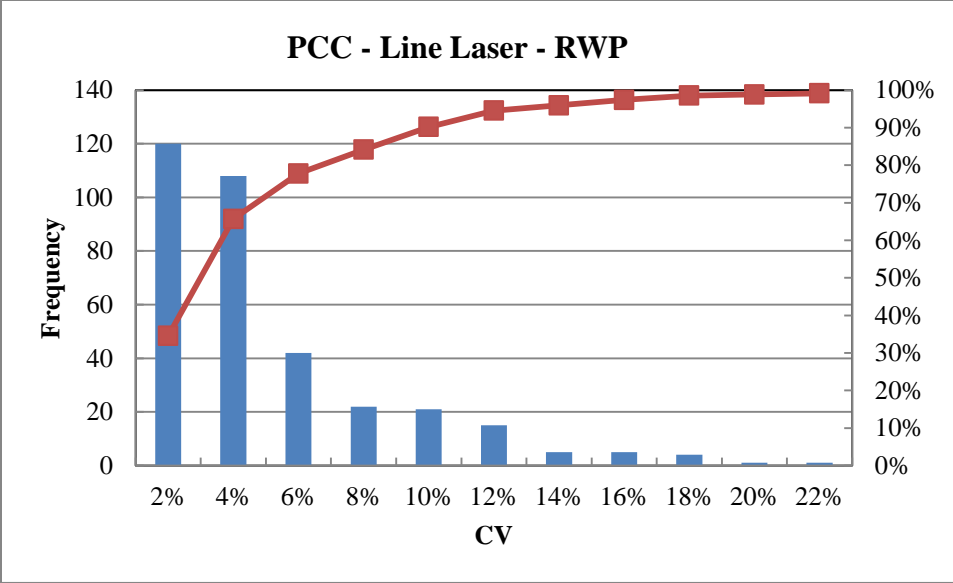


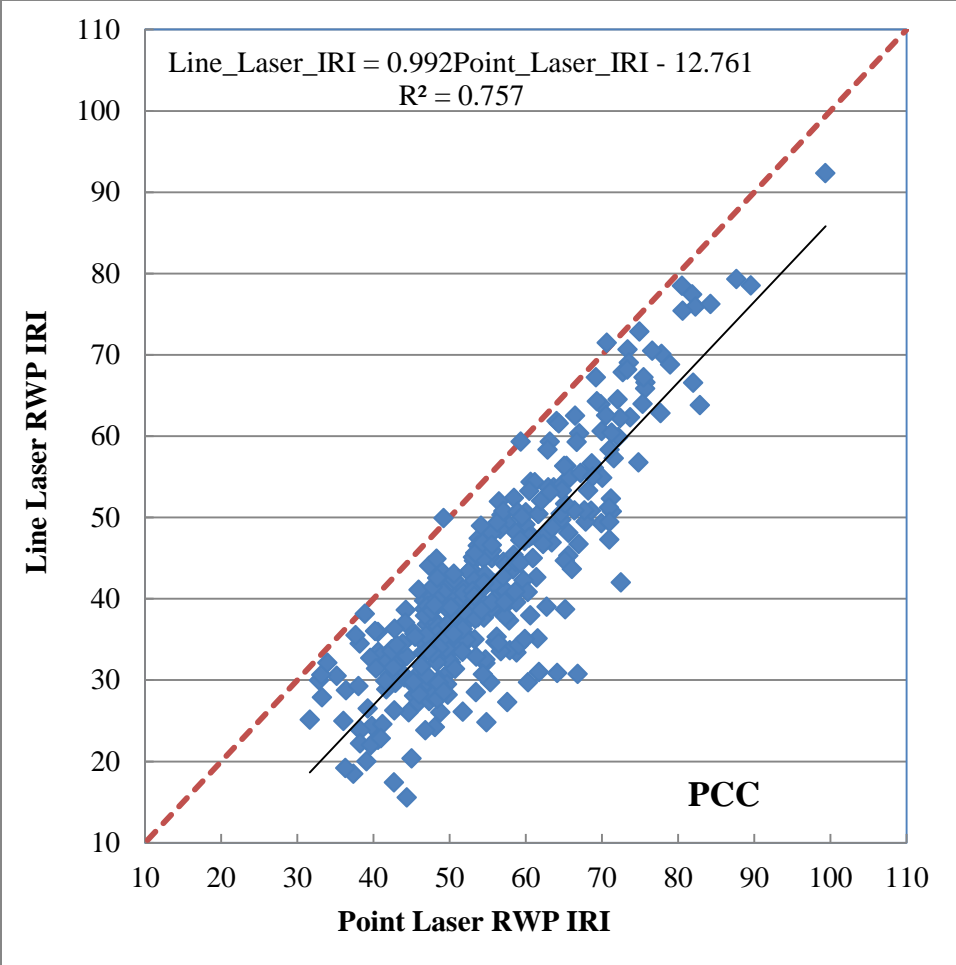
PCC - Coefficient of Variation:

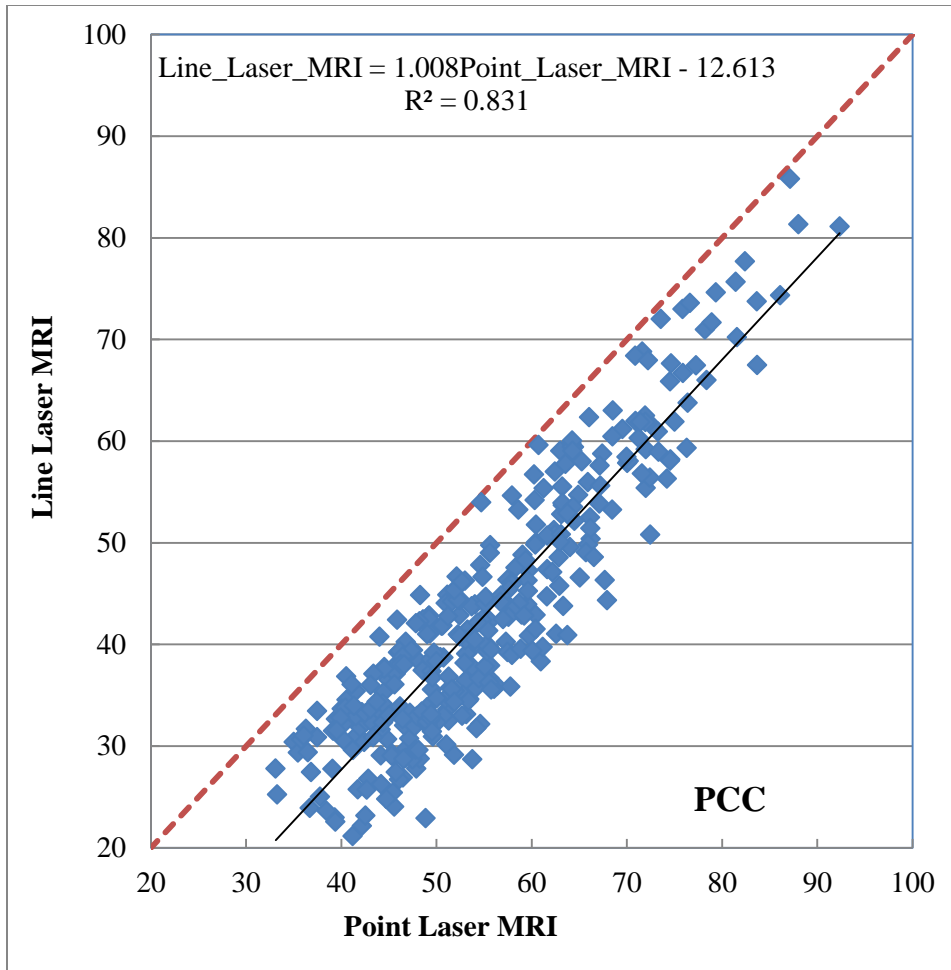
n = 347	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	4.33%	5.39%	3.76%	4.21%
Median	3.83%	4.74%	2.56%	2.87%
Standard Deviation	2.50%	3.29%	4.42%	4.22%
Minimum	0.28%	0.19%	0.09%	0.09%
Maximum	13.51%	16.91%	44.09%	27.23%











For PCC w/MRI < 96in./mile:

PCC w/MRI < 96in./mile - Paired t-test:

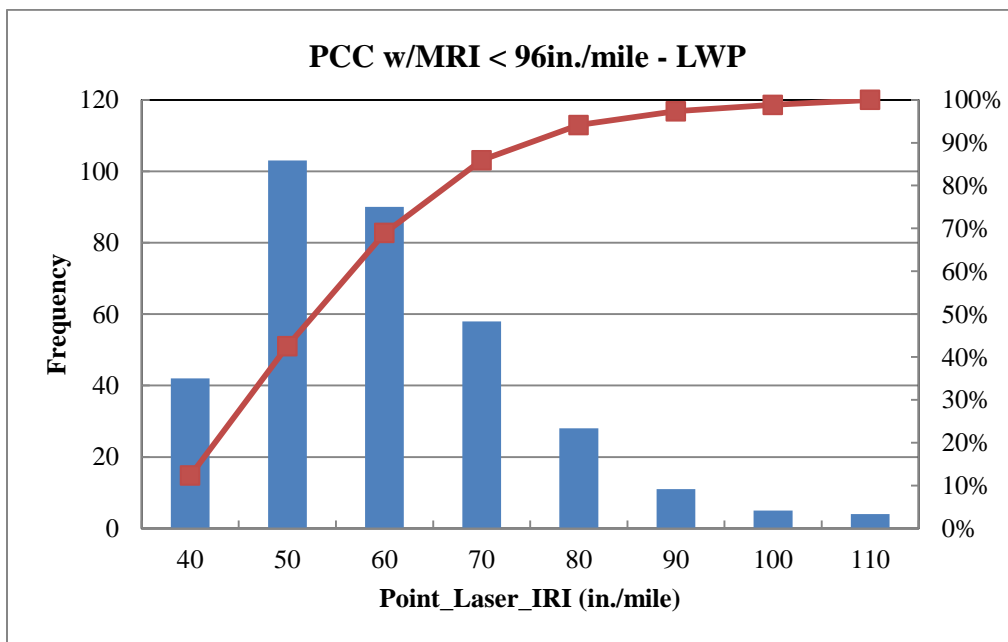
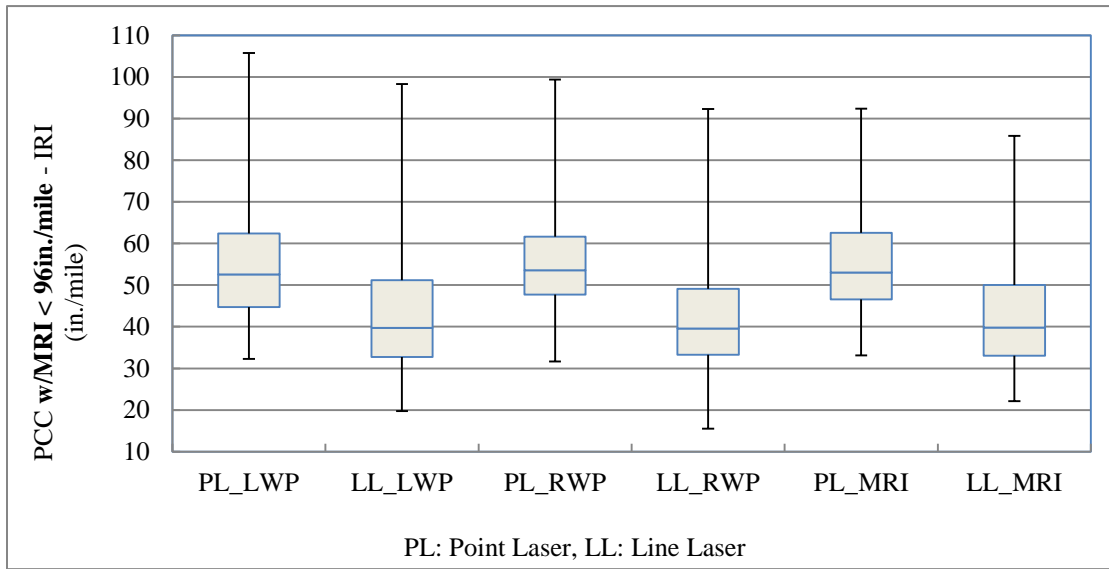
df = 340	LWP	RWP	MRI
t Stat	35.942	39.094	43.621
P(T<=t) one-tail	0.000	0.010	0.000
t Critical one-tail	1.649	1.649	1.649
P(T<=t) two-tail	0.000	0.000	0.000
t Critical two-tail	1.967	1.967	1.967
Reject H_0 ?	Yes	Yes	Yes

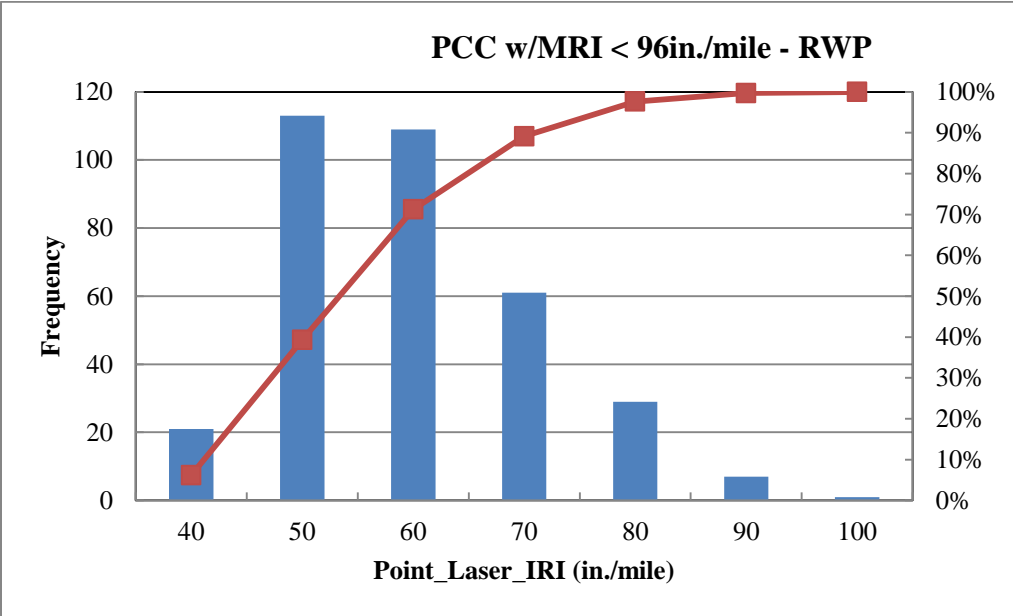
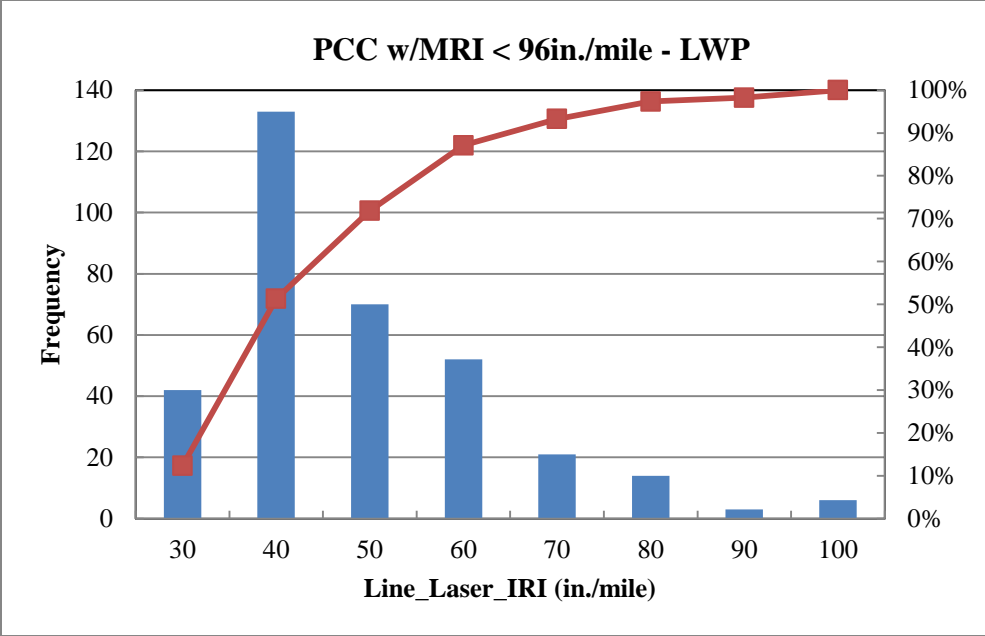
PCC w/MRI < 96in./mile - F-test:

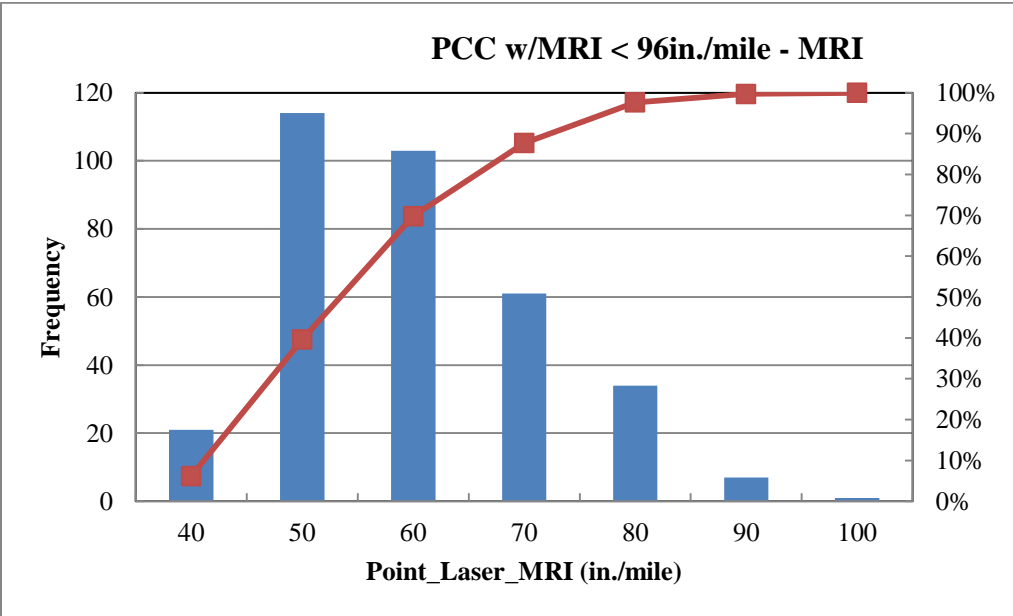
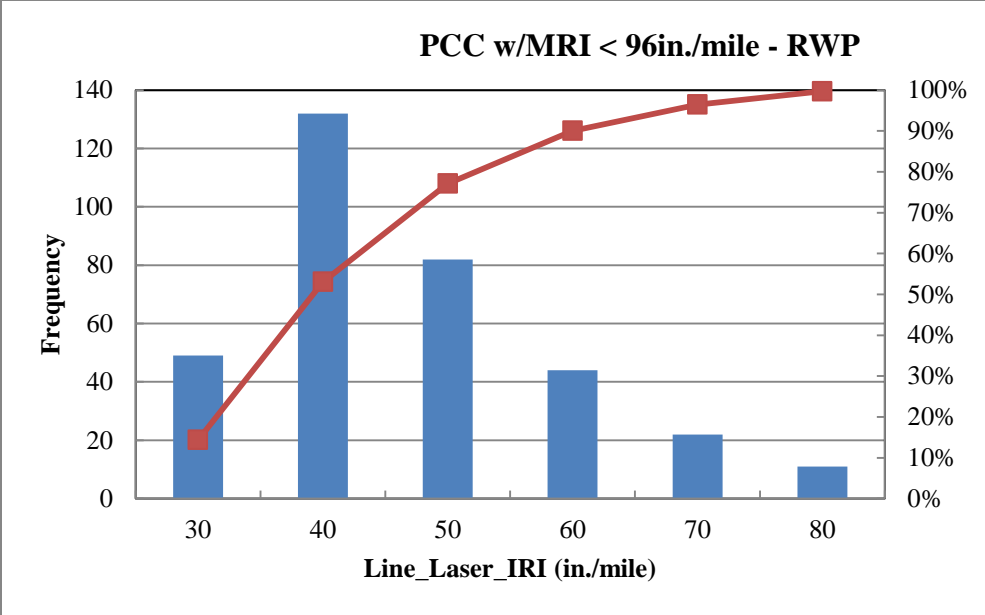
df = 340	LWP	RWP	MRI
F	1.133	1.286	1.205
P(F<=f) one-tail	0.124	0.010	0.043
F Critical one-tail	1.196	1.196	1.196
Reject H_0 ?	No	No	No

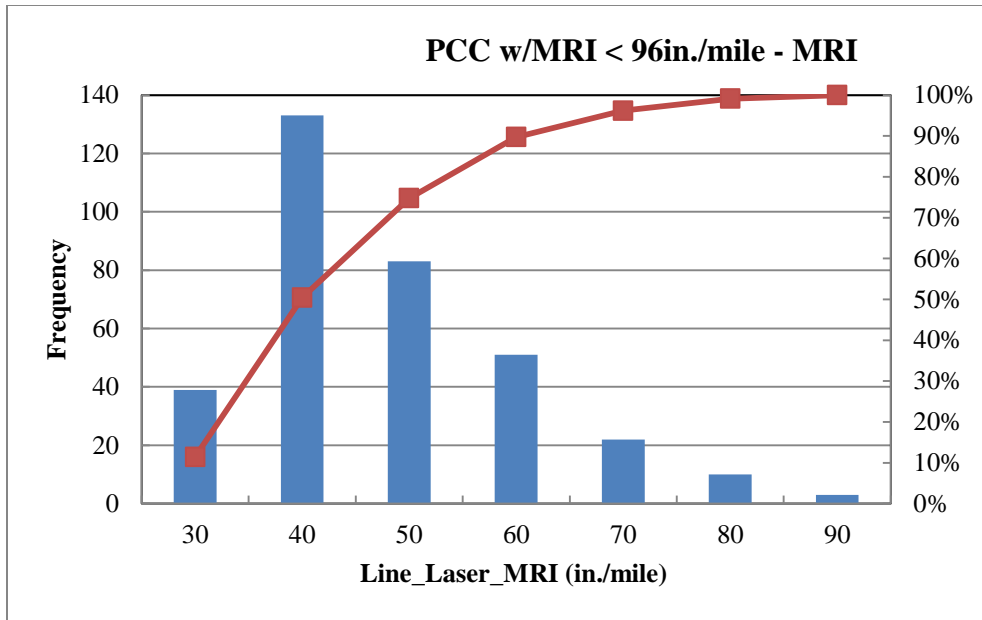
PCC w/MRI < 96in./mile - IRI:

n = 341	Point Laser			Line Laser		
	LWP	RWP	MRI	LWP	RWP	MRI
Mean (in./mile)	54.86	55.03	54.94	43.65	41.88	42.76
Median (in./mile)	52.58	53.55	53.06	39.71	39.55	39.80
Standard Deviation	13.89	11.01	11.30	14.78	12.49	12.40
Minimum (in./mile)	32.28	31.66	33.10	32.28	31.66	22.16
Maximum (in./mile)	105.72	99.38	92.35	105.72	99.38	85.82



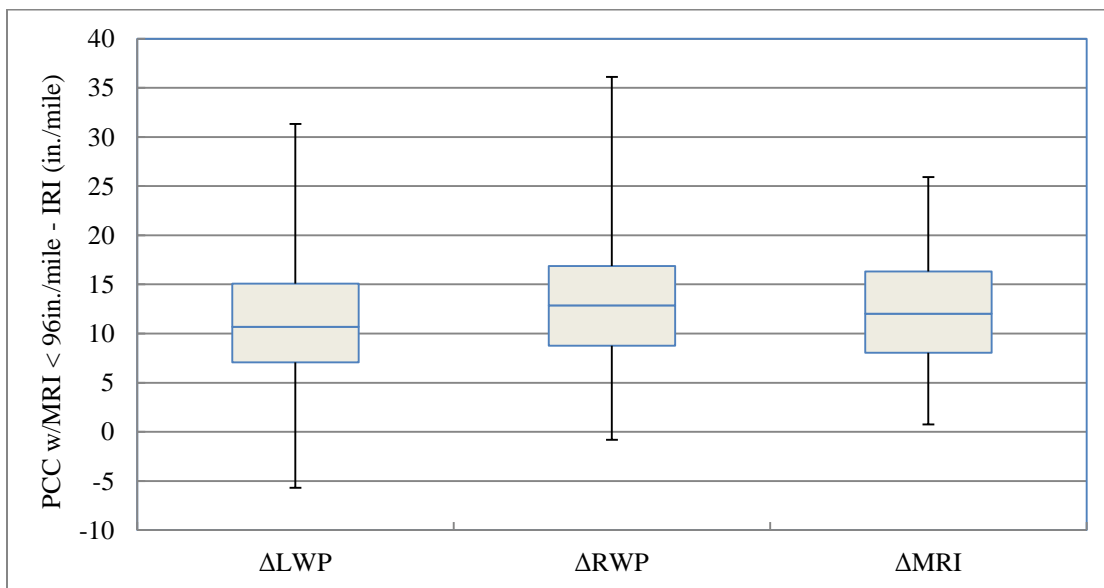


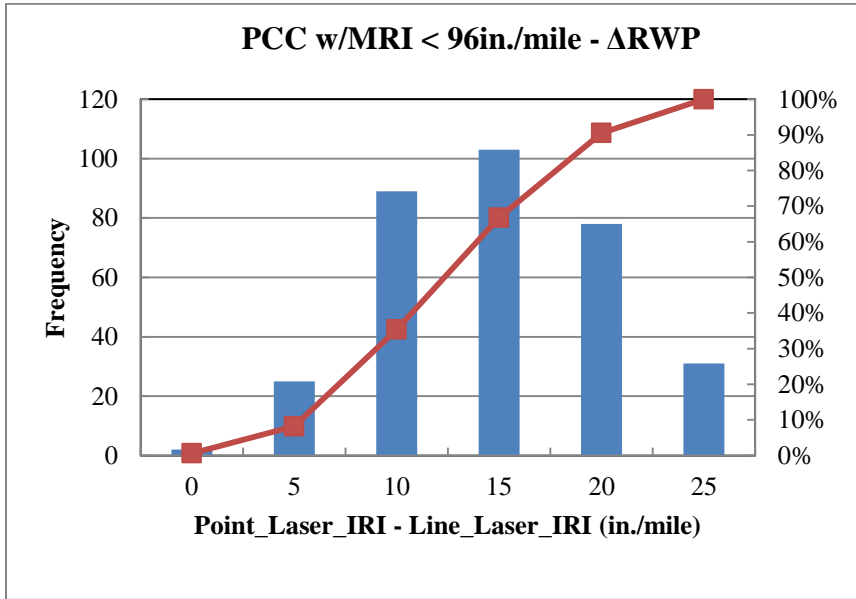
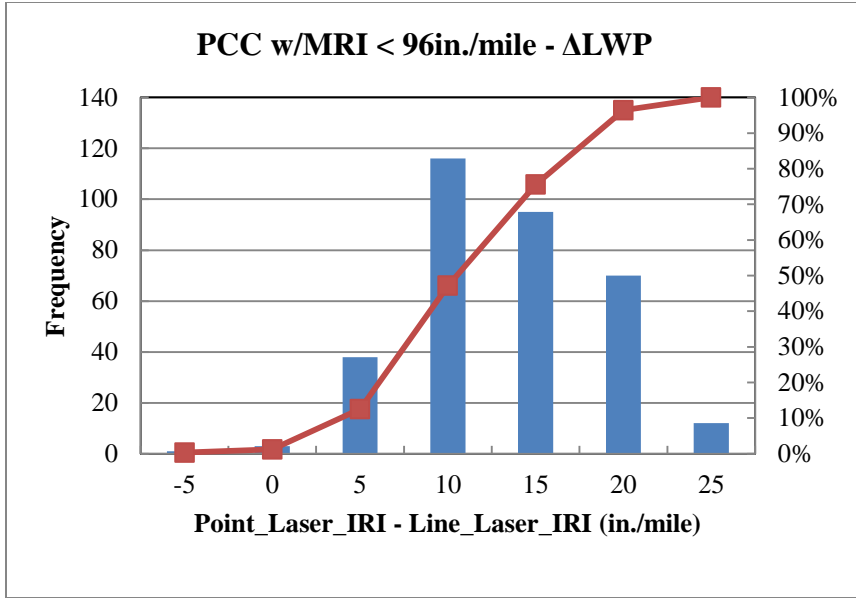


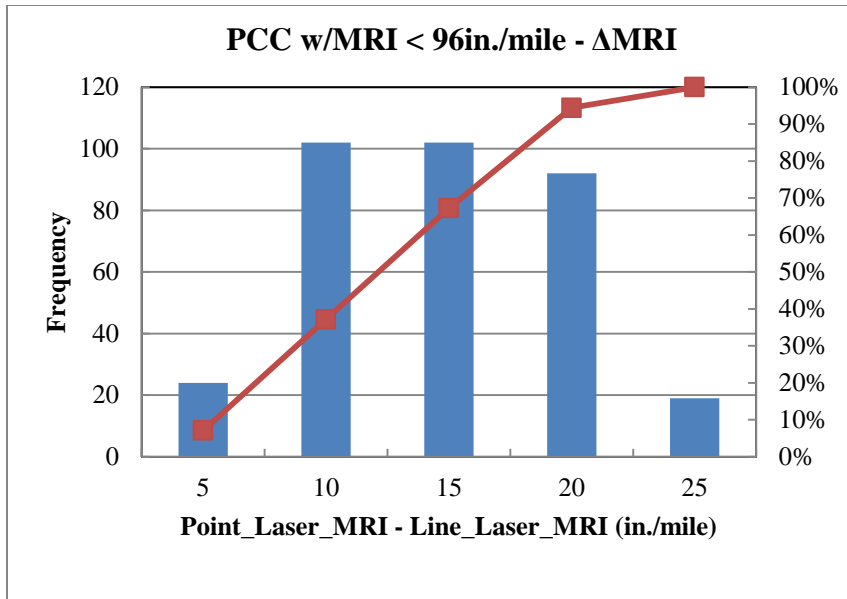


PCC w/MRI < 96in./mile - (Point Laser IRI – Line Laser IRI):

n = 341	Δ LWP	Δ RWP	Δ MRI
Mean (in./mile)	11.21	13.15	12.18
Median (in./mile)	10.69	12.87	12.01
Standard Deviation	5.76	6.21	5.16
Minimum (in./mile)	-5.70	-0.81	0.75
Maximum (in./mile)	31.31	36.12	25.93

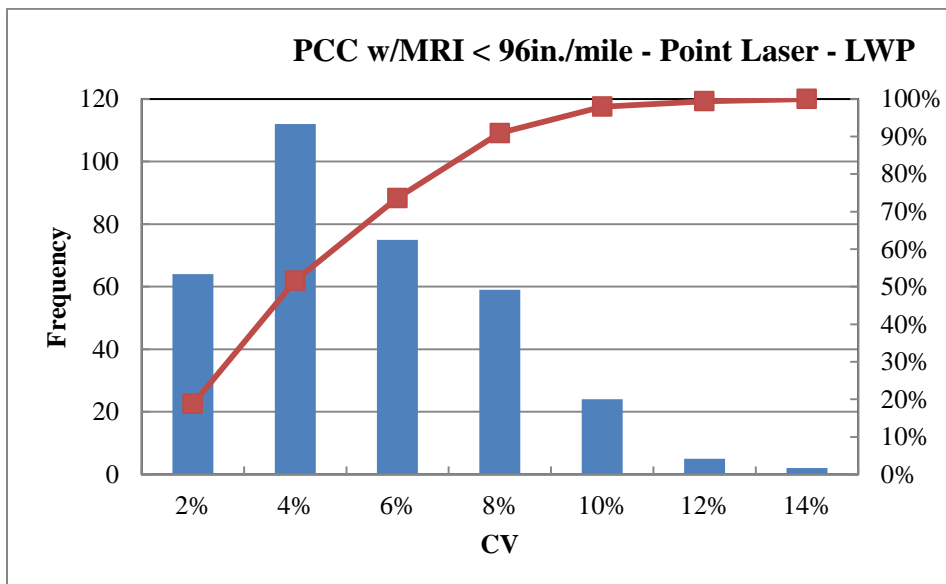


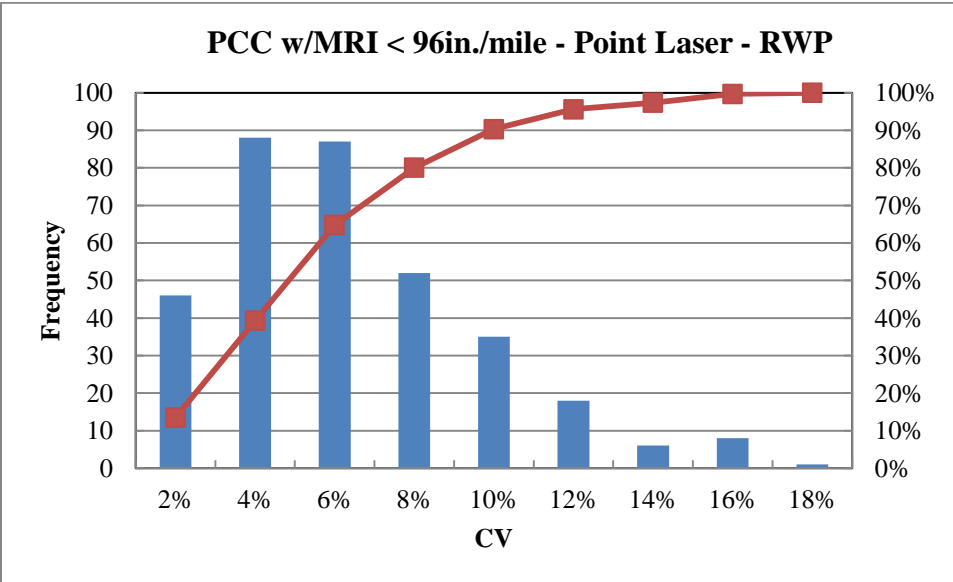
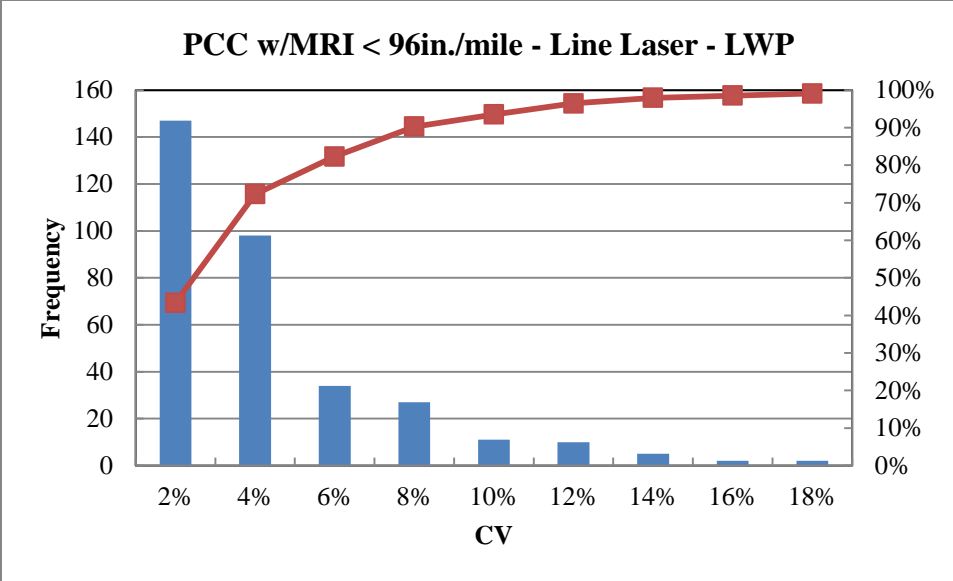


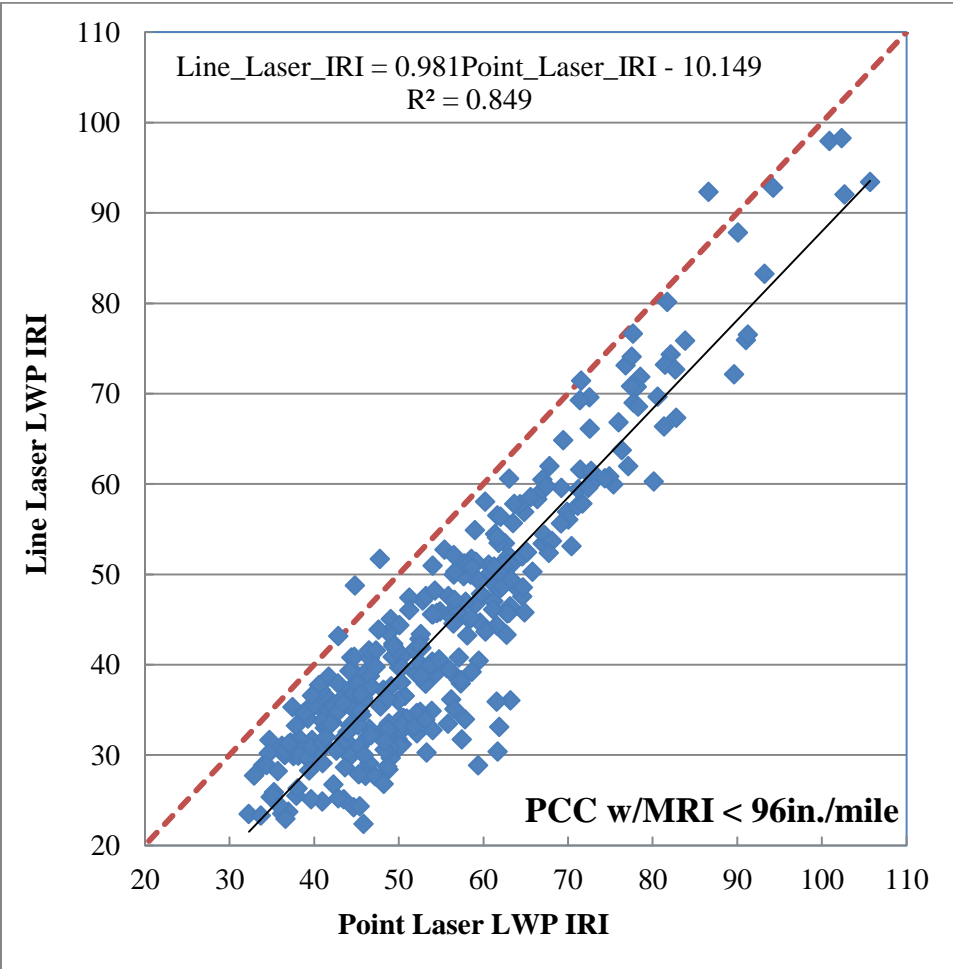
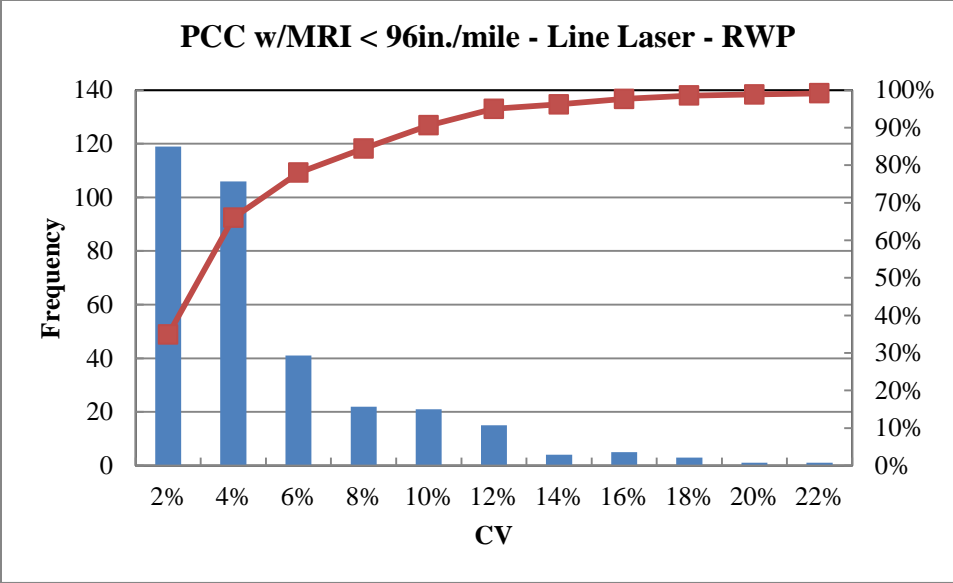


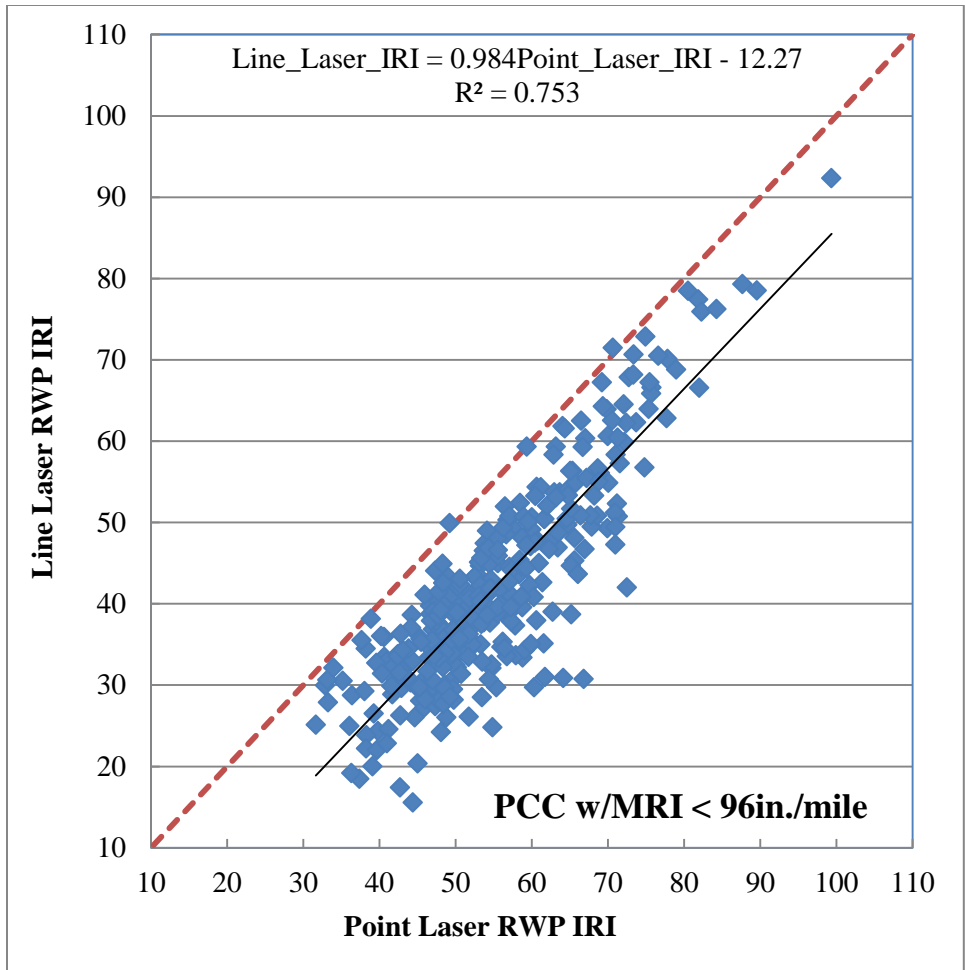
PCC w/MRI < 96in./mile - Coefficient of Variation:

n = 341	Point Laser		Line Laser	
	LWP	RWP	LWP	RWP
Mean	4.33%	5.39%	3.76%	4.21%
Median	3.83%	4.74%	2.56%	2.87%
Standard Deviation	2.50%	3.29%	4.42%	4.22%
Minimum	0.28%	0.19%	0.09%	0.09%
Maximum	13.51%	16.91%	44.09%	27.23%

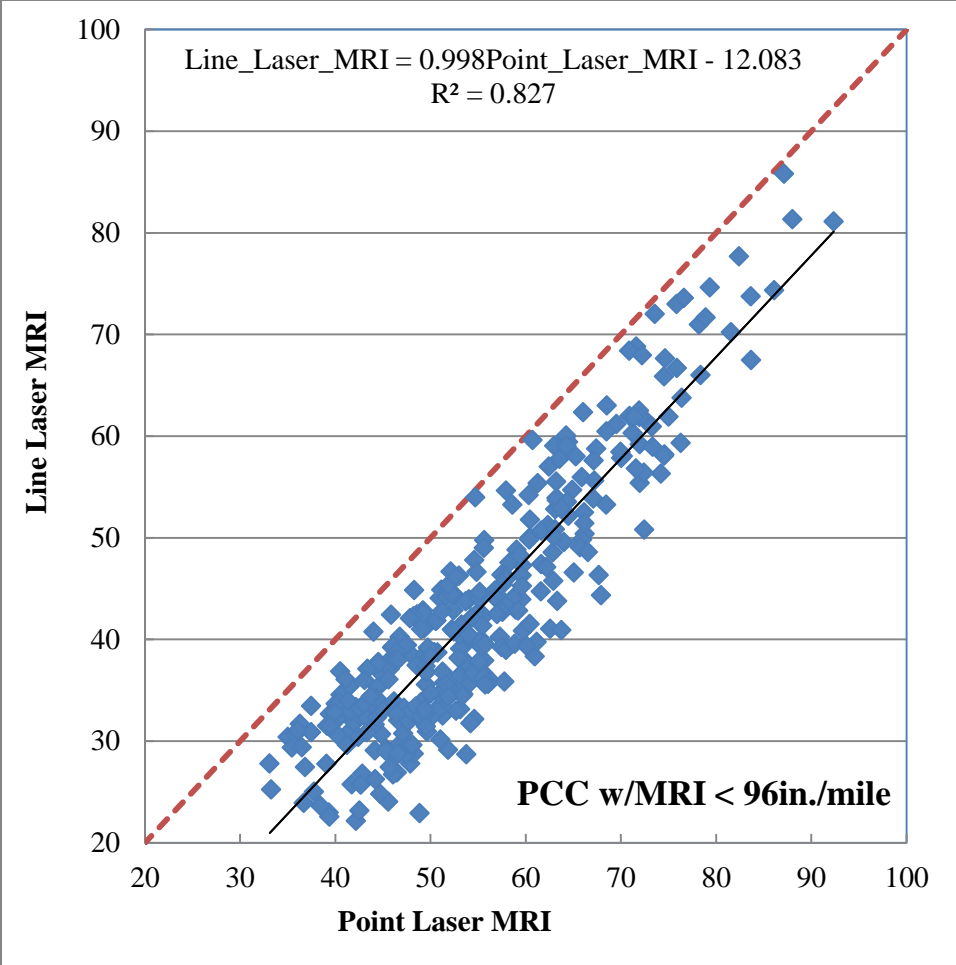








http://www.scdot.org/doing/technicalPDFs/supTechSpecs/PCC_Pavement_Rideability.pdf



Appendix 2: Recommended Updates for SC-M-403 Table 6

Initial Ride	107%	105%	100%	95%	Repair
57	< 45	45 - 55	56 - 80	81 - 86	> 86
58	< 45	45 - 55	56 - 80	81 - 86	> 86
59	< 45	45 - 55	56 - 80	81 - 86	> 86
60	< 45	45 - 55	56 - 80	81 - 86	> 86
61	< 45	45 - 55	56 - 80	81 - 86	> 86
62	< 45	45 - 55	56 - 80	81 - 86	> 86
63	< 45	45 - 55	56 - 80	81 - 86	> 86
64	< 45	45 - 55	56 - 80	81 - 86	> 86
65	< 45	45 - 55	56 - 80	81 - 87	> 87
66	< 45	45 - 55	56 - 80	81 - 87	> 87
67	< 45	45 - 55	56 - 80	81 - 88	> 88
67	< 45	45 - 55	56 - 80	81 - 88	> 88
68	< 45	45 - 55	56 - 80	81 - 89	> 89
69	< 45	45 - 55	56 - 80	81 - 89	> 89
70	< 45	45 - 55	56 - 80	81 - 90	> 90
71	< 45	45 - 55	56 - 80	81 - 90	> 90
72	< 45	45 - 55	56 - 80	81 - 91	> 91
73	< 45	45 - 55	56 - 81	82 - 91	> 91
74	< 45	45 - 55	56 - 81	82 - 92	> 92
75	< 45	45 - 55	56 - 81	82 - 92	> 92
76	< 45	45 - 55	56 - 82	83 - 93	> 93
77	< 45	45 - 55	56 - 82	83 - 93	> 93
78	< 45	45 - 55	56 - 82	83 - 93	> 93
79	< 45	45 - 55	56 - 82	83 - 94	> 94
80	< 45	45 - 55	56 - 83	84 - 94	> 94
81	< 45	45 - 55	56 - 83	84 - 95	> 95
82	< 45	45 - 55	56 - 83	84 - 95	> 95
83	< 45	45 - 55	56 - 84	85 - 96	> 96
84	< 45	45 - 55	56 - 84	85 - 96	> 96
85	< 45	45 - 55	56 - 84	85 - 96	> 96
86	< 45	45 - 55	56 - 84	85 - 96	> 96
86	< 45	45 - 55	56 - 85	86 - 97	> 97
87	< 45	45 - 55	56 - 85	86 - 97	> 97
88	< 45	45 - 55	56 - 85	86 - 97	> 97
89	< 45	45 - 55	56 - 86	87 - 98	> 98
90	< 45	45 - 55	56 - 86	87 - 98	> 98
91	< 45	45 - 55	56 - 86	87 - 98	> 98
92	< 45	45 - 55	56 - 86	87 - 98	> 98
93	< 45	45 - 55	56 - 87	88 - 100	> 100
94	< 45	45 - 55	56 - 87	88 - 100	> 100

Initial Ride	107%	105%	100%	95%	Repair
95	< 45	45 - 55	56 - 87	88 - 100	> 100
96	< 45	45 - 55	56 - 87	88 - 100	> 100
97	< 45	45 - 55	56 - 88	89 - 101	> 101
98	< 45	45 - 55	56 - 88	89 - 101	> 101
99	< 45	45 - 55	56 - 88	89 - 101	> 101
100	< 45	45 - 55	56 - 88	89 - 101	> 101
101	< 45	45 - 55	56 - 89	90 - 102	> 102
102	< 45	45 - 55	56 - 89	90 - 102	> 102
103	< 45	45 - 55	56 - 89	90 - 102	> 102
104	< 45	45 - 55	56 - 90	91 - 103	> 103
104	< 45	45 - 55	56 - 90	91 - 103	> 103
105	< 45	45 - 55	56 - 90	91 - 103	> 103
106	< 45	45 - 55	56 - 90	91 - 103	> 103
107	< 45	45 - 55	56 - 91	92 - 104	> 104
108	< 45	45 - 55	56 - 91	92 - 104	> 104
109	< 45	45 - 55	56 - 91	92 - 104	> 104
110	< 45	45 - 55	56 - 91	92 - 104	> 104
111	< 45	45 - 55	56 - 92	93 - 105	> 105
112	< 45	45 - 55	56 - 92	93 - 105	> 105
113	< 45	45 - 55	56 - 92	93 - 105	> 105
114	< 45	45 - 55	56 - 92	93 - 105	> 105
115	< 45	45 - 55	56 - 93	94 - 106	> 106
116	< 45	45 - 55	56 - 93	94 - 106	> 106
117	< 45	45 - 55	56 - 93	94 - 106	> 106
118	< 45	45 - 55	56 - 93	94 - 106	> 106
119	< 45	45 - 55	56 - 94	95 - 107	> 107
120	< 45	45 - 55	56 - 94	95 - 107	> 107
121	< 45	45 - 55	56 - 94	95 - 107	> 107
122	< 45	45 - 55	56 - 94	95 - 107	> 107
122	< 45	45 - 55	56 - 95	96 - 108	> 108
123	< 45	45 - 55	56 - 95	96 - 108	> 108
124	< 45	45 - 55	56 - 95	96 - 108	> 108
125	< 45	45 - 55	56 - 95	96 - 108	> 108
126	< 45	45 - 55	56 - 96	97 - 109	> 109
127	< 45	45 - 55	56 - 96	97 - 109	> 109
128	< 45	45 - 55	56 - 96	97 - 109	> 109
129	< 45	45 - 55	56 - 96	97 - 109	> 109
130	< 45	45 - 55	56 - 96	97 - 109	> 109
131	< 45	45 - 55	56 - 97	98 - 110	> 110
132	< 45	45 - 55	56 - 97	98 - 110	> 110

Initial Ride	107%	105%	100%	95%	Repair
133	< 45	45 - 55	56 - 97	98 - 110	> 110
134	< 45	45 - 55	56 - 98	99 - 111	> 111
135	< 45	45 - 55	56 - 98	99 - 111	> 111
136	< 45	45 - 55	56 - 98	99 - 111	> 111
137	< 45	45 - 55	56 - 98	99 - 111	> 111
138	< 45	45 - 55	56 - 100	101 - 112	> 112
139	< 45	45 - 55	56 - 100	101 - 112	> 112
140	< 45	45 - 55	56 - 100	101 - 112	> 112
140	< 45	45 - 55	56 - 100	101 - 112	> 112
141	< 45	45 - 55	56 - 101	102 - 113	> 113
142	< 45	45 - 55	56 - 101	102 - 113	> 113
143	< 45	45 - 55	56 - 101	102 - 113	> 113
144	< 45	45 - 55	56 - 101	102 - 113	> 113
145	< 45	45 - 55	56 - 101	102 - 113	> 113
146	< 45	45 - 55	56 - 102	103 - 114	> 114
147	< 45	45 - 55	56 - 102	103 - 114	> 114
148	< 45	45 - 55	56 - 102	103 - 114	> 114
149	< 45	45 - 55	56 - 102	103 - 114	> 114
150	< 46	46 - 56	57 - 103	104 - 115	> 115
151	< 46	46 - 56	57 - 103	104 - 115	> 115
152	< 46	46 - 56	57 - 103	104 - 115	> 115
153	< 46	46 - 56	57 - 103	104 - 115	> 115
154	< 47	47 - 57	58 - 104	105 - 116	> 116
155	< 47	47 - 57	58 - 104	105 - 116	> 116
156	< 47	47 - 57	58 - 104	105 - 116	> 116
157	< 47	47 - 57	58 - 104	105 - 116	> 116
158	< 48	48 - 58	59 - 105	106 - 117	> 117
159	< 48	48 - 58	59 - 105	106 - 117	> 117
159	< 48	48 - 58	59 - 105	106 - 117	> 117
160	< 48	48 - 58	59 - 105	106 - 117	> 117
161	< 48	48 - 58	59 - 105	106 - 117	> 117
162	< 49	49 - 59	60 - 106	107 - 118	> 118
163	< 49	49 - 59	60 - 106	107 - 118	> 118
164	< 49	49 - 59	60 - 106	107 - 118	> 118
165	< 49	49 - 59	60 - 106	107 - 118	> 118
166	< 50	50 - 60	61 - 107	108 - 119	> 119
167	< 50	50 - 60	61 - 107	108 - 119	> 119
168	< 50	50 - 60	61 - 107	108 - 119	> 119
169	< 50	50 - 60	61 - 107	108 - 119	> 119
170	< 51	51 - 61	62 - 108	109 - 120	> 120

Initial Ride	107%	105%	100%	95%	Repair
171	< 51	51 - 61	62 - 108	109 - 120	> 120
172	< 51	51 - 61	62 - 108	109 - 120	> 120
173	< 51	51 - 61	62 - 108	109 - 120	> 120
174	< 51	51 - 61	62 - 108	109 - 120	> 120
175	< 52	52 - 62	63 - 109	110 - 121	> 121
176	< 52	52 - 62	63 - 109	110 - 121	> 121
177	< 52	52 - 62	63 - 109	110 - 121	> 121
177	< 52	52 - 62	63 - 109	110 - 121	> 121
178	< 53	53 - 63	64 - 110	111 - 122	> 122
179	< 53	53 - 63	64 - 110	111 - 122	> 122
180	< 53	53 - 63	64 - 110	111 - 122	> 122
181	< 53	53 - 63	64 - 110	111 - 122	> 122
182	< 53	53 - 63	64 - 110	111 - 122	> 122
183	< 55	55 - 64	65 - 111	112 - 123	> 123
184	< 55	55 - 64	65 - 111	112 - 123	> 123
185	< 55	55 - 64	65 - 111	112 - 123	> 123
186	< 55	55 - 64	65 - 111	112 - 123	> 123
187	< 56	56 - 65	66 - 112	113 - 124	> 124
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189	< 56	56 - 65	66 - 112	113 - 124	> 124
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192	< 57	57 - 66	67 - 113	114 - 125	> 125
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199	< 58	58 - 67	68 - 114	115 - 126	> 126
200	< 59	59 - 68	69 - 115	116 - 127	> 127
201	< 59	59 - 68	69 - 115	116 - 127	> 127
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203	< 59	59 - 68	69 - 115	116 - 127	> 127
204	< 59	59 - 68	69 - 115	116 - 127	> 127
205	< 60	60 - 69	70 - 116	117 - 128	> 128
206	< 60	60 - 69	70 - 116	117 - 128	> 128
207	< 60	60 - 69	70 - 116	117 - 128	> 128
208	< 60	60 - 69	70 - 116	117 - 128	> 128

Initial Ride	107%	105%	100%	95%	Repair
209	< 60	60 - 69	70 - 116	117 - 128	> 128
210	< 61	61 - 70	71 - 117	118 - 129	> 129
211	< 61	61 - 70	71 - 117	118 - 129	> 129
212	< 61	61 - 70	71 - 117	118 - 129	> 129
213	< 61	61 - 70	71 - 117	118 - 129	> 129
213	< 62	62 - 71	72 - 118	119 - 130	> 130
214	< 62	62 - 71	72 - 118	119 - 130	> 130
215	< 62	62 - 71	72 - 118	119 - 130	> 130
216	< 62	62 - 71	72 - 118	119 - 130	> 130
217	< 62	62 - 71	72 - 118	119 - 130	> 130
218	< 63	63 - 72	73 - 119	120 - 131	> 131
219	< 63	63 - 72	73 - 119	120 - 131	> 131
220	< 63	63 - 72	73 - 119	120 - 131	> 131
221	< 63	63 - 72	73 - 119	120 - 131	> 131
222	< 63	63 - 72	73 - 119	120 - 131	> 131
223	< 64	64 - 73	74 - 120	121 - 132	> 132
224	< 64	64 - 73	74 - 120	121 - 132	> 132
225	< 64	64 - 73	74 - 120	121 - 132	> 132
226	< 64	64 - 73	74 - 120	121 - 132	> 132
227	< 64	64 - 73	74 - 120	121 - 132	> 132
228	< 65	65 - 74	75 - 121	122 - 133	> 133
229	< 65	65 - 74	75 - 121	122 - 133	> 133
230	< 65	65 - 74	75 - 121	122 - 133	> 133
231	< 65	65 - 74	75 - 121	122 - 133	> 133
232	< 65	65 - 74	75 - 121	122 - 133	> 133
232	< 66	66 - 75	76 - 122	123 - 134	> 134
233	< 66	66 - 75	76 - 122	123 - 134	> 134
234	< 66	66 - 75	76 - 122	123 - 134	> 134
235	< 66	66 - 75	76 - 122	123 - 134	> 134
236	< 66	66 - 75	76 - 122	123 - 134	> 134
237	< 67	67 - 76	77 - 123	124 - 135	> 135
238	< 67	67 - 76	77 - 123	124 - 135	> 135
239	< 67	67 - 76	77 - 123	124 - 135	> 135
240	< 67	67 - 76	77 - 123	124 - 135	> 135
241	< 67	67 - 76	77 - 123	124 - 135	> 135
242	< 68	68 - 77	78 - 124	125 - 136	> 136
243	< 68	68 - 77	78 - 124	125 - 136	> 136
244	< 68	68 - 77	78 - 124	125 - 136	> 136
245	< 68	68 - 77	78 - 124	125 - 136	> 136
246	< 68	68 - 77	78 - 124	125 - 136	> 136

Initial Ride	107%	105%	100%	95%	Repair
247	< 69	69 - 78	79 - 125	126 - 137	> 137
248	< 69	69 - 78	79 - 125	126 - 137	> 137
249	< 69	69 - 78	79 - 125	126 - 137	> 137
250	< 69	69 - 78	79 - 125	126 - 137	> 137
250	< 69	69 - 78	79 - 125	126 - 137	> 137
251	< 70	70 - 79	80 - 126	127 - 138	> 138
252	< 70	70 - 79	80 - 126	127 - 138	> 138
253	< 70	70 - 79	80 - 126	127 - 138	> 138
254	< 70	70 - 79	80 - 126	127 - 138	> 138
255	< 70	70 - 79	80 - 126	127 - 138	> 138
256	< 71	71 - 80	81 - 127	128 - 139	> 139
257	< 71	71 - 80	81 - 127	128 - 139	> 139
258	< 71	71 - 80	81 - 127	128 - 139	> 139
259	< 71	71 - 80	81 - 127	128 - 139	> 139
260	< 71	71 - 80	81 - 127	128 - 139	> 139
261	< 72	72 - 81	82 - 128	129 - 140	> 140
262	< 72	72 - 81	82 - 128	129 - 140	> 140
263	< 72	72 - 81	82 - 128	129 - 140	> 140
264	< 72	72 - 81	82 - 128	129 - 140	> 140
265	< 72	72 - 81	82 - 128	129 - 140	> 140
266	< 73	73 - 82	83 - 129	130 - 141	> 141
267	< 73	73 - 82	83 - 129	130 - 141	> 141
268	< 73	73 - 82	83 - 129	130 - 141	> 141
268	< 73	73 - 82	83 - 129	130 - 141	> 141
269	< 73	73 - 82	83 - 129	130 - 141	> 141
270	< 74	74 - 83	84 - 130	131 - 142	> 142
271	< 74	74 - 83	84 - 130	131 - 142	> 142
272	< 74	74 - 83	84 - 130	131 - 142	> 142
273	< 74	74 - 83	84 - 130	131 - 142	> 142
274	< 74	74 - 83	84 - 130	131 - 142	> 142
275	< 74	74 - 83	84 - 130	131 - 142	> 142
276	< 75	75 - 84	85 - 131	132 - 144	> 144
277	< 75	75 - 84	85 - 131	132 - 144	> 144
278	< 75	75 - 84	85 - 131	132 - 144	> 144
279	< 75	75 - 84	85 - 131	132 - 144	> 144
280	< 75	75 - 84	85 - 131	132 - 144	> 144
281	< 76	76 - 85	86 - 132	133 - 145	> 145
282	< 76	76 - 85	86 - 132	133 - 145	> 145
283	< 76	76 - 85	86 - 132	133 - 145	> 145
284	< 76	76 - 85	86 - 132	133 - 145	> 145

Initial Ride	107%	105%	100%	95%	Repair
285	< 76	76 - 85	86 - 132	133 - 145	> 145
286	< 77	77 - 86	87 - 133	134 - 146	> 146
286	< 77	77 - 86	87 - 133	134 - 146	> 146
287	< 77	77 - 86	87 - 133	134 - 146	> 146
288	< 77	77 - 86	87 - 133	134 - 146	> 146
289	< 77	77 - 86	87 - 133	134 - 146	> 146
290	< 78	78 - 87	88 - 134	135 - 147	> 147
291	< 78	78 - 87	88 - 134	135 - 147	> 147
292	< 78	78 - 87	88 - 134	135 - 147	> 147
293	< 78	78 - 87	88 - 134	135 - 147	> 147
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295	< 78	78 - 87	88 - 134	135 - 147	> 147
296	< 79	79 - 88	89 - 135	136 - 148	> 148
297	< 79	79 - 88	89 - 135	136 - 148	> 148
298	< 79	79 - 88	89 - 135	136 - 148	> 148
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302	< 80	80 - 89	90 - 136	137 - 149	> 149
303	< 80	80 - 89	90 - 136	137 - 149	> 149
304	< 80	80 - 89	90 - 136	137 - 149	> 149
304	< 80	80 - 89	90 - 136	137 - 149	> 149
305	< 80	80 - 89	90 - 136	137 - 149	> 149
306	< 81	81 - 90	91 - 137	138 - 150	> 150
307	< 81	81 - 90	91 - 137	138 - 150	> 150
308	< 81	81 - 90	91 - 137	138 - 150	> 150
309	< 81	81 - 90	91 - 137	138 - 150	> 150
310	< 81	81 - 90	91 - 137	138 - 150	> 150
311	< 82	82 - 91	92 - 138	139 - 151	> 151
312	< 82	82 - 91	92 - 138	139 - 151	> 151
313	< 82	82 - 91	92 - 138	139 - 151	> 151
314	< 82	82 - 91	92 - 138	139 - 151	> 151
315	< 82	82 - 91	92 - 138	139 - 151	> 151
316	< 82	82 - 91	92 - 138	139 - 151	> 151
317	< 83	83 - 92	93 - 139	140 - 152	> 152
318	< 83	83 - 92	93 - 139	140 - 152	> 152
319	< 83	83 - 92	93 - 139	140 - 152	> 152
320	< 83	83 - 92	93 - 139	140 - 152	> 152
321	< 83	83 - 92	93 - 139	140 - 152	> 152
322	< 84	84 - 93	94 - 140	141 - 153	> 153

Initial Ride	107%	105%	100%	95%	Repair
323	< 84	84 - 93	94 - 140	141 - 153	> 153
323	< 84	84 - 93	94 - 140	141 - 153	> 153
324	< 84	84 - 93	94 - 140	141 - 153	> 153
325	< 84	84 - 93	94 - 140	141 - 153	> 153
326	< 84	84 - 93	94 - 140	141 - 153	> 153
327	< 85	85 - 94	95 - 141	142 - 154	> 154
328	< 85	85 - 94	95 - 141	142 - 154	> 154
329	< 85	85 - 94	95 - 141	142 - 154	> 154
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331	< 85	85 - 94	95 - 141	142 - 154	> 154
332	< 86	86 - 95	96 - 142	143 - 155	> 155
333	< 86	86 - 95	96 - 142	143 - 155	> 155
334	< 86	86 - 95	96 - 142	143 - 155	> 155
335	< 86	86 - 95	96 - 142	143 - 155	> 155
336	< 86	86 - 95	96 - 142	143 - 155	> 155
337	< 86	86 - 95	96 - 142	143 - 155	> 155
338	< 87	87 - 96	97 - 144	145 - 156	> 156
339	< 87	87 - 96	97 - 144	145 - 156	> 156
340	< 87	87 - 96	97 - 144	145 - 156	> 156
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343	< 88	88 - 97	98 - 145	146 - 157	> 157
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354	< 90	90 - 100	101 - 147	148 - 159	> 159
355	< 90	90 - 100	101 - 147	148 - 159	> 159
356	< 90	90 - 100	101 - 147	148 - 159	> 159
357	< 90	90 - 100	101 - 147	148 - 159	> 159
358	< 90	90 - 100	101 - 147	148 - 159	> 159
359	< 90	90 - 100	101 - 147	148 - 159	> 159
359	< 91	91 - 101	102 - 148	149 - 160	> 160

Initial Ride	107%	105%	100%	95%	Repair
360	< 91	91 - 101	102 - 148	149 - 160	> 160
361	< 91	91 - 101	102 - 148	149 - 160	> 160
362	< 91	91 - 101	102 - 148	149 - 160	> 160
363	< 91	91 - 101	102 - 148	149 - 160	> 160
364	< 91	91 - 101	102 - 148	149 - 160	> 160
365	< 92	92 - 102	103 - 149	150 - 161	> 161
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373	< 93	93 - 103	104 - 150	151 - 162	> 162
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375	< 93	93 - 103	104 - 150	151 - 162	> 162
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384	< 95	95 - 105	106 - 152	153 - 164	> 164
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386	< 95	95 - 105	106 - 152	153 - 164	> 164
387	< 95	95 - 105	106 - 152	153 - 164	> 164
388	< 96	96 - 106	107 - 153	154 - 165	> 165
389	< 96	96 - 106	107 - 153	154 - 165	> 165
390	< 96	96 - 106	107 - 153	154 - 165	> 165
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392	< 96	96 - 106	107 - 153	154 - 165	> 165
393	< 96	96 - 106	107 - 153	154 - 165	> 165
394	< 97	97 - 107	108 - 154	155 - 166	> 166
395	< 97	97 - 107	108 - 154	155 - 166	> 166
396	< 97	97 - 107	108 - 154	155 - 166	> 166
396	< 97	97 - 107	108 - 154	155 - 166	> 166
397	< 97	97 - 107	108 - 154	155 - 166	> 166

Initial Ride	107%	105%	100%	95%	Repair
398	< 97	97 - 107	108 - 154	155 - 166	> 166
399	< 98	98 - 108	109 - 155	156 - 167	> 167
400	< 98	98 - 108	109 - 155	156 - 167	> 167
401	< 98	98 - 108	109 - 155	156 - 167	> 167
402	< 98	98 - 108	109 - 155	156 - 167	> 167
403	< 98	98 - 108	109 - 155	156 - 167	> 167
404	< 98	98 - 108	109 - 155	156 - 167	> 167
405	< 100	100 - 109	110 - 156	157 - 168	> 168
406	< 100	100 - 109	110 - 156	157 - 168	> 168
407	< 100	100 - 109	110 - 156	157 - 168	> 168
408	< 100	100 - 109	110 - 156	157 - 168	> 168
409	< 100	100 - 109	110 - 156	157 - 168	> 168
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412	< 101	101 - 110	111 - 157	158 - 169	> 169
413	< 101	101 - 110	111 - 157	158 - 169	> 169
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414	< 101	101 - 110	111 - 157	158 - 169	> 169
415	< 101	101 - 110	111 - 157	158 - 169	> 169
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417	< 102	102 - 111	112 - 158	159 - 170	> 170
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420	< 102	102 - 111	112 - 158	159 - 170	> 170
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432	< 104	104 - 113	114 - 160	161 - 172	> 172
433	< 104	104 - 113	114 - 160	161 - 172	> 172
434	< 105	105 - 114	115 - 161	162 - 173	> 173
435	< 105	105 - 114	115 - 161	162 - 173	> 173

Initial Ride	107%	105%	100%	95%	Repair
436	< 105	105 - 114	115 - 161	162 - 173	> 173
437	< 105	105 - 114	115 - 161	162 - 173	> 173
438	< 105	105 - 114	115 - 161	162 - 173	> 173
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443	< 106	106 - 115	116 - 162	163 - 174	> 174
444	< 106	106 - 115	116 - 162	163 - 174	> 174
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446	< 106	106 - 115	116 - 162	163 - 174	> 174
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448	< 107	107 - 116	117 - 163	164 - 175	> 175
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452	< 107	107 - 116	117 - 163	164 - 175	> 175
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454	< 108	108 - 117	118 - 164	165 - 176	> 176
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456	< 108	108 - 117	118 - 164	165 - 176	> 176
457	< 108	108 - 117	118 - 164	165 - 176	> 176
458	< 108	108 - 117	118 - 164	165 - 176	> 176
459	< 109	109 - 118	119 - 165	166 - 177	> 177
460	< 109	109 - 118	119 - 165	166 - 177	> 177
461	< 109	109 - 118	119 - 165	166 - 177	> 177
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463	< 109	109 - 118	119 - 165	166 - 177	> 177
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466	< 110	110 - 119	120 - 166	167 - 178	> 178
467	< 110	110 - 119	120 - 166	167 - 178	> 178
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469	< 110	110 - 119	120 - 166	167 - 178	> 178
469	< 110	110 - 119	120 - 166	167 - 178	> 178
470	< 110	110 - 119	120 - 166	167 - 178	> 178
471	< 111	111 - 120	121 - 167	168 - 179	> 179
472	< 111	111 - 120	121 - 167	168 - 179	> 179
473	< 111	111 - 120	121 - 167	168 - 179	> 179
474	< 111	111 - 120	121 - 167	168 - 179	> 179
475	< 111	111 - 120	121 - 167	168 - 179	> 179

Supplemental Technical Specification for

Rideability for Asphalt Mixtures

SCDOT Designation: SC-M-403 (3/16)

1. SCOPE

- 1.1. The Resident Construction Engineer (**RCE**) will evaluate asphalt surfaces for a satisfactory ride. If conditions permit and unless otherwise specified in the special provisions, the Materials and Research Engineer will test the asphalt surface in accordance with **SC-T-125** when requested by the **RCE**. General guidelines for the application of this specification are shown in Figure 1.
-

2. REFERENCED DOCUMENTS

- 2.1. **SC-T-125**, *Measurement of Pavement Rideability using the Dynatest 5051 Mark III Road Surface Profiler with LMI 3D Gocator series wheel path lasers.*
 - 2.2. **SC-M-502**
-

3. REQUIREMENTS FOR TESTING

- 3.1. For **SC-T-125** to be used, the following conditions must be met:
 - A constant speed of at least 35 miles per hour is maintainable throughout each section that measurements are made.
 - The sections to be tested have a final posted speed limit of at least 45 mph.
 - The project has at least 0.5 miles of pavement that may be tested without interruptions or exclusions (such as, but not limited to, bridges, stop signs, railroad crossings, speed limit below 45 mph, signalized intersections, or sharp curves posted for less than 35 mph.)
-

4. REQUIREMENTS FOR NEW CONSTRUCTION

- 4.1. On newly constructed roadway projects that include two or more uniform lifts of asphalt, the maximum acceptable IRI for full pay for each nominal 0.1-mile segment of vehicle lane, when tested in accordance with **SC-T-125**, is 65 inches per mile, with the following exceptions. If the new construction is directly tied to existing pavement for widening and the existing pavement is being overlaid with two or more lifts of asphalt, then Subsection 5.3 (Table 3.) applies to all adjacent new wheelpaths in a segment and direction unless the route is defined as limited access in Table 2. If the new construction is directly tied to existing pavement for widening and the existing pavement is being overlaid with a single lift of asphalt, then the requirements of Sections 6 or 7, as applicable, for a given segment and direction applies to all adjacent new wheelpaths unless the route is defined as limited

access in Table 2. Pay adjustments apply only to the course of asphalt that will constitute the final riding surface.

- 4.2. When the IRI value exceeds 65 (or 90 if Table 3. applies) inches per mile but does not exceed 80 (or 111 if Table 3. applies), then a price reduction will be made in accordance with Table 1 or Table 3 as applicable. Alternatively, the Contractor may elect to correct such deficient sections without additional compensation. Follow the requirements for repair in Subsection 10. If corrections are not made, then the price adjustment is based on the original contract unit price per ton of the asphalt modified according to Table 1 or Table 3, as applicable. Deduct as a lump sum the total amount of any reduction in payment from monies due.
- 4.3. Sections of roadway for which the IRI value is 81 (or 112 if Table 3. applies) inches per mile or above, as applicable, will be reviewed by the **RCE** on an individual basis. If the **RCE** determines that the section is unacceptable, remove the material and replace or overlay it subject to the approval of the **RCE**. Follow the requirements for repair in Subsection 9. Should the **DCE** determine that the material may remain in place and does not require an overlay or other corrective action, then a price adjustment will be assessed based on the applicable Schedule for Adjusted Payment. If corrections are not made, then the price adjustment is based on the original contract unit price per ton of the asphalt modified according to Table 1 or Table 3, as applicable. Deduct as a lump sum the total amount of any reduction in payment from monies due.

Table 1. Schedule For Adjusted Payment – New Construction and Multiple Lift Overlay on Interstate and Limited Access Segments	
Segment IRI (inches/mile)	Price Adjustment – Asphalt Final Riding Course
Less than 39	107%
39 – 43	105%
44 – 65	100%
66 – 70	95%
71 – 75	90%
76 – 80	80%
Greater than 80	For each additional increment of 5 inches per mile of roughness above 80 inches per mile, reduce payment by an additional 10% from 80% if the DCE determines the material may remain in place.

5. REQUIREMENTS FOR MULTIPLE LIFT RESURFACING PROJECTS

- 5.1. The requirements of this section apply to overlays of existing pavement with two or more asphalt lifts. A lift is defined as any asphalt mix applied at a specified contract application rate across the road segment.
- 5.2. Limited access segments that receive 2 lifts or more of asphalt will be tested in accordance with Subsection 4 with incentives and pay reductions assessed according to Table 1 regardless of the lift thicknesses. Limited access routes are defined as those listed in Table 2, Limited Access Routes.

Table 2. Limited Access Routes		
Route	Location	Comments
All routes designated as an interstate.	Statewide	
US 123	Pickens County	MP 3.1 to 17.6 only
SC 277	Richland County	Zoned 55 mph or greater
SC 22	Horry County	
SC 31	Horry County	

- 5.3. For resurfacing projects entailing 2 or more lifts of asphalt on routes not given in Table 2, the requirement for new construction, as given in Subsection 4, apply with the schedule for adjusted payment shown in Table 3 in lieu of Table 1.

Table 3. Schedule For Adjusted Payment – Multiple Lift Overlay on Non-Limited Access Segments and Reclamation	
Segment IRI (inches/mile)	Price Adjustment – Asphalt Final Riding Course
Less than 46	107%
46 – 54	105%
55 – 90	100%
91 – 95	95%
96 – 101	90%
102 – 106	85%
107 – 111	80%
Greater than 111	For each additional increment of 5 inches per mile of roughness above 111 inches per mile, reduce payment by an additional 10% from 80% if the DCE determines the material may remain in place.

6. REQUIREMENTS FOR RESURFACING PROJECTS OVER 150 PSY

- 6.1. The requirements of this section apply to overlays of existing pavement with a contract application rate of greater than 150 psy. When a resurfacing project involves two or more uniform asphalt lifts, the requirements for new pavement, as given in Subsection 4, apply. However, the rideability requirements as shown in Table 3 apply in lieu of Table 1, except for segments that are on interstate and limited access routes for which Table 1 applies. For single lift overlays, except OGFC, of existing pavement with a contract application rate of greater than 150 psy, all incentives and pay reductions will otherwise be assessed according to this Subsection. If the overlay is OGFC, then the requirements of Table 4 apply without regard to number and thickness of lifts.

Table 4. Schedule For Adjusted Payment – OGFC Overlay	
Segment IRI (inches/mile)	Price Adjustment – Asphalt Final Riding Course
Less than 31	107%
31 – 36	105%
37 – 57	100%
58 – 63	95%
64 – 68	90%
69 – 73	80%
Greater than 73	For each additional increment of 5 inches per mile of roughness above 73 inches per mile, reduce payment by an additional 10% from 80% if the DCE determines the material may remain in place.

- 6.2. Where applicable, the existing pavement will be tested by the Department in accordance with SC-T-125 or other method specified in the special provisions before any work is performed and then again on the finished surface. Payment for the final asphalt riding surface course will be made based on the improvement over the initial rideability for each 0.1 mile segment as shown in Table 6, Rideability Requirements for Resurfacing.
- 6.3. All pay adjustments apply only to the course of asphalt that will constitute the final riding surface. The asphalt mix tonnage subject to adjustment is based on the original plan quantity for the asphalt as shown on the typical section. The total amount of any reduction in payment is deducted as a lump sum from monies due. Where measurements on the finished surface exceeds the repair threshold limit for the corresponding initial roughness as given in the column titled “Repair” in Table 6, the Department, at the discretion of the **DCE**, may require corrective action or elect to apply a pay reduction to the asphalt final riding surface course in lieu of correction.
- 6.4. If the Department elects to require correction, correct such sections without additional compensation such that the finished surface has an acceptable rideability. Follow the requirements for repair in Subsection 10. Final rideability is considered acceptable when the repaired segment has a rideability value less than or equal to that shown in the “Repair” column. Segments requiring repair prior to acceptance are not eligible for payment in excess of 100%, however a 5% pay reduction will be applied if the post-repair rideability is in the range shown as “95%” in Table 6.
- 6.5. If the Department elects to apply a pay reduction as provided in Subsection 6.3, then the payment for asphalt tonnage for that segment will be made at 95% of the bid unit price minus an additional 2% for each inch per mile of roughness up to 20 inches per mile above the rideability value given in the “Repair” column of Table 6. For each additional inch of roughness per mile greater than the “Repair” value plus 20 inches per mile, an additional reduction of 4% per inch will apply. If the final rideability is 34 inches per mile or more above the repair threshold, the section would be accepted without pay for the material subject to reduction.

Example 1: A segment has an initial ride of 255 inches per mile. After overlay, the ride is 139 inches per mile, which is 1 inch per mile above the repair threshold. Payment for the section would be $(95\% - (2\% \times 1 \text{ inch})) = 93\%$ of the bid unit price for the surface lift.

Example 2: A segment has an initial ride of 255 inches per mile. After overlay, the ride is 158 inches per mile, which is 20 inches per mile above the repair threshold. Payment for the section would be $(95\% - (2\% \times 20 \text{ inches})) = 55\%$ of the bid unit price for the surface lift.

Example 3: A segment has an initial ride of 255 inches per mile. After overlay, the ride is 159 inches per mile, which is 21 inches per mile above the repair threshold. Payment for the section would be $(95\% - (2\% \times 20 \text{ inches}) - (4\% \times 1 \text{ inch})) = 51\%$ of the bid unit price for the surface lift.

Example 4: A segment has an initial ride of 255 inches per mile. After overlay, the ride is 172 inches per mile, which is 34 inches per mile above the repair threshold. The ASPHALT final riding course for the segment would be accepted without pay.

7. REQUIREMENTS FOR SINGLE LIFT OVERLAYS LESS THAN OR EQUAL TO 150 PSY

- 7.1. The requirements for this section apply to overlays with a contract application rate less than or equal to 150 psy, except for OGFC. If the overlay is OGFC, then the requirements of Table 4 apply.
- 7.2. Where applicable, the existing pavement will be tested by the Department in accordance with SC-T-125 or other method specified in the special provisions before any work is performed and then again on the finished surface. Payment for the final asphalt riding surface course will be made based on the change in final rideability over the initial rideability for each 0.1 mile segment.
- 7.3. For overlays where this subsection applies and the initial ride is 142 inches per mile or less, full payment is made if the final rideability is less than or equal to the initial rideability.
- 7.4. For overlays where this subsection applies and the initial ride is greater than 142 inches per mile and less than or equal to 157 inches per mile, full payment is made if the final rideability is less than or equal to 142 inches per mile.
- 7.5. For overlays where this subsection applies and the initial ride is greater than 158 inches per mile, full payment is made if the final rideability is less than or equal to the initial rideability times 0.9, rounded up to the nearest whole number.

- 7.6. The repair threshold for a segment is 1.1 times the full payment rideability value rounded up to the nearest whole number.
- 7.7. If the final ride for a segment is greater than the full-payment rideability, but less than or equal to the repair threshold, payment on the asphalt final riding surface for that segment is made at 95% of the unit bid price.
- 7.8. If the final ride for a segment is greater than the repair threshold, the Department, at the discretion of the **DCE**, may elect to require repairs to correct the rideability or apply a pay reduction.
- 7.9. If the Department elects to require correction, correct such sections without additional compensation such that the finished surface has an acceptable rideability. Follow the requirements for repair in Subsection 10. Final rideability is considered acceptable when the repaired segment has a rideability value less than or equal to the repair threshold. A 5% pay reduction will be applied if the post-repair rideability is in the range given in Subsection 7.7.
- 7.10. If the Department elects to apply a pay reduction, then payment for asphalt mixture quantity for that segment will be made as given in Section 6.5, except that the repair threshold is determined as given in Section 7.6.

8. REQUIREMENTS FOR RECLAMATION PROJECTS

- 8.1. The requirements for this section apply to segments where the existing pavement has been reclaimed in accordance with Section 306 of the Standard Specifications, including any applicable Special Provisions, Supplemental Specifications, or other addenda, prior to overlay with asphalt or bituminous surfacing.
- 8.2. If the reclamation is being overlaid with a single lift of asphalt surface, ensure that the final rideability is 133 inches per mile or less. All incentive and pay reductions will follow Subsection 6 of this specification for a pre-overlay rideability of 286 inches per mile, regardless of asphalt thickness of the single lift.
- 8.3. If the reclamation is being overlaid with multiple uniform lifts of asphalt, then ensure that the rideability meets the requirements for new construction as given in Subsection 4 of this specification except that the rideability requirements are as shown Table 3, instead of Table 1. All incentives and pay reductions will otherwise be assessed according to Subsection 5.

9. REQUIREMENTS FOR SURFACE PLANING (MICRO-MILLING)

- 9.1. A 1156 foot test section will be constructed as per Section 4.1 of Special Provision titled Surface Planing of Asphalt Pavement. The test section will be tested by the Department for rideability following Subsection 9.4 The maximum acceptable rideability is 78 inches per mile for each 0.1 mile segment. The first and last 50 feet of the test section will not be included in the two 0.1 mile segments. **The RCE will provide the SCDOT Office of Materials and Research with at least three business days of notice prior to the need of rideability testing.**
- 9.2. If rideability is not met on this section, do no further work and provide a written plan of action to the RCE detailing what steps will be taken to improve operations. The RCE may require corrective action to the test section prior to acceptance or accept the test section as is. Once the plan has been approved by the RCE, construct a second test section at a different location from the first. If the second test section meets the requirements and is approved by the RCE, continuous milling may commence. If the second test section fails to meet the requirements, continue to construct test 1156 foot sections until satisfactory results are achieved.
- 9.3. The Department will test and accept the milled surface for rideability as given in Subsections 9.4 through 9.6. The Adjusted Schedule of Payment given in Table 5 below will apply to the contract unit price for the micro-milling as given in Subsection 6 of the Micro-Milling special provision.
- 9.4. *Testing*
- 9.4.1. When existing Asphalt Pavement is milled as a means to improve the rideability and surface characteristics, the pavement is tested according to **SC-T-125**, however **SC-T-125** is modified such that the IRI measured for each wheelpath is averaged and the average value is reported for the section. The section will be tested with the profiler three times and the three IRI values are averaged to determine the overall IRI for the section. The testing will be performed by the Department's Pavement Evaluation Unit after all grinding operations are complete if the pavement meets the requirements of Subsection 4.2. The International Roughness Index (IRI) is reported in inches per mile in 0.1-mile nominal lots.
- 9.5. *Rideability*
- 9.5.1. The pavement is considered acceptable if the IRI roughness is 87 inches per mile or less after grinding operations are complete unless otherwise specified in the Special Provisions. Based on the measured roughness, the contract unit price for Grinding and Texturing Existing Pavement is adjusted according to Table 5, shown below.

Table 5. Schedule For Adjusted Payment – Micro-Milling	
IRI Roughness (inches/mile)	Adjusted Unit Price
Less than or equal to 48	125%
49 - 62	110%
63 - 78	100%
79 - 87	90%
Greater than 87	Corrective Action Required

9.6. *Further Corrective Action*

9.6.1. In the event that the initial IRI of the ground surface is greater than 87 inches per mile, perform further work on the pavement such that the IRI is reduced to 87 inches per mile or less at no expense to the Department. Additional remedial work may also be optionally conducted at lower initial IRI roughness levels. Prior to any corrective action, submit a written remediation plan to the RCE for approval. Conduct no corrective work until the RCE has approved the written plan. If the initial IRI roughness is less than 79 inches per mile, the Department reserves the right to reject any additional corrective work if, in the Department’s opinion, additional work will be detrimental to the pavement or reduce the pavement thickness excessively. The final adjusted unit price for Grinding and Texturing Existing Pavement is determined based on Table 5 and the IRI measured after corrective action is applied.

10. REQUIREMENTS FOR REPAIR

10.1. This section covers the requirements for the repairs of surface deficiencies elected by either the Contractor or Department, as applicable.

10.2. Obtain written approval of the **RCE** for the method of correcting the surface deficiencies; however under no circumstances shall the pavement be subject to an artificial heat source over 175°F. If repairs consist of patching, then ensure that the patches are the full width of the lane. Also, when patches are less than 250 feet apart, combine the patches into one continuous patch, unless otherwise directed by the RCE.

10.3. The RCE may withhold payment for the asphalt (or portion thereof) until the deficiencies have been corrected, and the surface is re-tested and provides an acceptably smooth ride.

10.4. No more than 100% of the contract unit price will be paid for sections where corrective work has been made.

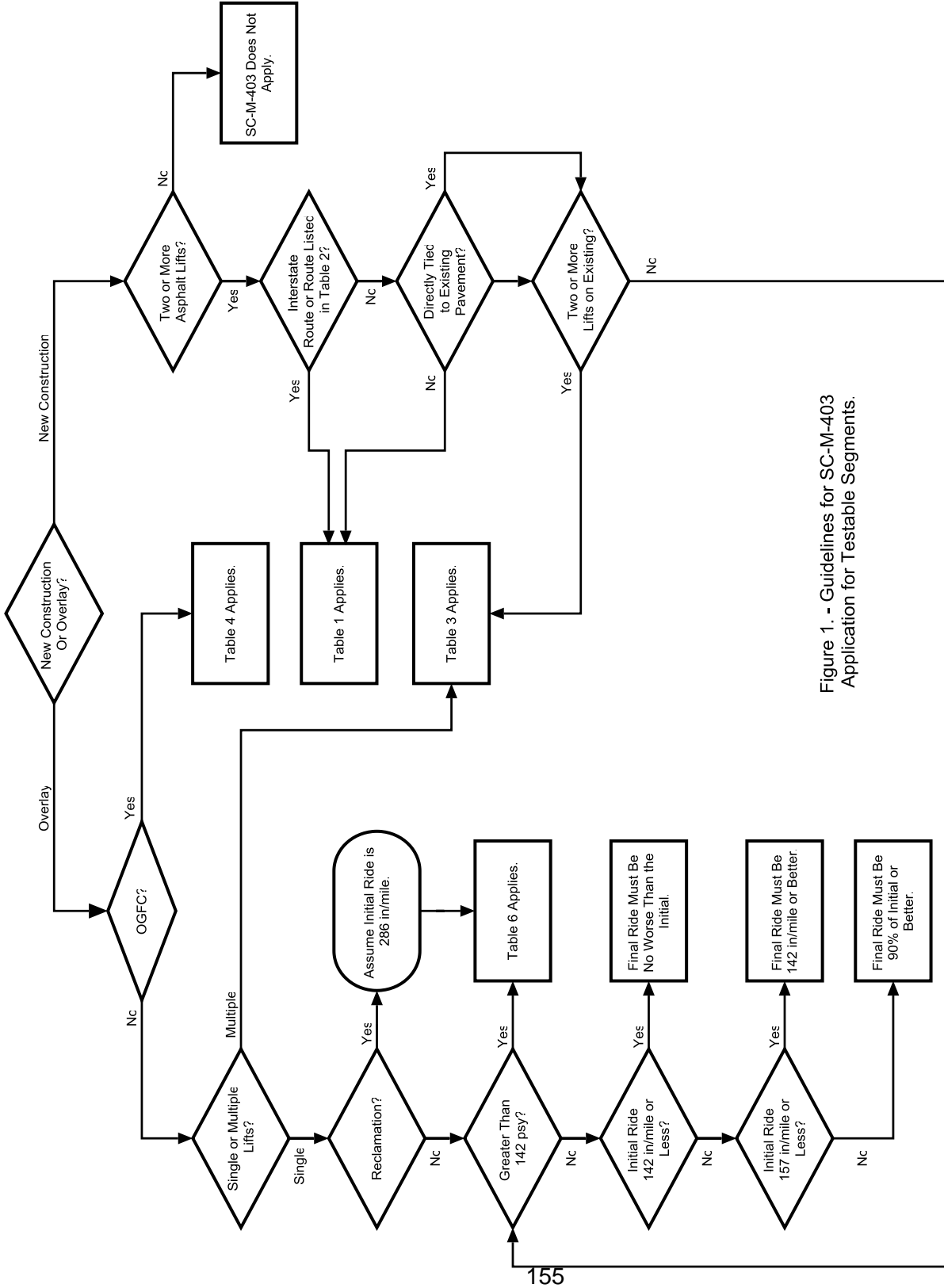


Figure 1. - Guidelines for SC-M-403 Application for Testable Segments.

Initial Ride	107%	105%	100%	95%	Repair
57	< 45	45 - 55	56 - 80	81 - 86	> 86
58	< 45	45 - 55	56 - 80	81 - 86	> 86
59	< 45	45 - 55	56 - 80	81 - 86	> 86
60	< 45	45 - 55	56 - 80	81 - 86	> 86
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67	< 45	45 - 55	56 - 80	81 - 88	> 88
67	< 45	45 - 55	56 - 80	81 - 88	> 88
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72	< 45	45 - 55	56 - 80	81 - 91	> 91
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86	< 45	45 - 55	56 - 85	86 - 97	> 97
87	< 45	45 - 55	56 - 85	86 - 97	> 97
88	< 45	45 - 55	56 - 85	86 - 97	> 97
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91	< 45	45 - 55	56 - 86	87 - 98	> 98
92	< 45	45 - 55	56 - 86	87 - 98	> 98
93	< 45	45 - 55	56 - 87	88 - 100	> 100
94	< 45	45 - 55	56 - 87	88 - 100	> 100

Initial Ride	107%	105%	100%	95%	Repair
95	< 45	45 - 55	56 - 87	88 - 100	> 100
96	< 45	45 - 55	56 - 87	88 - 100	> 100
97	< 45	45 - 55	56 - 88	89 - 101	> 101
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Initial Ride	107%	105%	100%	95%	Repair
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Initial Ride	107%	105%	100%	95%	Repair
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Initial Ride	107%	105%	100%	95%	Repair
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248	< 69	69 - 78	79 - 125	126 - 137	> 137
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Initial Ride	107%	105%	100%	95%	Repair
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Initial Ride	107%	105%	100%	95%	Repair
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Initial Ride	107%	105%	100%	95%	Repair
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Initial Ride	107%	105%	100%	95%	Repair
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Initial Ride	107%	105%	100%	95%	Repair
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472	< 111	111 - 120	121 - 167	168 - 179	> 179
473	< 111	111 - 120	121 - 167	168 - 179	> 179

Initial Ride	107%	105%	100%	95%	Repair
474	< 111	111 - 120	121 - 167	168 - 179	> 179
475	< 111	111 - 120	121 - 167	168 - 179	> 179

Supplemental Technical Specification for

PCC Pavement Rideability

SCDOT Designation: SC-M-502 (03/16)

1. SCOPE

- 1.1. The Resident Construction Engineer (RCE) will evaluate Portland cement concrete (PCC) pavement surfaces for a satisfactory ride. If conditions permit and unless otherwise specified in the special provisions, the Materials and Research Engineer will test the PCC pavement surface in accordance with **SC-T-124** or **SC-T-125** as appropriate. Unless otherwise stated, the Contractor will make all corrective action required by this Standard at no expense to the Department.
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2. REFERENCED DOCUMENTS

- 2.1. SCDOT Standard Specifications Division 500
 - 2.2. **SC-T-124**, Operation of the Cox Model C8200 Electronic Profilograph for Surface Measurement
 - 2.3. **SC-T-125**, Measurement of Pavement Rideability using the Dynatest 5051 Mark III Road Profiler with LMI 3D Gocator series wheel path lasers.
 - 2.4. **SC-M-503**, PCC Pavement Thickness Measurement and Tolerance
-

3. EQUIPMENT

- 3.1. *Diamond Grinding*
 - 3.1.1. Use only a self-propelled grinding and texturing machine with diamond blades mounted on a multi-blade arbor with a minimum cutting-head width of 36 inches. Equipment that causes strain or damage to the underlying surface of the pavement is not acceptable. Repair or replace any equipment that causes excessive ravels, aggregate fractures, spalls, or disturbance of the transverse or longitudinal joints.
-

4. REQUIREMENTS FOR TESTING

- 4.1. For **SC-T-124** to be used, the following conditions must be met:
 - 4.1.1. The segment of roadway is a minimum continuous length of 0.1 miles, not including bridges.
 - 4.1.2. The segment consists of mainline roadway, ramps at least 0.1 mile in continuous length, or shoulder pavement designated for eventual mainline use. Other shoulder pavement and ramps less than 0.1 mile in continuous length are not appropriate for testing by **SC-T-124**.
- 4.2. For **SC-T-125** to be used, the following conditions must be met:

- 4.2.1. The segment of roadway is a minimum continuous length of 0.5 miles, not including bridges.
- 4.2.2. The segment is posted for a speed limit of 45 mph or greater and has no stop signs or traffic signals that would impede the profiler.

5. REQUIREMENTS FOR NEW CONSTRUCTION.

5.1. *Pavement with a Tined or Broomed Final Surface*

5.1.1. *Final Finishing*

5.1.1.1 After the surface has been prepared as described in Subsection 501.4.10 and the water sheen has practically disappeared, texture the pavement using a drag strip. Use a drag strip consisting of a seamless strip of damp burlap, cotton fabric, or artificial turf that produces a uniform surface of gritty texture after dragging it longitudinally with a slight back-and-forth motion along the full-width of the pavement.

5.1.1.2 Ensure that the drag is an integral part of the paving train or, in the case of stationary side forms, is mounted on a bridge that travels on the forms. The minimum acceptable length of the drag strip is 3 feet. Ensure that the bottom edge of the drag strip remains in full contact with the pavement surface for the full width of the pavement. Where burlap fabric is used, ensure that the drag strip consists of at least two layers with the bottom layer approximately 6 inches longer than the upper layer(s). Maintain the drag in a condition that produces a concrete surface of uniform appearance and reasonably free from grooves over 1/16 inch in depth. Ensure that the drag is maintained clean and free from encrusted matter. If a drag is unable to be cleaned, discard it and replace with a new drag.

5.1.2. *Belting and Brooming*

5.1.2.1 In order to obtain the desired surface qualities or texture, the RCE may require the use of an approved belt or belting procedure or an approved brooming operation. A belting or brooming operation may be required separately, jointly, or along with the fabric or turf drag.

5.1.3. *Tining*

5.1.3.1 When all finishing is complete, unless the pavement is intended to receive a diamond ground surface as the final finish, texture the surface using mechanical equipment for grooving plastic concrete that uses rectangular-shaped steel tines. Ensure that the tines are evenly spaced at intervals of 0.5 inches on center and are sized such that they produce transverse grooves in the hardened surface of the concrete that are approximately 0.08 inch to 0.12 inch in width and 0.10 inch to 0.15 inch in depth. Irregular areas where the use of the automatic tining equipment is not practical may be textured using a manually-operated rake that will produce transverse grooves meeting the dimensional requirements given above.

5.1.4. *Initial Surface Check*

5.1.4.1 Ensure that the pavement is true to the specified cross slope and grade. As soon as the concrete has cured sufficiently to walk on, but not later than 9:00 AM the day following placement, the RCE or the RCE's designated representative will check the transverse and

longitudinal surface contour of all mainline pavement and ramp pavement, as well as any shoulder pavement intended as a future lane, with a 10-foot straightedge or other device approved by the Materials and Research Engineer. All variations of 1/8 inch or more, exclusive of texturing, will be plainly marked on the surface. Straightedge tests are made at approximate 100-foot intervals, but may be taken more frequently at the RCE's sole discretion if uneven areas are encountered or suspected.

5.1.5. *Immediate Correction*

5.1.5.1 Immediately attempt to correct the marked areas by rubbing with a carborundum brick and water. However, in no case is it acceptable to rub the surface to the degree that contact with the coarse aggregate is made and the enveloping mortar is broken. If variations of 1/8 inch or more remain after rubbing, remove these areas with a power-driven grinding machine after the concrete has attained approximate full strength, but not less than 21 days after placement. Promptly replace any curing compound disturbed by the straightedge check or rubbing activities.

5.1.6. *Profilograph Measurement*

5.1.6.1 For pavement meeting the requirements of Subsection 4.1, a measured profile index greater than 12 with a 0.1-inch blanking band is not acceptable for any 0.25-mile lot in any wheelpath. Additionally, individual bumps greater than 0.2 inch above the blanking band are also unacceptable. Unless otherwise specified, the Department's Pavement Evaluation Unit will make profile measurements using **SC-T-124** to determine the profile index and bump size.

5.1.7. *Further Corrective Action*

5.1.7.1 The Contractor must correct unacceptable conditions either by removing and replacing the unacceptable pavement or by using a power-driven grinding machine after the pavement has achieved approximate full strength, but not less than 21 days after placement. If the total length of grinding exceeds 132 linear feet as measured parallel to the centerline of the roadway in any 0.25-mile segment, regardless of the transverse grinding width, grind 100% of the entire surface area of that segment for the full width of the individual lane being measured to achieve a uniform appearance. Conduct all grinding operations in accordance with Section 5.2.3 contained herein. Prior to any corrective work, the Contractor will provide the RCE with a written plan of corrective action and receive approval from the RCE before implementation.

5.2. *New Pavement with a Diamond Ground Final Surface:*

5.2.1. *Surface Finish*

5.2.1.1 Texturing by mechanical equipment for grooving plastic concrete using steel tines is not required when the final surface will be textured by diamond grinding. All other required finishing and texturing, including texturing using a drag strip is conducted according to the Standard Specifications and Subsection 5.1, above. Tining and/or diamond grinding is not required for shoulder pavement unless otherwise directed in the Plans or Contract. However, a brooming or belting process as given in Subsection 5.1 is required for shoulder pavement to provide a medium to heavy broom finish. All drags, brooming, and belting are included in the unit price for Portland Cement Concrete Pavement and are not measured or paid separately.

5.2.2. *Diamond Grinding*

5.2.2.1 Conduct diamond grinding operations using equipment as specified in Section 3 and in accordance with the requirements provided herein. Perform no diamond grinding until the pavement has attained sufficient strength to be opened to all types of traffic, and no sooner than 21 days after placement unless otherwise directed by the RCE. Complete all diamond grinding on any section prior to opening that section to other than construction traffic unless otherwise instructed by the RCE.

5.2.2.2 Perform grinding and texturing on the entire surface area of the lanes specified in the Plans or as directed by the RCE. Ensure that the surface on each side of transverse joints is uniformly ground and textured until the surface on both sides of the joints and all cracks are in the same plane and meet the surface requirements contained herein. This may require additional passes of the equipment to texture both sides of a faulted joint.

5.2.2.3 Ensure that the finished surface has a corduroy-type texture consisting of grooves that are between 0.090 and 0.150 inch wide. Ensure that the land area between the grooves is between 0.060 and 0.125 inch wide and the peaks of the ridges are 1/16 inch higher than the bottom of the grooves.

5.2.2.4 Ensure that all grooves and adjacent passes are parallel to each other and the roadway, with no variation. Completely lap adjacent passes, allowing no unground surface between them. However, do not allow adjacent passes to overlap more than 1.5 inches. When measured with a 3-foot straightedge, ensure that adjacent passes are within 1/8 inch of the same height. Texture not less than 98 percent of the specified surface, with 100 percent of the specified area as a target. Allow no ridges between lanes after grinding. Feather out any remaining ridges on the outside edge into the shoulder in a separate operation to the satisfaction of the RCE. When grinding the shoulder is necessary to remove ridges, this operation is not counted in the area for payment and is conducted at no expense to the Department.

5.2.2.5 At no expense to the Department, correct any deficiencies in the final surface due to improper operations and/or equipment. This includes, but is not limited to, a) corrugation due to "out-of-round" wheels or improper cutting operations, b) depressions created due to improper starting or stopping operations, or c) unground ridges due to defective blades. Make all corrections parallel to and matching existing operations.

5.2.2.6 Remove residue from the grinding and texturing operation from the roadway. Do not permit residue to flow across shoulders or lanes occupied by traffic. Also, do not allow residue to flow into gutters or other drainage structures. Remove solid residue from the pavement surface before such material is blown by the action of traffic or wind. Perform a final sweeping using power equipment before opening the pavement to traffic.

5.2.3. *Joint Sealing*

5.2.3.1 Complete all joint sealing operations after diamond grinding operations are conducted, including diamond grinding on adjacent lanes. Before and during grinding, place and maintain an appropriately sized temporary backer rod in the initial saw cut at a depth sufficient to prevent contact with the grinding operation in order to prevent slurry and other contaminants from entering the saw cut. Remove and discard the temporary backer road shortly in advance of joint sealing activities.

5.3. *Rideability Requirements*

5.3.1. After overall grinding operations are completed, the Department’s Pavement Evaluation Unit will measure the rideability of the pavement using SC-T-125 and based on nominal 0.1-mile lots and report the International Roughness Index (IRI) in inches per mile. Based on the results of these measurements, an adjusted pay factor for Portland Cement Concrete Pavement for each lot is applied based on Table 1 shown below.

Table 1. Schedule For Adjusted Payment – New Construction	
IRI (inches/mile)	Adjusted Unit Price
Less than or equal to 47	105%
48 - 52	103%
53 - 57	101%
58 - 66	100%
67 - 71	95%
72 - 76	90%
77 - 81	80%
82 and above	See Note 1

Note 1: For each additional increment of 5 inches per mile of IRI above 81 inches per mile, make an additional 10% reduction based on the contract unit price of the Portland Cement Concrete Pavement.

5.3.2. When the IRI exceeds 66 and the RCE determines that the pavement does not have an acceptably smooth ride, correct such deficient sections without additional compensation. The RCE may withhold payment for the pavement until the deficiencies have been corrected, and the surface is re-tested and provides an acceptably smooth ride. Obtain written approval of the RCE for the method of correcting the surface deficiencies. The RCE will deduct as a lump sum the total amount of any reduction in payment from monies due.

- 5.3.3. The RCE will review sections of roadway for which the IRI roughness measurement is 82 inches per mile or above on an individual basis. If the RCE determines that the section is unacceptable, remove the pavement and replace or perform additional diamond grinding subject to the approval of the RCE. Should the RCE determine that the material may remain in place and does not require other corrective action, a price adjustment will be assessed based on the Schedule for Adjusted Payment shown in Table 1.
- 5.3.4. **SC-T-125** is modified such that the IRI measured for each wheelpath is averaged and the average value is reported for the section. The section will be tested with the profiler three times and the three IRI values are averaged to determine the overall IRI for the section.

5.4. *Pavement Thickness*

- 5.4.1. When diamond grinding and texturing is required on new pavement as part of the original construction, requirements for pavement thickness tolerance as given in Supplemental Technical Specification **SC-M-503** or contract special provisions apply after all grinding operations are complete and accepted. It is the Contractor's responsibility to consider potential loss of pavement thickness from the grinding operation and adjust initial pavement thickness accordingly to ensure that the finished product has the required thickness.

6. REQUIREMENTS FOR REHABILITATION PROJECTS

6.1. *Diamond Grinding*

- 6.1.1. Perform diamond grinding operations in accordance with the requirements of Section 5.2.2.

6.2. *Testing*

- 6.2.1. When existing Portland Cement Concrete Pavement is diamond ground as a means to improve the rideability and surface characteristics, the pavement is tested according to **SC-T-125, Measurement of Pavement Rideability using the Dynatest 5051 Mark III Road Profiler** as modified in Section 5.3.4. The testing will be performed by the Department's Pavement Evaluation Unit after all grinding operations are complete if the pavement meets the requirements of Subsection 4.2. The International Roughness Index (IRI) is reported in inches per mile in 0.1-mile nominal lots.

6.3. *Rideability*

- 6.3.1. The pavement is considered acceptable if the IRI roughness is 87 inches per mile or less after grinding operations are complete unless otherwise specified in the Special Provisions. Based on the measured roughness, the contract unit price for Grinding and Texturing Existing Concrete Pavement is adjusted according to Table 2, shown below.

Table 2. Schedule For Adjusted Payment – Existing Pavement	
IRI Roughness (inches/mile)	Adjusted Unit Price
Less than or equal to 48	125%
49 - 62	110%
63 - 78	100%
79 - 87	90%
Greater than 87	Corrective Action Required

6.4. *Further Corrective Action*

6.4.1. In the event that the initial IRI of the ground surface is greater than 87 inches per mile, perform further work on the pavement such that the IRI is reduced to 87 inches per mile or less at no expense to the Department. Additional remedial work may also be optionally conducted at lower initial IRI roughness levels. Prior to any corrective action, submit a written remediation plan to the RCE for approval. Conduct no corrective work until the RCE has approved the written plan. If the initial IRI roughness is less than 79 inches per mile, the Department reserves the right to reject any additional corrective work if, in the Department's opinion, additional work will be detrimental to the pavement or reduce the pavement thickness excessively. The final adjusted unit price for Grinding and Texturing Existing Concrete Pavement is determined based on Table 2 and the IRI measured after corrective action is applied.