Research & Technology Transfer

Alaska Department of Transportation & Public Facilities

Selection of Pavement Marking Materials

Billy Connor, P.E.
Jim Bennett, P.E.

Publication Number:
FHWA-AK-RD-00-01

Selection of Pavement Marking Materials
Interim Report

INTRODUCTION

Finding the most cost effective pavement marking material continues to be a concern of maintenance and traffic engineers throughout the nation. Numerous durable pavement markings are readily available. The cost of these materials continues to drop, making them more attractive.

Durable striping materials, although initially more expensive, are more desirable for two primary reasons. They remain visible far longer than water or solvent based paints. And the retroreflectivity is considerably higher both initially and after trafficking. As the nation's population ages, night visibility of pavement marking materials becomes more critical. To this end, the Federal Highway Administration (FHWA) is in the process of developing minimum retroreflectivity standards.

FHWA is willing to participate in pavement marking maintenance contingent on the development of a striping policy based upon performance and cost effectiveness criteria.

Alaska DOT&PF Research and Technology Transfer placed two test decks to evaluate the longevity of several marking materials. One test deck was placed north of Anchorage in the northbound lanes near milepost 28 of the Glenn Highway. The other was placed in Fairbanks in the westbound lanes of the Mitchell Expressway between Lathrop Street and Peger Road. Monitoring continues on both test decks. The original project anticipated a short timeframe to complete this task. However, due to the longevity of the striping materials tested and the lack of minimum retroflectivity standards, this has proven to take more time. To date, wear has not been sufficient to determine the life of the tested materials. However, we can draw some conclusions from the information garnered to date.

SITE SELECTION CRITERIA

Test decks were selected using the guidelines prescribed in ASTM D-713. Sections should:

- Have four lanes of divided highway
- Have a minimum average daily traffic of 5,000
- Be free-rolling with no grades, curves or intersections or access points near enough to cause excessive braking or turning movements
- Have good drainage
- Have full exposure to the sun throughout the daylight hours
- Be uniform throughout the test length
- Have a surface that is representative of the pavements for where the marking materials would be applied in practice
- Have been open to traffic a minimum of one year before the test deck was installed.

MATERIALS TESTED

A total of eight materials were applied to the test decks; all are classified as durable materials. Each material was installed as a surface application and as a grooved inlay application. The spray and cold extruded methyl methacrylate (MMA) materials were applied in varying thickness as described in Figures 1 and 2. On the Fairbanks test deck, one stripe of paint used by Northern Region Maintenance and Operations was installed as a control section. A complete listing of the materials is given in Table 1. Each of these products was assigned a Product Number as indicated in Table 1. The Product Number is then used when referring to the material it is assigned to when reporting any field test results. The 3M representative withdrew his product from the Anchorage test deck because the temperature range during installation was 35 – 50 degrees. 3M prefers to install its product when the temperature is above 60 degrees.

ANCHORAGE TEST DECK

The Anchorage test deck (Glenn Highway) is a bituminous asphalt site with an Average Annual Daily Traffic (AADT) of 9,800 for the northbound lanes. A permanent classification counter station is nearby. The surface is five years old, with no resurfacing or surface repair, and has good drainage. It is a divided four-lane highway, located near a high bluff, approximately 28 miles north of Anchorage. Because the high bluff is to the south of the site, much of the direct sunlight on the test deck is blocked during the "low-sun" period (November through March). The test deck is in the two northbound lanes. Test deck installation began on Tuesday, September 29, 1998 and was completed the next day.

The manufacturer's representatives placed all of the striping materials. For each test deck, interested contractors bid to perform the necessary preparation work (e.g. groove the roadway), provide installation equipment, and provide the required traffic control. The manufacturers supplied all of the necessary pavement marking material. The Alaska DOT&PF Research Engineer supervised and documented the installation of the pavement marking materials.

The test stripes are 4" transverse lines running across the roadway from the right side of the left edge line to the left side of the right edge line. This was done to prevent the traffic from trying to avoid the test stripes. As with any new changes to the roadway, the traveling public gets concerned with anomalies in the traffic path, and this may cause unwanted changes in the driving patterns. To encourage normal driving patterns, we installed two gated advisory signs at each test deck site to inform the traveling public that the transverse stripes were part of a test section.

The marking material layouts for each test deck are shown in Figures 1 and 2. Note that the two test deck layouts are not identical.

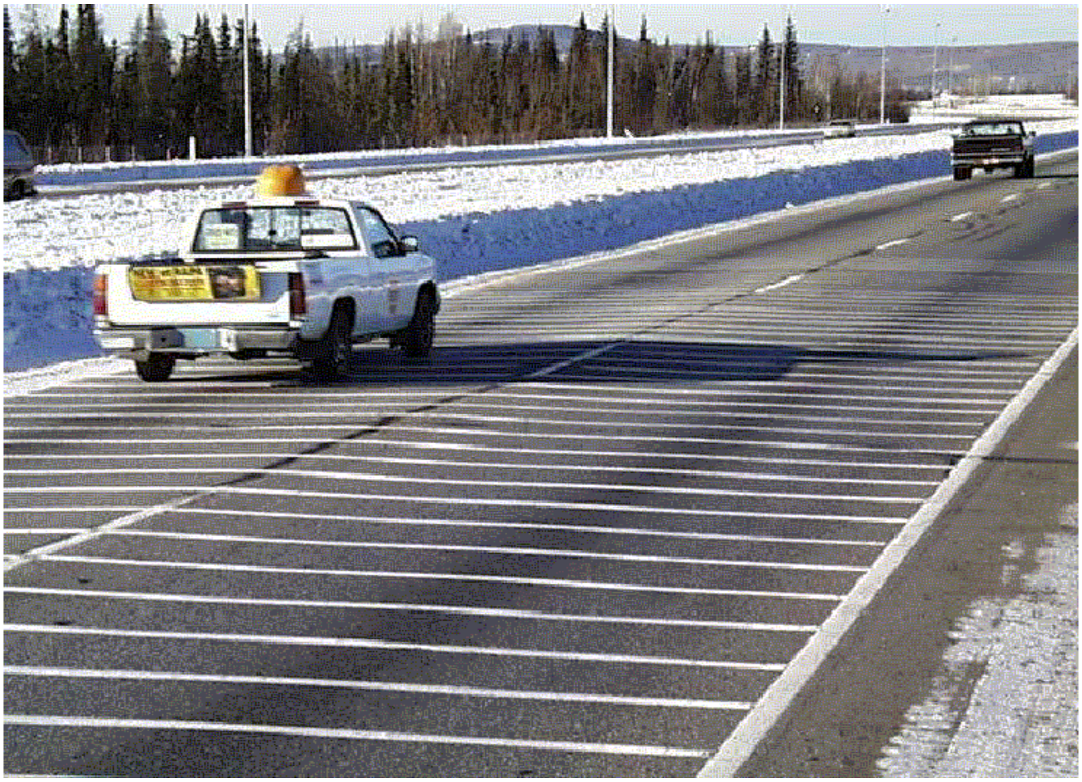
Contractors installed each preformed thermoplastic material in both a surface application and a grooved inlay application. Likewise each spray and cold extruded MMA material was installed in both a surface application and a grooved application at varying mil thickness. The grooved applications of MMA had a 20-30 mil "cap". Figure 1 describes the various application criteria.

We recorded the air and pavement temperatures as well as the weather conditions as shown in Table 4.

The first field testing occurred within 14 days of the installation and after all excess glass beads were removed. Temperature and weather conditions hampered subsequent field-testing at the Anchorage site until the following summer. The manufacturer of the LTL 2000 recommends the unit not be used when the surface is wet or when the air temperature is at or below freezing. These constraints effectively eliminate any testing during the months of October through March, and made testing during the remaining months dependent upon "dry road surface" conditions. Field evaluations will continue on all materials for at least another year.

We took reflectivity measurements with an LTL 2000 Retroreflectometer positioned parallel to the stripe being tested, at points along the test stripe including wheel and non-wheel paths. These data are provided in Tables 2a and 2b.

FAIRBANKS TEST DECK



The Fairbanks test deck (Mitchell Expressway) is a bituminous asphalt site with an Average Annual Daily Traffic (AADT) of 6,050 for both lanes through December 1999. A permanent counter station is nearby. The surface is 11 years old, with no resurfacing or surface repair, and has good drainage. It is a divided four-lane highway, located in the Tanana Flats, approximately 2 miles south of downtown Fairbanks. This site has full exposure to the sun throughout the daylight hours. The test deck is in the two westbound lanes. We began the installation of the test deck on Saturday, August 14th and completed the work on Monday, August 30, 1999.

Again the manufacturer’s representatives were on site during placement. The first retroreflectivity tests were taken on August 30, 1999. These data are presented in Tables 3a and 3b.

DISCUSSION OF DATA

Table 5, which compares the initial readings of all marking materials used, assumes the thickness does not significantly impact the initial retroreflectivity of the product. Note that the initial retroreflectivity of the paint is significantly lower than all of the durable striping materials. The Oregon Department of Transportation suggests the improved visibility alone warrants the use of durable striping on their major arterial routes (Oregon DOT– 1998).

The coefficient of variation, Cv, in Table 5 represents the normalized variation in the readings. This indicates the uniformity of the product. Since these materials were placed under controlled conditions, one could expect that the uniformity would be better than that expected under production placement. From Table 5 we see that the Experimental Flint Preformed Thermoplastic had the greatest coefficient of variation followed by the Stimsonite Preformed Thermoplastic and then by paint. Flint installed the experimental product for their information only and is not representative of their products. The remaining materials had approximately one half the variation. This indicates that we can expect a considerably more uniform product.

Table 2b shows the data collected in Anchorage on July 15, 1999. The values are considerably lower than anticipated, ranging from 9 to 126. Data from similar test decks in other states indicates values range from 50 to 150 after one year. There are several reasons these values are low.

- Improper application of the sinker and floater beads.
- Studded tire wear.
- Dirty stripes.
- Uneven road surface causes erroneous readings.

One could suspect that the readings were simply wrong. However, this is not likely because the manufacturer's representative was on site, he calibrated the LTL, took the readings and then checked the calibration again, which passed. Visual inspection of the stripes indicates only minor visible damage to the marking materials. A more careful inspection will be made in May 2000 to determine the cause of the low readings. We will also take reflectivity readings of the in-service paints. While no paint was placed at this location, maintenance staff indicates that under conditions similar to this site, paint will last only a few months. Supporting this information, the paint that is in the wheel paths on the Fairbanks test deck has been completely removed by March 2000.

OBSERVATIONS FROM IN-SERVICE SITES

In 1998, Oregon DOT traveled several Alaskan highways measuring retroreflectivity of methyl methacrylate pavement marking materials. The results of this study confirmed the decision of the Oregon DOT to use methyl striping on many of its highways (Oregon DOT – 1998). The results of this survey are provided in Tables 6a and 6b. Note that a

9-year-old site on the Richardson Highway near North Pole measured around 150 milicandella. This is higher than the initial maintenance paint placed in the test deck in Fairbanks. Further, lines placed alongside the methyl stripes were barely visible. Typical values measured for three-year-old methyl striping is around 250. Readings on the Parks Highway showed that methyl had 250 while adjacent solvent-based paint stripes had readings of 100. Based on this, and discussions with M&O personnel, the Maintenance striping will be in need of replacement within three years, even on low volume roads.

CURRENT PRACTICE

In order to develop a pavement marking strategy, we must first understand current practice. In short, maintenance forces restripe the roadways when they determine it is warranted. Without definitive guidelines, there is no other choice. Even so, there are general trends which help compare current practice with durable striping materials. In urban Anchorage, the roads and streets are typically striped in early May and again in late August, indicating a maximum marking life of about four months. On heavily traveled rural roads such as the Glenn Highway between Anchorage and Wasilla, striping is refreshed annually. On the lower volume rural roads, maintenance crews restripe on a two to three year cycle.

In the Fairbanks area, urban striping occurs annually. Heavily traveled rural roads like the Richardson Highway between Fairbanks and Eielson are restriped annually. Low volume rural roads such as the Richardson Highway between Big Delta and Glennallen are restriped on a three-year cycle. The Parks Highway is typically restriped annually.

Maintenance supervisors indicate that current practice may not be "state-of-the-art", but until better guidelines and minimum standards are developed, they have no means of judging the adequacy of their efforts. Both Northern and Central Regions have only one striping crew. Southeast Region contracts their striping.

PRIOR RESEARCH ON ALASKAN PAVEMENT MARKINGS

Jian Lu (Lu – 1995) looked at the performance of traffic markings in cold regions and found that while there are no standard specifications for minimum reflectivity for traffic markings, field studies have been conducted to determine minimum field luminance and retroreflectivity levels. Based on a study by Graham and King, Jian Lu concluded that a minimum reflectivity should be 100 mcd/m^2/lx. New York State and France suggest the minimum reflectivity be 140 and 150 respectively (Lu - 1995).

COST COMPARISON

The ADOT&PF Design Section in Anchorage uses an estimate of $1.05/LF/4" line for the surface application of a 90 mil MMA product. The ADOT&PF Design Section in

Fairbanks uses an estimate of $1.10/LF/4" line for the surface application of a 60 mil MMA product, and an estimate of $0.15/LF/4" line for paint. While the Fairbanks Maintenance staff does not track the cost of paint striping on a per foot basis, they believe the design estimate is reasonable. This value for paint will be used for comparison.

Based on the application costs alone (again, the minimum acceptable reflectivity level has not been established), an estimated life for MMA of seven years and a Present Worth rate of return of 7%, the breakeven period is one year. That is, if restriping is required annually, the water or solvent-based paint and MMA are about equal in cost. If restriping is required every two years, the MMA is about twice as expensive. Continuing, if restriping is required every three years, MMA become about three times as expensive. The use of durable pavement marking certainly makes sense on high volume roads. However, does the improved night visibility of durable markings warrant the increased costs on low volume rural roads? This becomes the major issue on lower volume roads.

Night visibility is very important to the driver on rural roads. Striping gives the driver a visible reference of the roadway location and its alignment as far as the headlights can illuminate the striping. Night visibility of our aging driving population is diminishing. High visibility signs and roadway markings are becoming increasingly important. Failure to provide this delineation represents a cost and reduced safety to the travelling public.

The process of re-striping includes an unquantified cost known as risk; the risk of being involved in an accident. Each time the striping crew is on the road, the chance of an accident increases. To reduce this risk, the striping crews work during off-peak hours in the urban areas. By going to a durable line, we reduce the amount of time they are in this situation (Oregon DOT – 1998).

CONCLUSIONS

There is no doubt that durable pavement markings are superior to paint. The data collected to date indicate the initial retroreflectivity is two to three times that of paint. While we did not place a paint stripe as a control section at the Anchorage site, experience and data collected from a test deck placed in 1982 (Woodward-Clyde – 1983), clearly indicate that paint would have been entirely removed in a few months. Consequently, even though the retroreflectivity measurements were lower than anticipated, the durable pavement markings are still usable using current maintenance criteria.

Based on the survey done by Oregon DOT, we believe we can expect at least nine years of service on high volume rural roads. We typically restripe these roads on a one to two year cycle with no retroreflectivity measurements.

Based on the performance to date, we see strong evidence that durable pavement markings are cost effective for high volume roads. Further, durable markings are probably not cost effective for low volume roads paved with bituminous surface treatments (BST) or high float surfacing. These pavements typically have a life of two to eight years depending on the foundation characteristics. In these cases, even paint may outlast the surface.

The dilemma that occurs is with medium to low volume roads paved with hot asphalt pavement. In many cases, durable striping may last as long as the pavement. In this case, placing durable striping when the roadway is reconstructed or rehabilitated may be desirable. If we account for improved visibility, we can easily argue that durable striping materials should be used for rural roads with an anticipated remaining surface life of five or more years.

RECOMMENDATIONS

Based on the expected life of the various pavement markings, the associated costs, and the anticipated levels of service, several recommendations are offered.

Table 7 shows these recommendations in a compact and comprehensive matrix form.

Table 7

Pavement Marking Application Matrix						
Surface	***Type of Marking***	***Area***	***Expected Pvmt Life***	***Average Annual Daily Traffic***		
				<=2,000	***2,000<ADT<10,000***	***>=10,000***
Stable Pavements	Longitudinal	Urban	> 1 year	Paint	Methyl	Methyl
			<= 1 year	Paint	Paint	Paint
		Rural	> 3 years	Paint	Methyl or Paint	Methyl
			<= 3 years	Paint	Paint	Paint
	Transverse & Symbols	All	> 1 year	Durable	Durable	Durable
			<= 1 year	Paint	Paint	Paint
BST, High Float, and pavements that need regular patching	All	All	All	Paint	Paint	Paint

FUTURE WORK

In an effort to increase our database, we will revise the project scope to include the measurements of retroreflectivity of the painted traffic markings maintained by M&O personnel. This information will be very useful once the minimum retroreflectivity levels for traffic markings are established.

Table 1

List of Pavement Marking Materials

	Anchorage Test Deck	Number		Fairbanks Test Deck	Number
1	Flint Trading - PREMARK 20/20 FLEX	AK-A1-01	1	Flint Trading - PREMARK 20/20 FLEX	AK-F1-01
2	Flint Trading - Experimental	AK-A1-02	2	Stimsonite Preformed Tape	AK-F1-02
3	DuraStripe - Spray MMA	AK-A1-03	3	DuraStripe - Spray MMA	AK-F1-03
4	DuraStripe - Cold Extruded MMA	AK-A1-04	4	DuraStripe - Cold Extruded MMA	AK-F1-04
			5	Rite-Mark - Spray MMA	AK-F1-05
			6	Rite-Mark - Cold Extruded MMA	AK-F1-06
			7	Columbia Water-based MMA	AK-F1-07
			8	Maintenance Paint (Control)	AK-F1-08

Figure 1

Anchorage Test Deck

20	AK-A1-04	Grooved	250 mil	
19	AK-A1-04	Grooved	190 mil	
18	AK-A1-04	Grooved	120 mil	
17	AK-A1-04	Grooved	90 mil	
16	AK-A1-04	Surface	150 mil	
15	AK-A1-04	Surface	120 mil	
14	AK-A1-04	Surface	90 mil	
13	AK-A1-04	Surface	60 mil	
12	AK-A1-03	Grooved	250 mil	
11	AK-A1-03	Grooved	190 mil	
10	AK-A1-03	Grooved	120 mil	
9	AK-A1-03	Grooved	90 mil	
8	AK-A1-03	Surface	150 mil	
7	AK-A1-03	Surface	120 mil	
6	AK-A1-03	Surface	90 mil	
5	AK-A1-03	Surface	60 mil	
		Grooved	40 mil	3M preformed tape / not installed
		Grooved	40 mil	3M preformed tape / not installed
4	AK-A1-02	Grooved	90 mil	
3	AK-A1-02	Surface	125 mil	
2	AK-A1-01	Grooved	90 mil	
1	AK-A1-01	Surface	125 mil	

Direction of Travel

Figure 2a

Fairbanks Test Deck

20	AK-F1-06	Surface	90 mil	
19	AK-F1-06	Surface	60 mil	
18	AK-F1-01	Grooved	90 mil	
17	AK-F1-01	Surface	125 mil	
16	AK-F1-03	Grooved	250 mil	
15	AK-F1-03	Grooved	190 mil	
14	AK-F1-03	Grooved	120 mil	
13	AK-F1-03	Grooved	90 mil	
12	AK-F1-03	Surface	150 mil	
11	AK-F1-03	Surface	120 mil	
10	AK-F1-03	Surface	90 mil	
9	AK-F1-03	Surface	60 mil	
8	AK-F1-04	Grooved	250 mil	
7	AK-F1-04	Grooved	190 mil	
6	AK-F1-04	Grooved	120 mil	
5	AK-F1-04	Grooved	90 mil	
4	AK-F1-04	Surface	150 mil	
3	AK-F1-04	Surface	120 mil	
NA	AK-F1-04	Surface	90 mil	This line was not proper and was abandoned
2	AK-F1-04	Surface	60 mil	
1	AK-F1-04	Surface	90 mil	

⇧ Direction of Travel ⇧

Figure 2b

Fairbanks Test Deck

42	AK-F1-02	Grooved	90 mil	
41	AK-F1-02	Grooved	125 mil	
40	AK-F1-02	Surface	90 mil	
39	AK-F1-02	Surface	125 mil	
38	AK-F1-07	Grooved	120 mil	Material did not cure, line was removed
37	AK-F1-07	Grooved	90 mil	Material did not cure, line was removed
36	AK-F1-07	Surface	120 mil	Material did not cure, line was removed
35	AK-F1-07	Surface	60 mil	
34	AK-F1-05	Grooved	250 mil	
33	AK-F1-05	Grooved	190 mil	
32	AK-F1-05	Grooved	120 mil	
31	AK-F1-05	Grooved	90 mil	
30	AK-F1-05	Surface	150 mil	
29	AK-F1-05	Surface	120 mil	
28	AK-F1-05	Surface	90 mil	
27	AK-F1-05	Surface	60 mil	
26	AK-F1-06	Grooved	250 mil	
25	AK-F1-06	Grooved	190 mil	
24	AK-F1-06	Grooved	120 mil	
23	AK-F1-06	Grooved	90 mil	
22	AK-F1-06	Surface	150 mil	
21	AK-F1-06	Surface	120 mil	

Direction of Travel

Table 4

Weather Information During Installation of the Test Decks

Anchorage

Date	Time	Air Temperature Fahrenheit	Pavement Temperature Fahrenheit	Weather Conditions
9/29/98	12:45 PM	37	14	Clear
9/30/98	10:30 AM	48	39	Cloudy

Fairbanks

Date	Time	Air Temperature Fahrenheit	Pavement Temperature Fahrenheit	Weather Conditions
8/14/99	11:30 AM	54	No Reading	Cloudy
	1:30 PM	57	"	Cloudy
8/16/99	12:30 PM	64	No Reading	Mostly sunny
	4:00 PM	67	"	Mostly sunny
8/17/99	1:00 PM	76	No Reading	Mostly sunny
8/30/99	3:00 PM	63	No Reading	Cloudy

Table 2a

Glenn Highway Test Deck Reflectometer Readings on 981001

Stripe No.	Description	Distance from Left Edge Line (ft)								
		0.6	2.6	5	7.8	11.7	14.7	17.5	20	23.3
20	250 mil, Grooved, Ex., DuraStripe	161	327	165	303	366	360	206	399	255
19	190 mil, Grooved, Ex., DuraStripe	246	307	194	278	133	268	121	250	210
18	120 mil, Grooved, Ex., DuraStripe	149	241	133	186	166	284	186	258	464
17	90 mil, Grooved, Ex., DuraStripe	167	313	230	289	136	248	177	343	211
16	150 mil, Surface, Ex., DuraStripe	231	236	129	202	141	280	140	258	400
15	120 mil, Surface, Ex., DuraStripe	226	315	235	211	116	316	161	270	181
14	90 mil, Surface, Ex., DuraStripe	257	274	145	279	111	214	162	220	176
13	60 mil, Surface, Ex., DuraStripe	126	259	125	261	127	284	150	256	307
12	250 mil, Grooved, Spray, DuraStripe	126	281	301	316	172	325	267	301	183
11	190 mil, Grooved, Spray, DuraStripe	146	274	169	324	149	268	169	346	212
10	120 mil, Grooved, Spray, DuraStripe	134	205	204	249	189	239	211	319	221
9	90 mil, Grooved, Spray, DuraStripe	189	327	202	298	191	302	261	332	263
8	150 mil, Surface, Spray, DuraStripe	226	412	319	423	391	418	293	431	449
7	120 mil, Surface, Spray, DuraStripe	138	300	246	306	306	349	269	410	341
6	90 mil, Surface, Spray, DuraStripe	168	326	193	353	219	342	272	362	415
5	60 mil, Surface, Spray, DuraStripe	195	323	285	325	272	351	339	341	264
4	90 mil, Grooved, Flint Experiment	402	283	363	328	490	308	175	113	338
3	125 mil, Surface, Flint Experiment	110	297	680	451	232	72	497	43	398
2	90 mil, Grooved, PREMARK	266	106	282	263	361	250	439	529	426
1	125 mil, Surface, PREMARK	348	163	204	110	193	141	176	151	238
		LT edge	wheel rut	C/Lane	wheel rut	white skip	wheel rut	C/Lane	wheel rut	RT edge

⇧ Direction of Travel ⇧

Table 2b

Glenn Highway Test Deck Reflectometer Readings on 990715

Stripe No.	Description	Distance from Left Edge Line (ft)								
		0.6	2.6	5	7.8	11.7	14.7	17.5	20	23.3
20	250 mil, Grooved, Ex., DuraStripe	126	30	40	31	121	28	33	27	13
19	190 mil, Grooved, Ex., DuraStripe	39	32	34	35	67	32	32	28	19
18	120 mil, Grooved, Ex., DuraStripe	49	34	34	35	66	35	30	27	19
17	90 mil, Grooved, Ex., DuraStripe	63	39	39	35	79	31	32	30	24
16	150 mil, Surface, Ex., DuraStripe	33	38	37	34	51	32	34	30	32
15	120 mil, Surface, Ex., DuraStripe	26	41	42	37	38	34	33	30	28
14	90 mil, Surface, Ex., DuraStripe	49	31	35	33	75	30	30	27	28
13	60 mil, Surface, Ex., DuraStripe	80	39	38	35	54	29	35	29	32
12	250 mil, Grooved, Spray, DuraStripe	48	22	28	29	66	36	23	17	26
11	190 mil, Grooved, Spray, DuraStripe	86	18	25	21	100	17	20	20	14
10	120 mil, Grooved, Spray, DuraStripe	68	20	35	17	62	16	26	20	41
9	90 mil, Grooved, Spray, DuraStripe	51	19	28	19	66	14	22	19	31
8	150 mil, Surface, Spray, DuraStripe	30	19	29	28	30	22	21	16	24
7	120 mil, Surface, Spray, DuraStripe	38	19	27	20	67	21	22	20	29
6	90 mil, Surface, Spray, DuraStripe	52	20	24	19	37	20	26	18	27
5	60 mil, Surface, Spray, DuraStripe	61	21	26	20	46	21	25	18	28
4	90 mil, Grooved, Flint Experiment	89	9	82	10	73	12	57	11	88
3	125 mil, Surface, Flint Experiment	62	9	61	9	73	12	68	13	76
2	90 mil, Grooved, PREMARK	50	29	29	27	43	11	34	26	31
1	125 mil, Surface, PREMARK	37	32	28	28	46	29	36	31	31
		LT edge	wheel rut	C/Lane	wheel rut	white skip	wheel rut	C/Lane	wheel rut	RT edge

⇧ Direction of Travel ⇧

Table 3a

Mitchell Highway Test Deck Reflectometer Readings on 990830

Stripe No.	Description	Distance from Left Edge Line (ft)								
		0.6	2.6	5	7.8	11.7	14.7	17.5	20	23.3
42	90 mil, Grooved, Stimsonite	238	501	216	237	259	573	292	439	490
41	125 mil, Grooved, Stimsonite	254	162	161	161	192	182	179	289	267
40	90 mil, Surface, Stimsonite	233	89	110	154	220	105	130	87	152
39	125 mil, Surface, Stimsonite	230	147	178	188	178	158	143	142	202
38	120 mil, Grooved, Spray, Columbia		Material did not cure, line was removed							
37	90 mil, Grooved, Spray, Columbia		Material did not cure, line was removed							
36	120 mil, Surface, Spray, Columbia		Material did not cure, line was removed							
	Maintenance Paint	162	211	170	124	111	79	77	53	106
35	60 mil, Surface, Spray, Columbia	255	282	325	364	334	344	283	273	270
34	250 mil, Grooved, Spray, Rite-Mark	276	294	223	267	206	235	258	216	222
33	190 mil, Grooved, Spray, Rite-Mark	230	241	124	216	143	245	189	253	282
32	120 mil, Grooved, Spray, Rite-Mark	395	243	297	325	316	368	334	357	288
31	90 mil, Grooved, Spray, Rite-Mark	354	384	247	306	189	253	211	222	261
30	150 mil, Surface, Spray, Rite-Mark	279	244	173	239	181	274	293	230	278
29	120 mil, Surface, Spray, Rite-Mark	196	234	173	248	157	234	199	207	237
28	90 mil, Surface, Spray, Rite-Mark	264	255	240	285	203	250	237	243	221
27	60 mil, Surface, Spray, Rite-Mark	297	288	193	266	230	266	238	253	279
26	250 mil, Grooved, Ex., Rite-Mark	362	347	350	360	250	366	301	337	322
25	190 mil, Grooved, Ex., Rite-Mark	424	421	346	421	351	405	348	329	369
24	120 mil, Grooved, Ex., Rite-Mark	217	246	171	313	288	363	351	375	379
23	90 mil, Grooved, Ex., Rite-Mark	306	158	141	302	133	298	286	138	341
22	150 mil, Surface, Ex., Rite-Mark	298	318	300	420	293	418	367	332	379
21	120 mil, Surface, Ex., Rite-Mark	402	382	294	405	249	415	378	348	304
20	90 mil, Surface, Ex., Rite-Mark	419	372	259	370	230	402	314	325	328
19	60 mil, Surface, Ex., Rite-Mark	394	355	252	332	214	349	282	301	275
		LT edge	wheel rut	C/Lane	wheel rut	white skip	wheel rut	C/Lane	wheel rut	RT edge

Direction of Travel

Table 3b

Mitchell Highway Test Deck Reflectometer Readings on 990830

Stripe		Distance from Left Edge Line (ft)								
No.	Description	0.6	2.6	5	7.8	11.7	14.7	17.5	20	23.3
18	90 mil, Grooved, PREMARK	367	299	253	396	412	370	307	278	587
17	125 mil, Surface, PREMARK	510	453	324	465	399	282	259	452	385
16	250 mil, Grooved, Spray, DuraStripe	304	320	168	274	153	270	191	304	372
15	190 mil, Grooved, Spray, DuraStripe	282	307	222	313	240	357	274	315	262
14	120 mil, Grooved, Spray, DuraStripe	284	336	221	332	213	343	314	271	273
13	90 mil, Grooved, Spray, DuraStripe	276	347	269	371	209	309	245	265	237
12	150 mil, Surface, Spray, DuraStripe	275	266	192	319	269	331	302	348	377
11	120 mil, Surface, Spray, DuraStripe	235	187	355	338	306	296	204	280	392
10	90 mil, Surface, Spray, DuraStripe	394	329	333	329	370	474	389	413	417
9	60 mil, Surface, Spray, DuraStripe	292	306	263	343	341	324	290	285	364
8	250 mil, Grooved, Ex., DuraStripe	80	87	76	109	84	81	74	66	91
7	190 mil, Grooved, Ex., DuraStripe	94	149	76	78	86	89	84	92	85
6	120 mil, Grooved, Ex., DuraStripe	96	157	76	94	162	99	79	84	77
5	90 mil, Grooved, Ex., DuraStripe	114	103	104	118	111	97	88	98	83
4	150 mil, Surface, Ex., DuraStripe	175	100	70	105	88	98	95	107	216
3	120 mil, Surface, Ex., DuraStripe	89	105	87	98	82	100	86	95	116
2	60 mil, Surface, Ex., DuraStripe	78	90	81	128	137	98	220	90	102
1	90 mil, Surface, Ex., DuraStripe	204	109	92	108	107	111	89	99	97
		LT edge	wheel rut	C/Lane	wheel rut	white skip	wheel rut	C/Lane	wheel rut	RT edge

Direction of Travel

Table 5

The values under "Average" are based on initial readings taken after installation.

		Fairbanks 990830		Coefficient of Variation	Anchorage 981001		Coefficient of Variation
Stripe Numbers	Product	Average	Standard Deviation	Cv	Average	Standard Deviation	Cv
39 - 42	Stimsonite Preformed Thermoplastic	220.5	114.36	0.52	N / A	N / A	N / A
35	Columbia Spray	303.3	38.70	0.13	N / A	N / A	N / A
	Maintenance Paint	121.4	51.04	0.42	N / A	N / A	N / A
27 - 34	Rite-Mark Spray MMA	250.8	52.84	0.21	N / A	N / A	N / A
19 - 26	Rite-Mark Cold Extruded MMA	323.5	70.99	0.22	N / A	N / A	N / A
17 - 18, 1 - 2	Flint Preformed Thermoplastic - PREMARK	377.7	92.40	0.24	258.1	120.61	0.47
9 - 16, 5 - 12	DuraStripe Spray MMA	299.6	62.12	0.21	278.3	80.45	0.29
1 - 8, 13 - 20	DuraStripe Cold Extruded MMA	102.4	30.96	0.30	229.3	77.34	0.34
3 - 4	Flint Preformed Thermoplastic - Experiment	N / A	N / A	N / A	310.0	167.37	0.54

Table 6a

Data from Oregon DOT field survey of Alaskan roads

October 1998

Location	Description	Surface Age	Material	Measurement (millicandellas)	Pavement Marker
Parks Hwy	south of Fairbanks	3 years	methyl methacrylate	245	
Parks Hwy	south of Fairbanks	3 years	solvent based paint	100	
Richardson Hwy	south of Fairbanks, towards Tok	9 years	methyl methacrylate	150	
	(ADT is 10,325)				
Parks Hwy	Mile Post 342	3 years	Dura Stripe, Type 5 (Spray)		
				200 - 300	Legend (Arrow)
				190	Wheel track (Arrow legend)
				250 - 325	White Fog
				160	Double Yellow Skip (Right)
				120	Double Yellow Skip (Left)
				240 - 260	White Fog
Parks Hwy	Mile Post 342	4 years	Solvant Based Paint		
				110 - 115	White Fog
Richardson Hwy	Mile Post 345	9 years	Dura Stripe (Extruded 120 mil)		
				250	Legend (Arrow)
				350	Legend (ONLY)
				150	NB White Fog
				170	NB White Skip
				240	NB Yellow Edge
				152	SB White Fog
				174	SB White Skip
				196	SB Yellow Edge

Table 6b

Data from Oregon DOT field survey of Alaskan roads

October 1998

Location	Description	Surface Age	Material	Measurement (millicandellas)	Pavement Marker
Richardson Hwy	Mile Post 346	9 years	Dura Stripe (Extruded 120 mil)		
				203	NB White Fog
				168	NB White Skip
				169	NB Yellow Edge
				125	SB White Fog
				181	SB White Skip
				166	SB Yellow Edge
Glenn Hwy	Mile Post 28	2 years	Dura Stripe, Type 5 (Spray)		
	(near the Anchorage Test Deck)			138	NB White Fog
				150	NB White Skip
				300	NB Yellow Edge
Sterling Hwy	about Mile Post 80	4 years	Dura Stripe, Type 5 (Spray)		
	(near Sterling)			142	NB White Fog
				182	NB White Skip
				248	NB Yellow Edge
				220	SB White Fog
				259	SB White Skip
				197	SB Yellow Edge
Sterling Hwy	near Cooper Landing	New (1998)	Preformed Tape, Mfg. Unknown		
				400	NB White Fog
				350	NB White Skip
				400	NB Yellow Edge

REFERENCES

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