DEVELOPMENT OF IMPROVED MIX DESIGN AND CONSTRUCTION PROCEDURES FOR COLD IN-PLACE RECYCLED PAVEMENTS

1984-1986 Construction Projects

Volume IV - Final Report

by

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16. Abstract

This is the fourth of a four-volume report prepared to document the results of the cold in-place recycling (CIR) effort in Oregon. The overall objective of the project was to develop improved mix design and construction procedures for cold recycled pavements. Volume I of this report described the efforts to accomplish this objective while Volume II contains supporting data for this research effort.

Volume III documents performance data over a two-year period (1986-1988) and includes recommendations for improved mix and thickness design for cold recycled pavements. Volume IV contains data to support the contents of Volume III as well as construction procedures and specifications for CIR.

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This is the final report concerned with the Development of Improved Design and Construction Procedures for Cold In-Place Recycled (CIR) Pavements. The authors are grateful for the cooperation of the Oregon State Highway Division field staff in Region 4 and to personnel in the State Highway Materials Laboratory in Salem, Oregon. Special appreciation is extended to Randy Davis, David Foster, and Patty Jo Waters of Region 4, Lew Scholl and Jim Wilson of the Research Section, and to Tony George and his staff in the Materials Section of the Oregon State Highway Division. O.K. Kim of Oregon State University helped with the testing. Laurie Dockendorf and Peggy Offutt typed the report.

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APPENDIX A

PROCEDURE USED TO MEASURE SPECIFIC GRAVITY

CHEVRON RESEARCH COMPANY
RICHMOND, CALIFORNIA

PROCEDURE - BULK SPECIFIC GRAVITY OF COMPACTED BITUMINOUS MIXTURES USING PARAFILM-COATED SPECIMENS

FEBRUARY 12, 1985

Author - H. F. Del Valle

Scope

This method is an improved version of ASTM Method D 1188 for determining the bulk specific gravity of compacted bituminous mixtures.

It describes the use of an elastomeric film instead of a paraffin coating to seal the mixture for weighing in water.

Apparatus

Balance with ample capacity and with sufficient sensitivity to enable the bulk specific gravity of the specimens to be calculated to at least four significant figures (that is, to at least three decimal places). It shall be equipped with a suitable suspension apparatus and basket to permit weighing the specimen while it is suspended from the center of the balance.

Water bath, equipped with an overflow outlet for maintaining a constant water level, for immersing the specimen in water while suspended under the balance. See Figure 1.

Parafilm "M" manufactured by American Can Company. Available from most scientific supply companies.

Test Specimens

Test specimens may be either cylindrically molded bituminous mixtures or field-cored specimens. Specimens shall be free of foreign materials such as seal coat, tack coat, foundation material, soil, paper, or foil.

Wrapping Procedure

With a sharp safety blade, cut two square pieces of parafilm, each of 4 x 4 in. Also, cut one piece of 4 x 8 in. for each sample. Follow the lines on the paper backing. Peel off the parafilm from its backing paper. Stretch out a 4- x 4-in. piece. Place it over one end of the sample. Proceed in the same way for the other end.

Encl. - Figure 1 (RA 850065)
Figure 2 (PR 841307-1)
Appendix A (PR 841307-2; PR 841307-3,4;
PR 841307-9; PR 841307-5,6;
PR 841307-7,10)

Use the 4- x 8-in. parafilm piece to cover the cylindrical sides. Stretch it out along the length to about 16 in. Immediately wrap around the entire surface. (The parafilm elasticity keeps it taut around the sample.)

With fingers, press around the edges, sealing possible openings. One layer of parafilm will be adequate for most of the samples. If extra protection is needed, add another layer. Use the same procedure as for the first layer. The attached appendix describes the wrapping procedure in detail.

Density Calculations

Weigh the dry, unwrapped, room temperature stabilized specimen. Designate this weight as A.

Weigh the coated specimen in air. Designate this weight as D.

Weigh the coated specimen in water at 25°C (77°F). Designate this weight as E.

Determine the specific gravity of parafilm at 25°C (77°F) (or assume a value of 0.9) and designate this as F.

Calculate the bulk specific gravity of the specimen as follows:

$$\text{Bulk Specific Gravity} = A/\ [D-E-(D-A)/F]$$

A = Weight of dry uncoated specimen, g,

D = Weight of dry specimen plus parafilm coat, g,

E = Weight of the dry specimen plus parafilm coating in water, g, and

F = Specific gravity of the parafilm at 25°C.

:dad

FIGURE 1

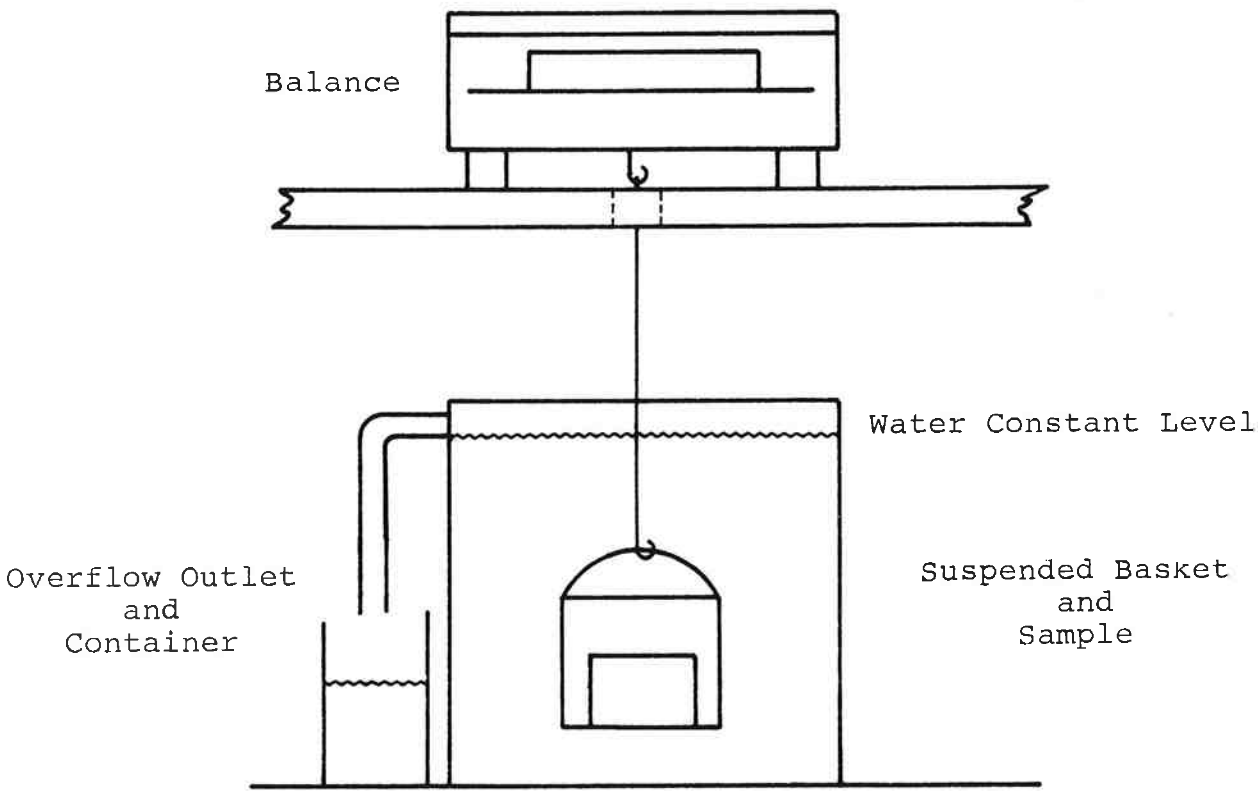
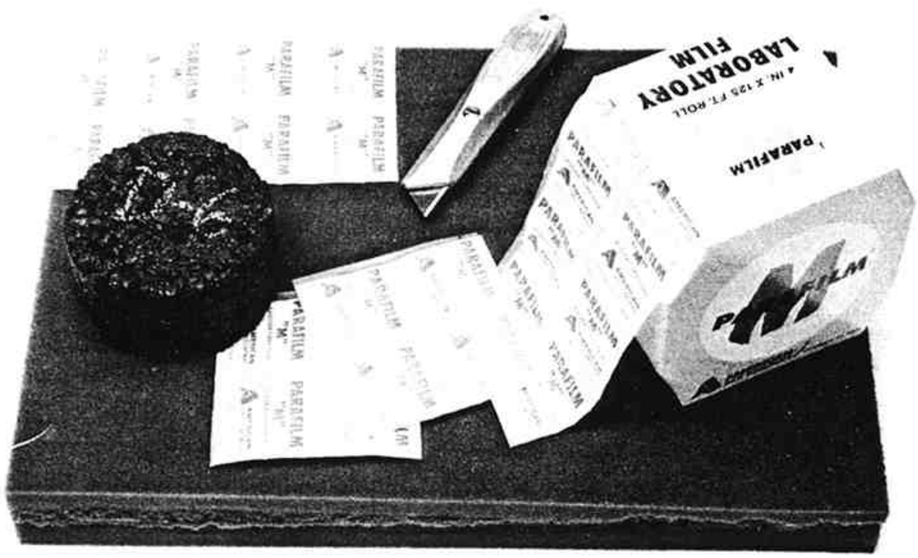

Balance
Water Constant Level
Overflow Outlet
and
Container
Suspended Basket
and
Sample

FIGURE 2



1. Materials and tools needed.

    a. Parafilm.
    b. Safety cutting knife.
    c. Polyurethane foam mat.
    d. Polyurethane foam disks. (Not shown.)

APPENDIX A

WRAPPING PROCEDURE

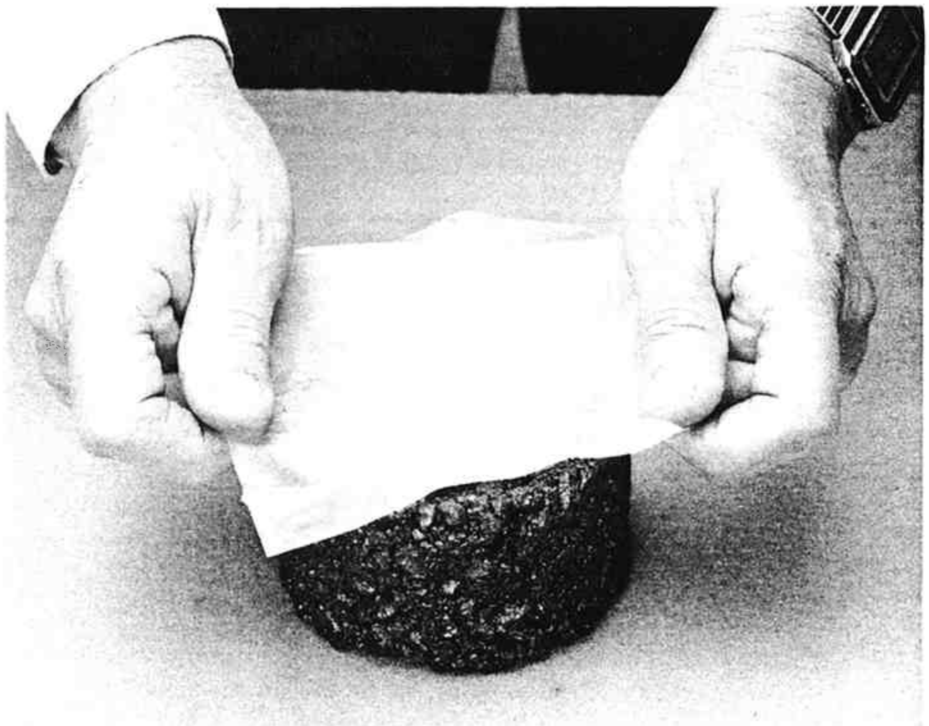


Figure A-1

Step 1. Cut the parafilm over a plywood board; remove the paper backing before stretching the film sheets. Grab the parafilm sheet and stretch it out in both directions one at a time, to about a 6- x 6-in. sheet and place it over one end of the compacted sample. See Figure A-1.

Figure A-2

Step 2. Press on the sides of the film around the sample. This will provide a partial adhesion of the film to the sample wall. See Figure A-2.

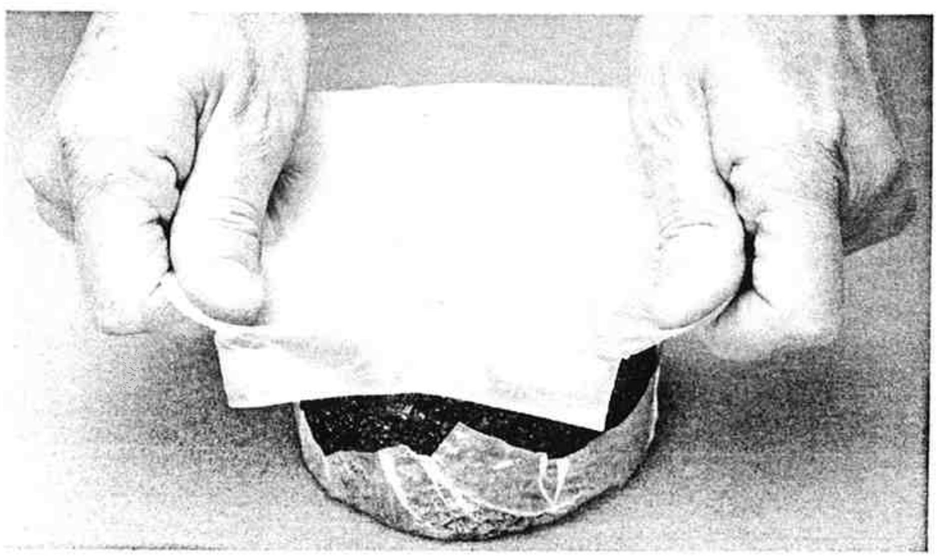


Figure A-3

Step 3. Once one flat end of the sample has been wrapped, turn it over and proceed in the same manner for the opposite end. Work on the polyurethane mat to prevent damage to the film which may occur if it is worked over a hard surface. See Figure A-3.

Figure A-4

Step 4. After the sample has been wrapped on both ends, it is necessary to remove air pockets that may be trapped between the sample walls and the film. In order to expel them, proceed as follows: Place the sample on the foam mat, place a 4-in. diameter disk over it, and press with another sample of the same diameter.

This procedure will eliminate all air pockets from both surfaces. See Figure A-4.

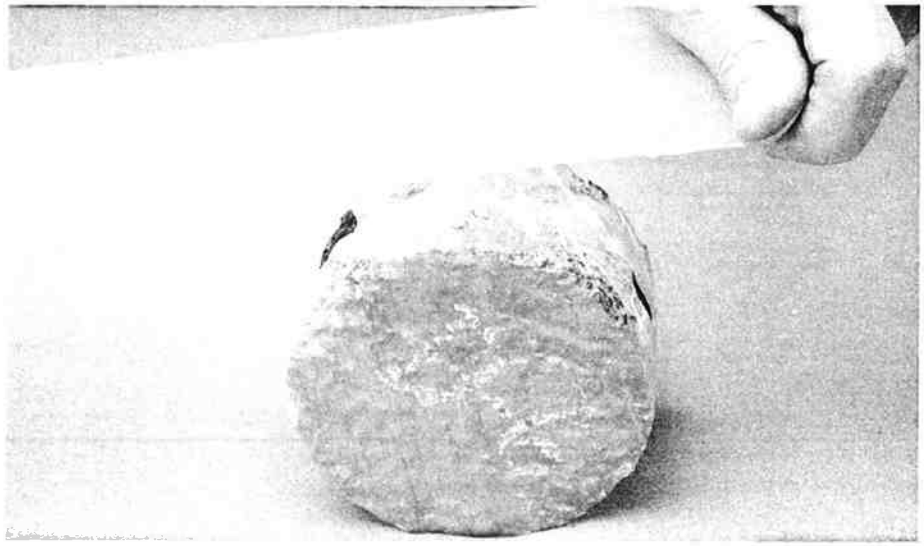


Figure A-5

Figure A-6

Step 5. Use the 4- x 8-in. piece of film to wrap around the core. Proceed as follows: Grab the film along the ends and stretch out to about 16 in. Place one end over the sample. Some adhesion will be accomplished. Roll it over in such a way that the stretched film covers the cylindrical side of the sample in about one and one-half turns. See Figures A-5 and A-6.

Figure A-7

Step 6. After the sample has been completely wrapped, proceed to seal the film covering by pressing and folding the edges against the sample. See Figure A-7.

Figure A-8

Step 7. Completely wrapped samples should be stored on the polyurethane foam mat to avoid damage to the thin parafilm. When working with a large number of samples stack them one atop another with a polyurethane mat disc between them. See Figure A-8.

APPENDIX B

FIELD PERFORMANCE DATA

Table B.1 - Deflection Measurements *

Project	Mile Point	Deflection, mils 1986	Deflection, mils 1987
MP 79.2 - Wasco Co. (Warm Springs)	88.00	0.65	0.71
	88.19	0.77	0.72
	88.28	0.71	0.67
	88.47	0.63	0.63
	88.56	0.55	0.52
	88.75	0.67	0.68
MP 18.0 - Powell Butte (Powell Butte Secondary)	11.00	1.63	----
	11.09	1.60	----
Powell Butte - Prineville (Ochoco Hwy)	12.10	1.83	----
	12.19	1.72	----
	28.52	2.05	2.03
	28.61	1.75	1.63
MP 89.6 - Jct. OR 19 (Ochoco Hwy)	96.91	1.35	----
	97.00	1.27	----
Lakeshore Dr. - Green-Springs Jct. (Lake of the Woods)	63.00	1.06	0.85
	63.19	1.17	1.08
	63.28	1.34	1.19
	63.47	1.38	1.12
	63.56	1.26	1.08
	63.75	1.22	1.03
US 97 - OR 39 (Lower Klamath)	4.53	1.50	----
	4.62	1.44	----
Sprague River Rd. - Bly (Klamath Falls-Lakeview)	23.11	1.93	----
	23.20	2.10	----
	41.03	1.97	----
	41.12	1.54	----

* As measured by geophone #1 (under & between applied loads)

Table B.2 - Ride Measurements *

Project	BMP	EMP	Ride, in./mile 1986	Ride, in./mile 1987
MP 79.2 - Wasco Co. (Warm Springs)	79.0	96.0	70.0	----
	96.0	79.0	74.0	----
	78.0	92.0	----	90.8
	91.0	78.0	----	92.7
Powell Butte - Prineville (Ochoco Hwy)	19.0	25.0	82.0	----
	25.0	19.0	81.0	----
MP 89.6 - Jct. OR 19 (Ochoco Hwy)	98.3	90.5	80.0	----
	90.5	98.3	79.0	----
Lakeshore Dr. - Green-Springs Jct. (Lake of the Woods)	62.4	68.7	64.0	----
	68.7	62.4	60.0	----
	62.0	67.0	----	51.7
	68.0	63.0	----	60.2
Sprague River Rd. - Bly (Klamath Falls-Lakeview)	35.9	53.6	76.0	----
	53.6	35.9	76.0	----

* As measured by the Mays ride meter.

Table B.3 - Pavement Condition *

Project	Condition Fall 1986	Condition Fall 1987	Condition Spring 1988
MP 79.2 - Wasco Co. (Warm Springs)	2	3	3 & 4
MP 18.0 - Powell Butte (Powell Butte Secondary)	4	2	2
Powell Butte - Prineville (Ochoco Hwy)	2 & 4	2 & 4	2 & 4
MP 89.6 - Jct. OR 19 (Ochoco Hwy)	2	1	1
Lakeshore Dr. - Green-Springs Jct. (Lake of the Woods)	5	1	1
US 97 - OR 39 (Lower Klamath)	2	2	2
Sprague River Rd. - Bly (KLamath Falls - Lakeview)	4	2	2

* OSHD Condition Rating Scale

Figure B.1 - Typical pavement surface condition of the MP 79.2 - Wasco Co. (Warm Springs) project. Photo was taken at MP 89.7 looking ahead on line on September 4, 1987. Surface is chip sealed.

Figure B.2 - Typical pavement surface condition of the Powell Butte - Prineville (Ochoco Hwy.) project. Photo was taken at MP 11.0 looking ahead on line on September 2, 1987. Surface is chip sealed.

Figure B.3 - Typical pavement surface condition of the MP 89.6 - Jct. OR 19 (Ochoco Hwy) project. Photo was taken at MP 96.4 looking ahead on line on September 9, 1987. Surface is chip sealed.

Figure B.4 - Typical pavement surface condition of the Lakeshore Dr. - Greensprings Jct, (Lake of the Woods) project. Photo was taken at MP 63.36 looking ahead on line on September 17, 1987. Surface is chip sealed.

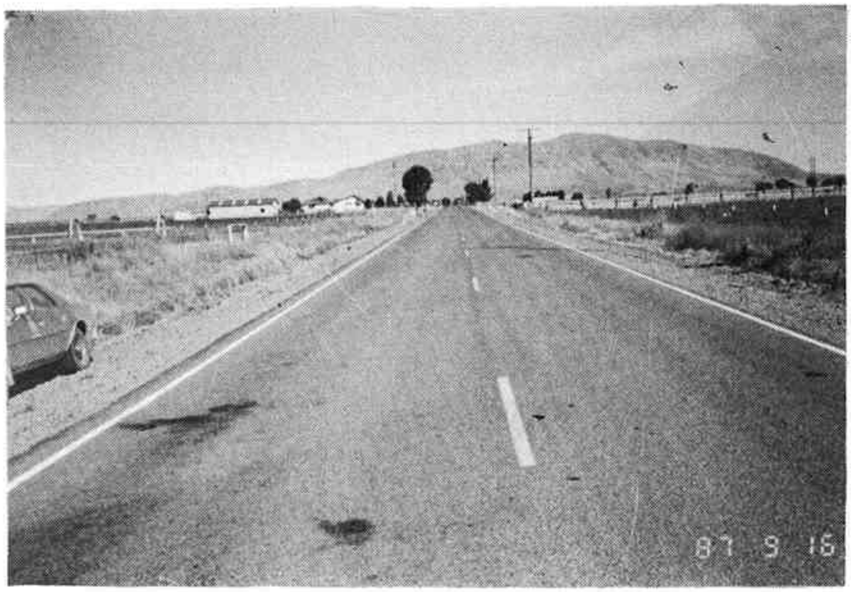


Figure B.5 - Typical pavement surface condition of the US 97 - OR 39 (Lower Klamath Hwy) project. Photo was taken at MP 3.65 looking ahead on line on September 16, 1987. Surface is chip sealed.

Figure B.6 - Typical pavement surface condition of the Sprague River Rd. - Bly (Klamalth Falls - Lakeview) project. Photo was taken at MP 39.0 looking ahead on line on September 16, 1987. Surface is chip sealed.

Table B.4 - Rut Depth Measurements (1986)

a) MP 89.6 - Jct. OR 19

MP	Left	Inside	Inside	Right
89.60	1/8	1/4	1/8	1/4
89.75	1/4	1/4	1/8	3/8
90.00	1/4	3/8	1/8	3/8
90.25	1/4	1/8	1/8	1/4
90.50	1/8	1/4	1/8	1/4
90.75	1/4	1/4	1/8	3/8
91.00	1/4	3/8	1/8	1/8
91.25	1/4	3/8	1/8	1/4
91.50	3/8	3/8	3/8	3/8
91.75	3/8	3/8	1/4	1/4
92.00	1/4	1/4	1/8	1/8
92.25	1/4	3/8	1/8	1/2
92.50	1/4	3/8	1/4	3/8
92.75	1/2	1/2	3/8	5/8
93.00	3/8	3/8	1/4	3/8
93.25	1/4	1/8	1/4	3/8
93.50	1/4	3/8	1/8	1/8
93.75	1/8	1/4	1/8	1/8
94.00	1/4	1/4	1/4	1/4
94.25	5/8	3/8	1/4	3/8
94.50	3/8	3/8	3/8	3/8
94.75	1/2	1/4	1/4	1/4
95.00	1/2	3/8	1/4	1/4
95.25	1/2	3/8	1/8	3/8
95.50	3/8	1/2	3/8	3/8
95.75	1/2	1/4	1/4	3/8
96.00	5/8	1/4	1/4	3/8
96.25	3/8	3/8	1/4	1/4
96.50	1/4	3/8	3/8	3/8
96.75	3/8	1/4	1/8	3/8
97.00	3/8	3/8	1/4	1/4
97.25	1/8	1/4	1/8	1/4
97.50	1/2	1/4	1/4	1/8
97.75	1/2	1/4	3/8	1/4
98.00	3/8	1/4	1/4	3/8
98.30	1/4	1/4	3/8	3/8

Table C.3 - Resilient Modulus and Fatigue Test Results for Field Cores (Fall 1986)

Project	Sample ID	Average Height (in.)	Resilient Modulus (ksi)	Fatigue Life (reps)
MP 79.2 - Wasco Co.;	A4	2.38	213	8482
Warm Springs	A5	2.26	581	16856
(Unit A) MP 88.45	A1	2.40	122	7769
MP 18.0 - Powell	C4	2.07	153	18940
Butte; Powell Butte	C5	2.01	194	11058
Secondary (Unit C)	C1	2.08	377	51490
Powell Butte -	D4	1.65	180	*
Prineville (HFE-150)	D5	*	*	*
(Unit D) Eastbound	D1	*	*	*
Powell Butte -	:D2	2.50	150	12250
Prineville (CMS-2S)	:D5	2.37	176	14500
(Unit D) Westbound	:D4	2.46	198	8114
MP 89.6 - OR 19;	G4	2.29	364	36566
Ochoco Hwy (Unit G)	G5	2.19	335	40476
	G1	2.20	372	22703
Lakeshore Dr. -	B4	2.37	397	10713
Greensprings Jct.;	B5	2.52	607	4585
Lake of the Woods	B1	2.36	534	2292
(Unit B)				
US 97 - OR 39;	:C4	2.58	361	6687
Lower Klamath	:C5	2.57	327	10108
(Unit C)	:C1	2.33	237	20620
Sprague River Rd.;	E4	2.34	416	14844
Klamath Falls -	E5	2.40	420	17233
Lakeview (Unit E)	E1	2.36	399	16650

* Core too thin for proper test

Table B.4 (continued) - Rut Depth Measurements (1986)

b) Lakeshore Dr. - Greensprings Jct.

MP	Left	Inside	Inside	Right				
62.40	3/8	3/8	0	1/8				
62.50	1/8	1/8	1/8	1/8				
62.75	1/8	1/4	5/8	1/8				
63.00	3/8	1/4	1/8	1/4				
63.25	3/8	3/8	1/8	1/8				
63.50	1/8	1/8	0	1/4				
63.75	1/8	1/4	1/8	3/4				
		Begin 3 lane EB						
64.00	1/8	0	1/4	1/4	1/4	3/8		
64.25	0	1/4	1/8	1/8	1/4	1/8		
64.50	1/4	1/4	1/8	1/8	1/4	3/8		
64.75	1/4	1/4	1/8	1/8	1/8	1/4		
65.00	1/4	1/4	0	1/8	1/8	1/8		
65.25	1/4	1/8	0	0	1/4	1/4		
		Begin 4 lane						
65.50	1/8	0	1/8	0	1/8	1/8	0	1/4
65.75	1/4	1/4	1/8	0	0	1/8	1/8	1/8
		End 4 lane begin 3 lane WB						
66.00	1/8	1/4	1/4	1/8	1/8	1/8		
66.25	1/8	0	1/8	0	1/8	1/4		
		End 3 lane WB						
66.50	1/8	0	1/8	0				
66.75	1/8	1/8	1/8	1/8				
67.00	3/8	0	1/4	1/8				
67.25	1/8	0	0	1/4				
67.50	1/8	1/8	1/8	1/8				
67.75	1/8	0	0	1/8				
		Begin 3 lane WB						
68.00	1/8	0	1/8	1/8	1/8	1/8		
68.25	1/8	0	1/8	0	1/4	1/4		
68.50	1/4	1/8	1/8	1/8	1/4	1/4		
		End 3 lane						
68.75	3/8	1/8	3/8	3/8				

Table B.4 (continued) - Rut Depth Measurements (1986)

c) US 97 - OR 39

MP	Left	Inside	Inside	Right
0.00	3/8	1/2	1/8	1/8
0.25	1/8	1/8	1/8	1/8
0.50	1/8	1/8	1/8	1/8
0.75	1/8	1/8	1/8	1/8
1.00	1/8	1/8	1/4	1/8
1.25	1/8	1/8	1/8	1/8
1.50	1/8	0	1/4	0
1.75	1/8	1/8	1/8	1/8
2.00	1/4	1/4	1/4	1/4
2.25	1/8	1/8	1/8	1/8
2.50	1/4	1/8	1/8	1/8
2.75	1/4	1/4	1/8	1/4
3.00	1/4	1/8	1/4	1/8
3.25	1/4	1/8	1/8	1/4
3.50	1/4	1/4	1/8	1/8
3.75	1/4	1/4	1/8	1/8
4.00	1/4	1/4	1/4	1/8
4.25	1/4	1/8	1/8	1/8
4.50	1/8	1/8	1/8	1/8
4.75	3/4	1/4	1/8	1/8
5.00	1/4	1/8	1/8	1/4
5.25	3/8	1/8	1/8	1/8
5.50	1/8	1/8	1/4	1/8
5.75	3/8	1/8	1/8	1/4
6.00	1/4	1/8	1/4	1/8
6.25	1/4	1/8	1/8	3/8
6.50	1/8	1/8	1/4	1/4

Table B.4 (continued) - Rut Depth Measurements (1986)

d) Sprague River Rd. - Bly

MP	Left	Inside	Inside	Right
35.80	1/8	1/8	1/4	1/4
36.00	0	1/8	1/8	1/8
36.25	3/8	1/8	1/8	1/8
36.50	1/4	1/4	1/8	1/8
36.75	0	1/8	0	1/4
37.00	1/8	1/4	1/8	1/4
37.25	1/4	1/4	1/8	1/8
37.50	1/8	1/8	1/8	1/8
37.75	1/8	1/4	1/8	1/4
38.00	1/4	0	1/8	0
38.25	3/8	1/4	1/4	1/8
38.50	3/8	1/8	1/4	1/8
38.75	1/4	1/4	1/8	1/4
39.00	1/4	1/8	3/8	1/4
39.25	1/4	1/4	1/4	1/4
39.50	3/8	1/4	1/4	3/8
39.75	1/4	3/8	3/8	3/8
40.00	1/4	1/4	1/4	1/4
40.25	3/8	3/8	3/8	1/4
40.50	1/4	1/4	1/8	1/8
40.75	1/4	3/8	1/4	1/4
41.00	3/8	1/4	1/4	1/4
41.25	3/8	5/8	3/8	3/8
41.50	3/8	3/8	3/8	3/8
41.75	1/4	1/4	3/8	1/8
42.00	1/8	1/4	1/8	1/4
42.25	1/4	1/2	3/8	1/4
42.50	1/4	1/8	3/8	1/8
42.75	5/8	1/4	3/8	1/4
43.00	1/8	1/8	1/8	1/4
43.25	1/4	3/8	3/8	1/4
43.50	1/2	1/2	3/8	3/8
43.75	1/8	1/4	1/2	1/2
44.00	1/8	1/4	1/4	1/4
44.25	1/8	1/8	1/8	1/4
44.50	1/2	1/4	1/2	1/8
44.75	1/4	1/8	1/4	1/8
45.00	3/8	1/2	3/8	3/8
45.25	3/8	1/4	1/8	1/4
45.50	1/4	1/4	3/8	1/4
45.75	1/4	1/2	3/8	3/8
46.00	3/8	3/8	3/8	1/4
46.25	1/8	1/2	1/4	1/8
46.50	3/8	1/4	1/4	1/8
46.75	1/8	1/4	3/8	3/8
47.00	3/8	1/4	1/4	1/8

Table B.4 (continued) - Rut Depth Measurements (1986)

d) Sprague River Rd. - Bly

MP	Left	Inside	Inside	Right
47.25	3/8	3/8	1/4	1/4
47.50	1/4	1/4	1/4	3/8
47.75	3/8	1/2	3/8	1/4
48.00	1/2	1/2	3/8	3/8
48.25	3/8	3/8	1/4	3/8
48.50	3/8	1/2	1/4	1/4
48.75	3/8	5/8	1/4	1/8
49.00	5/8	1/2	1/4	1/2
49.25	3/8	1/2	1/4	3/8
49.50	3/8	3/8	1/4	3/8
49.75	3/8	1/2	3/8	1/2
50.00	3/8	3/8	3/8	1/8
50.25	3/8	3/8	1/4	1/8
50.50	1/8	1/4	1/4	1/4
50.75	3/8	1/4	1/4	1/8
51.00	1/4	1/4	1/4	1/4
51.25	1/8	1/4	1/4	1/4
51.50	1/8	1/8	1/4	1/4
51.75	1/4	1/4	1/4	1/4
52.00	1/4	1/8	1/4	3/8
52.25	1/4	1/8	1/4	1/4
52.50	3/8	1/4	1/4	3/8
52.75	1/4	1/8	3/8	3/8
53.00	3/8	3/8	3/8	3/8
53.25	3/8	1/2	1/2	3/8
53.50	3/8	1/4	3/8	3/8

Table B.5 - Rut Depth Measurements (1987)

a) MP 79.2 - Wasco Co.

MP	Left	Inside	Inside	Right	Comments
79.00	1/8	0	1/8	1/8	
79.25	0	1/8	1/4	1/8	
79.50	0	1/8	1/8	1/4	79.6-79.9 SB: Oily,
79.75	3/8	1/8	1/8	1/4	rough spots.
80.00	1/4	1/8	1/8	1/4	
80.25	1/8	0	1/8	1/4	
80.50	1/4	1/4	1/4	1/8	
80.75	1/8	0	1/8	1/4	
81.00	1/4	1/4	1/8	1/4	
81.25	0	1/4	1/8	1/8	
81.50	1/4	1/8	1/4	1/8	
81.75	1/8	1/8	1/8	1/8	
82.00	38	0	0	1/8	
82.25	1/8	1/8	0	1/4	
82.50	1/8	1/4	1/4	3/8	82.65 NB: Rough spot
82.75	1/8	1/8	1/8	1/4	100 ft. long.
83.00	1/4	0	1/8	1/4	
83.25	1/4	1/8	1/8	1/4	83.35-83.65 SB: Deep
83.50	1/8	1/8	5/8	1/2	ruts, rough & oily.
83.75	1/4	1/8	1/8	0	83.80-84.3 SB: Deep
84.00	1/8	3/8	3/4	1/2	ruts, rough & oily.
84.25	1/4	1/8	1/2	3/8	
84.50	1/4	1/4	3/8	1/8	84.9 SB: Rough spot.
84.75	0	1/8	1/4	1/8	
85.00	1/4	3/8	1/4	0	
85.25					
85.50	1/4	1/4	1/4	1/8	
85.75	1/8	1/4	0	0	
86.00	1/4	1/4	1/8	1/8	
86.25	1/4	3/8	0	1/8	
86.50	1/4	1/4	1/8	0	86.65-86.85 SB: Rough
86.75	1/8	1/8	1/4	1/8	and oily
87.00	1/8	1/8	1/8	1/8	
87.25	1/8	1/4	1/4	1/8	
87.50	1/8	1/4	1/4	1/8	
87.75	3/8	1/4	0	1/8	
88.00	1/8	1/4	1/8	0	
88.25	1/4	1/4	1/2	1/8	88.4-89.0 SB: Inter-
88.50	1/4	3/8	5/8	1/8	mittent rough spots &
88.75	1/4	1/4	1/4	3/8	ruts.
89.00	1/8	1/4	1/4	1/4	
89.25	1/8	1/4	1/8	1/8	
89.50	1/4	1/8	1/8	1/4	
89.75	1/8	1/8	1/4	1/4	
90.00	1/8	1/8	1/8	1/4	90.1-90.3 SB: Oily &
90.25	1/8	1/4	1/2	5/8	ruts.

Table B.5 (continued) - Rut Depth Measurements (1987)

a) MP 79.2 - Wasco Co. (continued)

MP	Left	Inside	Inside	Right	Comments
90.50	1/4	3/8	1/4	1/4	
90.75	1/8	1/4	1/8	1/4	
91.00	1/8	1/4	1/8	1/4	
91.25	1/4	1/8	1/8	1/4	91.4-91.55 SB: Oily &
91.50	1/4	1/4	3/4	1/4	ruts.
91.75	3/8	1/8	1/8	1/8	91.75-92.1 SB: Oily &
92.00	1/4	1/8	1/4	1/8	ruts.
92.25	1/4	1/8	1/8	1/8	
92.50	1/8	1/8	1/8	1/8	
92.75	1/8	1/8	1/8	1/8	
93.00	1/8	1/8	3/4	3/8	93.0-93.35 SB:
93.25	1/4	1/8	7/8	1/4	Right side rutted.
93.50	1/8	1/8	1/4	1/4	
93.75	1/4	1/8	1/4	1/4	
94.00	1/4	1/8	1/2	1/4	
94.25	1/8	1/4	3/8	1/8	
94.50	1/8	1/8	1/4	1/8	
94.75	3/8	1/4	1/8	1/8	
95.00	1/4	1/8	1/8	1/4	
95.25	1/4	1/4	1/2	1/4	95.25 SB: 150 ft.
95.50	1/8	1/4	1/8	1/8	outside rut.
95.75	1/8	1/8	1/8	1/4	
96.00	1/4	1/8	1/8	1/8	
96.25	1/4	1/8	3/8	3/8	
96.50	1/8	1/8	1/4	1/4	

Table B.5 (continued) - Rut Depth Measurements (1987)

b) Powell Butte - Prineville

MP	Left	Inside	Inside	Right	Comments
6.80	1/8	1/8	1/4	1/8	
7.00	1/4	1/8	3/8	1/8	
7.25	1/2	1/4	1/4	1/4	
7.50	5/8	3/8	1/4	1/4	
7.75	1/4	1/8	1/4	1/8	7.85: Soft, oily spot.
8.00	3/8	3/8	3/8	3/8	
8.25	1/8	1/4	1/8	1/8	
8.50	1/4	1/4	1/4	1/8	
8.75	1/8	1/4	3/8	1/8	
9.00	3/8	1/4	1/8	1/8	
9.25	3/8	1/4	1/8	3/8	
9.50	1/4	3/8	1/4	1/8	
9.75	1/8	1/8	1/4	1/4	
10.00	3/8	3/8	1/4	1/4	
10.25	3/8	3/8	1/4	1/8	
10.50	1/4	3/8	3/8	3/8	
10.75	1/4	1/8	1/4	1/4	
11.00	3/8	3/8	1/4	3/8	
11.25	3/8	3/8	3/8	1/2	Fat spots.
11.50	1/4	3/8	3/8	1/8	
11.75	3/8	3/8	3/8	3/8	
12.00	1/2	1/4	1/4	1/8	
12.25	3/8	1/4	3/8	1/4	
12.50	3/8	1/4	1/4	1/4	
12.75	1/4	1/4	3/8	1/4	
13.00	5/8	1/4	3/8	1/2	
13.25	3/8	1/4	Patch	Patch	
13.50	3/8	3/8	3/8	1/8	
13.75	3/8	1/4	1/2	1/2	
14.00	3/8	3/8	3/8	3/8	
14.25	1/2	1/2	1/2	3/8	
14.50	3/8	3/8	3/8	3/8	
14.75	3/8	1/4	3/8	1/4	
15.00	3/8	3/8	Patch	Patch	
15.25	3/8	3/8	Patch	Patch	
15.50	3/8	1/4	Patch	Patch	
15.75	3/8	3/8	Patch	Patch	
16.00	1/4	3/8	Patch	Patch	
16.25	0	1/4	Patch	Patch	
16.50	1/4	1/4	1/4	1/8	

Table B.5 (continued) - Rut Depth Measurements (1987)

c) MP 89.6 - Jct. OR 19

MP	Left	Inside	Inside	Right
89.60	1/8	1/4	1/8	1/4
89.75	1/4	1/4	1/8	3/8
90.00	1/4	3/8	1/8	3/8
90.25	1/4	1/8	1/8	1/4
90.50	1/8	1/4	1/8	1/4
90.75	1/4	1/4	1/8	3/8
91.00	1/4	3/8	1/8	1/8
91.25	1/4	3/8	1/8	1/4
91.50	3/8	3/8	3/8	3/8
91.75	3/8	3/8	1/4	1/4
92.00	1/4	1/4	1/8	1/8
92.25	1/4	3/8	1/8	1/2
92.50	1/4	3/8	1/4	3/8
92.75	1/2	1/2	3/8	5/8
93.00	3/8	3/8	1/4	3/8
93.25	1/4	1/8	1/4	3/8
93.50	1/4	3/8	1/8	1/8
93.75	1/8	1/4	1/8	1/8
94.00	1/4	1/4	1/4	1/4
94.25	5/8	3/8	1/4	3/8
94.50	3/8	3/8	3/8	3/8
94.75	1/2	1/4	1/4	1/4
95.00	1/2	3/8	1/4	1/4
95.25	1/2	3/8	1/8	3/8
95.50	3/8	1/2	3/8	3/8
95.75	1/2	1/4	1/4	3/8
96.00	5/8	1/4	1/4	3/8
96.25	3/8	3/8	1/4	1/4
96.50	1/4	3/8	3/8	3/8
96.75	3/8	1/4	1/8	3/8
97.00	3/8	3/8	1/4	1/4
97.25	1/8	1/4	1/8	1/4
97.50	1/2	1/4	1/4	1/8
97.75	1/2	1/4	3/8	1/4
98.00	3/8	1/4	1/4	3/8
98.30	1/4	1/4	3/8	3/8

Table B.5 (continued) - Rut Depth Measurements (1987)

d) Lakeshore Dr. - Greensprings Jct.

MP	Left	Inside	Inside	Right				
62.40	3/8	3/8	0	1/8				
62.50	1/8	1/8	1/8	1/8				
62.75	1/8	1/4	5/8	1/8				
63.00	3/8	1/4	1/8	1/4				
63.25	3/8	3/8	1/8	1/8				
63.50	1/8	1/8	0	1/4				
63.75	1/8	1/4	1/8	3/4				
		Begin 3 lane EB						
64.00	1/8	0	1/4	1/4	1/4	3/8		
64.25	0	1/4	1/8	1/8	1/4	1/8		
64.50	1/4	1/4	1/8	1/8	1/4	3/8		
64.75	1/4	1/4	1/8	1/8	1/8	1/4		
65.00	1/4	1/4	0	1/8	1/8	1/8		
65.25	1/4	1/8	0	0	1/4	1/4		
		Begin 4 lane						
65.50	1/8	0	1/8	0	1/8	1/8	0	1/4
65.75	1/4	1/4	1/8	0	0	1/8	1/8	1/8
		End 4 lane begin 3 lane WB						
66.00	1/8	1/4	1/4	1/8	1/8	1/8		
66.25	1/8	0	1/8	0	1/8	1/4		
		End 3 lane WB						
66.50	1/8	0	1/8	0				
66.75	1/8	1/8	1/8	1/8				
67.00	3/8	0	1/4	1/8				
67.25	1/8	0	0	1/4				
67.50	1/8	1/8	1/8	1/8				
67.75	1/8	0	0	1/8				
		Begin 3 lane WB						
68.00	1/8	0	1/8	1/8	1/8	1/8		
68.25	1/8	0	1/8	0	1/4	1/4		
68.50	1/4	1/8	1/8	1/8	1/4	1/4		
		End 3 lane						
68.75	3/8	1/8	3/8	3/8				

Table B.5 (continued) - Rut Depth Measurements (1987)

e) US 97 - OR 39

MP	Left	Inside	Inside	Right
0.00	3/8	1/2	1/8	1/8
0.25	1/8	1/8	1/8	1/8
0.50	1/8	1/8	1/8	1/8
0.75	1/8	1/8	1/8	1/8
1.00	1/8	1/8	1/4	1/8
1.25	1/8	1/8	1/8	1/8
1.50	1/8	0	1/4	0
1.75	1/8	1/8	1/8	1/8
2.00	1/4	1/4	1/4	1/4
2.25	1/8	1/8	1/8	1/8
2.50	1/4	1/8	1/8	1/8
2.75	1/4	1/4	1/8	1/4
3.00	1/4	1/8	1/4	1/8
3.25	1/4	1/8	1/8	1/4
3.50	1/4	1/4	1/8	1/8
3.75	1/4	1/4	1/8	1/8
4.00	1/4	1/4	1/4	1/8
4.25	1/4	1/8	1/8	1/8
4.50	1/8	1/8	1/8	1/8
4.75	3/4	1/4	1/8	1/8
5.00	1/4	1/8	1/8	1/4
5.25	3/8	1/8	1/8	1/8
5.50	1/8	1/8	1/4	1/8
5.75	3/8	1/8	1/8	1/4
6.00	1/4	1/8	1/4	1/8
6.25	1/4	1/8	1/8	3/8
6.50	1/8	1/8	1/4	1/4

Table B.5 (continued) - Rut Depth Measurements (1987)

f) Sprague River Rd. - Bly

MP	Left	Inside	Inside	Right
35.80	1/8	1/8	1/4	1/4
36.00	0	1/8	1/8	1/8
36.25	3/8	1/8	1/8	1/8
36.50	1/4	1/4	1/8	1/8
36.75	0	1/8	0	1/4
37.00	1/8	1/4	1/8	1/4
37.25	1/4	1/4	1/8	1/8
37.50	1/8	1/8	1/8	1/8
37.75	1/8	1/4	1/8	1/4
38.00	1/4	0	1/8	0
38.25	3/8	1/4	1/4	1/8
38.50	3/8	1/8	1/4	1/8
38.75	1/4	1/4	1/8	1/4
39.00	1/4	1/8	3/8	1/4
39.25	1/4	1/4	1/4	1/4
39.50	3/8	1/4	1/4	3/8
39.75	1/4	3/8	3/8	3/8
40.00	1/4	1/4	1/4	1/4
40.25	3/8	3/8	3/8	1/4
40.50	1/4	1/4	1/8	1/8
40.75	1/4	3/8	1/4	1/4
41.00	3/8	1/4	1/4	1/4
41.25	3/8	5/8	3/8	3/8
41.50	3/8	3/8	3/8	3/8
41.75	1/4	1/4	3/8	1/8
42.00	1/8	1/4	1/8	1/4
42.25	1/4	1/2	3/8	1/4
42.50	1/4	1/8	3/8	1/8
42.75	5/8	1/4	3/8	1/4
43.00	1/8	1/8	1/8	1/4
43.25	1/4	3/8	3/8	1/4
43.50	1/2	1/2	3/8	3/8
43.75	1/8	1/4	1/2	1/2
44.00	1/8	1/4	1/4	1/4
44.25	1/8	1/8	1/8	1/4
44.50	1/2	1/4	1/2	1/8
44.75	1/4	1/8	1/4	1/8
45.00	3/8	1/2	3/8	3/8
45.25	3/8	1/4	1/8	1/4
45.50	1/4	1/4	3/8	1/4
45.75	1/4	1/2	3/8	3/8
46.00	3/8	3/8	3/8	1/4
46.25	1/8	1/2	1/4	1/8
46.50	3/8	1/4	1/4	1/8
46.75	1/8	1/4	3/8	3/8
47.00	3/8	1/4	1/4	1/8

Table B.5 (continued) - Rut Depth Measurements (1987)

f) Sprague River Rd. - Bly (continued)

MP	Left	Inside	Inside	Right
47.25	3/8	3/8	1/4	1/4
47.50	1/4	1/4	1/4	3/8
47.75	3/8	1/2	3/8	1/4
48.00	1/2	1/2	3/8	3/8
48.25	3/8	3/8	1/4	3/8
48.50	3/8	1/2	1/4	1/4
48.75	3/8	5/8	1/4	1/8
49.00	5/8	1/2	1/4	1/2
49.25	3/8	1/2	1/4	3/8
49.50	3/8	3/8	1/4	3/8
49.75	3/8	1/2	3/8	1/2
50.00	3/8	3/8	3/8	1/8
50.25	3/8	3/8	1/4	1/8
50.50	1/8	1/4	1/4	1/4
50.75	3/8	1/4	1/4	1/8
51.00	1/4	1/4	1/4	1/4
51.25	1/8	1/4	1/4	1/4
51.50	1/8	1/8	1/4	1/4
51.75	1/4	1/4	1/4	1/4
52.00	1/4	1/8	1/4	3/8
52.25	1/4	1/8	1/4	1/4
52.50	3/8	1/4	1/4	3/8
52.75	1/4	1/8	3/8	3/8
53.00	3/8	3/8	3/8	3/8
53.25	3/8	1/2	1/2	3/8
53.50	3/8	1/4	3/8	3/8

APPENDIX C

FIELD CORE DATA

Table C.1 - Gravity Data for Field Cores (Fall 1986)

Project	Sample ID	Bulk Specific Gravity	Rice Gravity *	Percent Voids
MP 79.2 - Wasco Co.;	A1	2.125	2.478	14.2
Warm Springs	A2	2.180	2.478	12.0
(Unit A)	A3	2.175	2.478	12.2
MP 18.0 - Powell	C1	1.963	2.343	16.2
Butte; Powell Butte	C2	2.044	2.343	12.8
Secondary (Unit C)	C3	2.060	2.343	12.1
Powell Butte -	D1	2.054	2.377	13.6
Prineville (HFE-150)	D2	2.006	2.377	15.6
(Unit D) Eastbound	D3	1.982	2.377	16.6
Powell Butte -	:D1	2.102	2.411	12.8
Prineville (CMS-2S)	:D2	2.125	2.411	11.9
(Unit D) Westbound	:D3	2.137	2.411	11.4
MP 89.6 - OR 19;	G1	2.131	2.452	13.1
Ochoco Hwy (Unit G)	G2	2.146	2.452	12.5
	G3	2.147	2.452	12.4
Lakeshore Dr. -	B1	2.083	2.311	9.9
Greensprings Jct.;	B2	2.030	2.311	12.2
Lake of the Woods	B3	2.063	2.311	10.7
(Unit B)				
US 97 - OR 39;	:C1	2.036	2.262	10.0
Lower Klamath	:C2	2.054	2.262	9.2
(Unit C)	:C3	2.024	2.262	10.5
Sprague River Rd.;	E1	2.165	2.380	9.0
Klamath Falls -	E2	2.158	2.380	9.3
Lakeview (Unit E)	E3	2.171	2.380	8.8

* Determined at ODOT

Table C.2 - Gravity Data for Field Cores (Fall 1987)

Project	Sample ID	Bulk Specific Gravity	Rice Gravity *	Percent Voids
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 88.45	A11	2.309	2.522	8.4
	A12	2.355	2.522	6.6
	A13	2.328	2.522	7.7
	A14	2.334	2.522	7.5
	A15	2.338	2.522	7.3
	A16	2.335	2.522	7.4
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.4	A21	2.376	2.586	8.1
	A22	2.384	2.586	7.8
	A23	2.384	2.586	7.8
	A24	2.378	2.586	8.0
	A25	2.367	2.586	8.5
	A26	2.366	2.586	8.5
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.6	A31	2.404	**	**
	A32	2.411	**	**
	A33	2.409	**	**
	A34	2.406	**	**
	A35	2.407	**	**
	A36	2.402	**	**
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 93.1	A41	2.374	2.571	7.7
	A42	2.382	2.571	7.4
	A43	2.393	2.571	6.9
	A44	2.381	2.571	7.4
	A45	2.384	2.571	7.3
	A46	2.37	2.571	7.8
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 93.4	A51	2.431	**	**
	A52	2.434	**	**
	A53	2.432	**	**
	A54	2.422	**	**
	A55	2.416	**	**
	A56	2.442	**	**
Powell Butte - Prineville (HFE-150) (Unit D) Eastbound	D21	2.321	2.496	7.0
	D22	2.328	2.496	6.7
	D23	2.341	2.496	6.2
	D24	2.244	2.496	10.1
	D25	2.345	2.496	6.0
	D26	2.350	2.496	5.8

Table C.2 (continued) - Gravity Data for Field Cores (Fall 1987)

Project	Sample ID	Bulk Specific Gravity	Rice Gravity *	Percent Voids
Powell Butte - Prineville (CMS-2S) (Unit D) Westbound	D11	2.321	2.511	7.6
	D12	2.310	2.511	8.0
	D13	2.320	2.511	7.6
	D14	2.319	2.511	7.6
	D15	2.316	2.511	7.8
	D16	2.302	2.511	8.3
MP 89.6 - OR 19; Ochoco Hwy (Unit G)	G1	2.227	2.468	9.8
	G2	2.245	2.468	9.0
	G3	2.256	2.468	8.6
	G4	2.231	2.468	9.6
	G5	2.264	2.468	8.3
	G6	2.254	2.468	8.7
Lakeshore Dr. - Greensprings Jct.; Lake of the Woods (Unit B)	B1	2.094	2.482	15.6
	B2	2.099	2.482	15.4
	B3	2.084	2.482	16.0
	B4	2.101	2.482	15.4
	B5	2.089	2.482	15.8
	B6	2.082	2.482	16.1
US 97 - OR 39; Lower Klamath (Unit C)	C1	2.174	2.358	7.8
	C2	2.181	2.358	7.5
	C3	2.174	2.358	7.8
	C4	2.166	2.358	8.1
	C5	2.154	2.358	8.7
	C6	2.158	2.358	8.5
Sprague River Rd.; Klamath Falls - Lakeview (Unit E)	E1	2.294	2.437	5.9
	E2	2.253	2.437	7.6
	E3	2.277	2.437	6.6
	E4	2.295	2.437	5.8
	E5	2.274	2.437	6.7
	E6	2.264	2.437	7.1

* Determined at ODOT

** Not Available

Table C.4 - Resilient Modulus and Fatigue Test Results for Field Cores (Fall 1987)

Project	Sample ID	Average Height (in.)	Resilient Modulus (ksi)	Fatigue Life (reps)
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 88.45	A11	2.54	227	70449
	A12	2.37	257	39264
	A13	2.66	243	40316
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.4	A21	2.22	316	26348
	A22	2.63	227	66025
	A23	2.25	272	33290
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.6	A31	1.74	249	40571
	A32	1.52	305	21003
	A33	1.78	359	30403
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 93.1	A41	1.90	329	*
	A42	1.83	386	36872
	A43	1.45	392	*
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 93.4	A51	2.41	527	26777
	A52	2.62	430	20403
	A53	2.47	443	27092
Powell Butte - Prineville (HFE-150) (Unit D) Eastbound	D21	2.34	464	33038
	D22	2.49	443	22140
	D23	2.49	475	47665
Powell Butte - Prineville (CMS-2S) (Unit D) Westbound	D11	1.86	469	34997
	D12	1.96	444	29568
	D13	1.78	462	32411
MP 89.6 - OR 19; Ochoco Hwy (Unit G)	G1	2.34	539	60244
	G2	1.84	593	79855
	G3	1.72	629	77316
Lakeshore Dr. - Greensprings Jct.; Lake of the Woods (Unit B)	B1	1.23	515	33186
	B2	2.45	437	40256
	B3	2.54	560	29341
US 97 - OR 39; Lower Klamath (Unit C)	C1	1.81	498	49683
	C2	2.14	442	*
	C3	1.93	477	58969
Sprague River Rd.; Klamath Falls - Lakeview (Unit E)	E1	2.31	426	28350
	E2	2.30	424	38514
	E3	2.40	466	37610

* Equipment Failure / No Test Results

Table C.5 - Marshall Stability Test Results for Field Cores (Fall 1986)

Project	Sample ID	Average Height (in.)	Marshall Stability (lbs)	Flow (in/1000)
MP 79.2 - Wasco Co.;	A2	2.55	699	54
Warm Springs	A3	2.39	612	57
(Unit A) MP 88.45	A6	2.52	772	65
MP 18.0 - Powell	C2	***	***	***
Butte; Powell Butte	C3	1.88	281	21
Secondary (Unit C)	C6	1.95	327	24
Powell Butte -	D2	1.75	222	24
Prineville (HFE-150)	D3	1.80	218	20
(Unit D) Eastbound	D6	1.68	239	16
Powell Butte -	*D1*	2.38	242	14
Prineville (CMS-2S)	*D3*	2.32	247	33
(Unit D) Westbound	*D6*	2.66	319	29
MP 89.6 - OR 19;	G2	2.12	424	18
Ochoco Hwy (Unit G)	G3	2.35	513	20
	G6	2.31	439	23
Lakeshore Dr. -	B2	2.38	531	23
Greensprings Jct.;	B3	2.78	719	44
Lake of the Woods	B6	2.58	565	19
(Unit B)				
US 97 - OR 39;	*C2*	2.30	498	22
Lower Klamath	*C3*	2.35	443	22
(Unit C)	*C6*	2.55	339	17
Sprague River Rd.;	E2	2.51	738	18
Klamath Falls -	E3	2.41	935	15
Lakeview (Unit E)	E6	2.42	706	19

*** No Test Results

Table C.6 - Marshall Stability Test Results for Field Cores (Fall 1987)

Project	Sample ID	Average Height (in.)	Marshall Stability (lbs)	Flow (in/1000)
MP 79.2 - Wasco Co.;	A14	2.58	895	16
Warm Springs	A15	2.44	919	20
(Unit A) MP 88.45	A16	2.60	768	22
MP 79.2 - Wasco Co.;	A24	1.89	902	19
Warm Springs	A25	1.96	814	20
(Unit A) MP 90.4	A26	1.99	833	21
MP 79.2 - Wasco Co.;	A34	1.96	1037	18
Warm Springs	A35	1.64	1064	16
(Unit A) MP 90.6	A36	1.79	942	16
MP 79.2 - Wasco Co.;	A44	1.73	1020	18
Warm Springs	A45	1.87	894	24
(Unit A) MP 93.1	A46	1.87	790	19
MP 79.2 - Wasco Co.;	A54	2.37	1406	13
Warm Springs	A55	2.32	1241	13
(Unit A) MP 93.4	A56	2.53	1152	15
Powell Butte -	D24	1.68	394	13
Prineville (HFE-150)	D25	2.41	1226	20
(Unit D) Eastbound	D26	2.51	1283	18
Powell Butte -	D14	1.69	891	15
Prineville (CMS-2S)	D15	1.91	667	17
(Unit D) Westbound	D16	2.10	636	22
MP 89.6 - OR 19;	G4	1.95	835	16
Ochoco Hwy (Unit G)	G5	2.38	773	21
	G6	1.56	1060	14
Lakeshore Dr. -	B4	2.48	638	20
Greensprings Jct.;	B5	2.52	585	19
Lake of the Woods	B6	2.52	620	19
(Unit B)				
US 97 - OR 39;	C4	2.08	1024	18
Lower Klamath	C5	1.81	1062	16
(Unit C)	C6	1.91	1009	20
Sprague River Rd.;	E4	2.32	1038	24
Klamath Falls -	E5	2.21	976	18
Lakeview (Unit E)	E6	2.20	932	18

Table C.7 - Gradation and Asphalt Content for Field Cores (Fall 1986)

Project	Asphalt Content (%)	Percent Passing *						
		3/4"	1/2"	3/8"	1/4"	#10	#40	#200
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 88.45	6.3	100	92	81	66	36	19	9.8
MP 18.0 - Powell Butte; Powell Butte Secondary (Unit C)	9.4	100	95	82	65	42	22	7.7
Powell Butte - Prineville (HFE-150) (Unit D) Eastbound	6.6	100	100	98	88	46	21	10.3
Powell Butte - Prineville (CMS-2S) (Unit D) Westbound	6.2	100	99	93	82	45	21	9.5
Lakeshore Dr. - Greensprings Jct.; Lake of the Woods (Unit B)	6.4	100	93	83	67	35	17	8.1
Sprague River Rd.; Klamath Falls - Lakeview (Unit E)	10.5	100	98	94	83	46	21	11.3

* U.S. Standard Sieve

Table C.8 - Gradation and Asphalt Content for Field Cores (Fall 1987)

Project	Asphalt Content (%)	Percent Passing * 3/4"	1/2"	3/8"	1/4"	#10	#40	#200
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 88.45	6.9	100	91	82	69	39	20	9.1
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.4	6.4	100	92	82	70	39	20	9.9
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.6	6.5	99	92	83	69	39	20	9.8
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 93.1	6.4	100	91	79	64	35	18	8.3
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 93.4	7.3	100	94	85	72	41	20	9.4
Powell Butte - Prineville (HFE-150) (Unit D) Eastbound	6.3	100	99	95	84	50	23	6.3
Powell Butte - Prineville (CMS-2S) (Unit D) Westbound	6.3	100	99	91	81	46	21	8.2
MP 89.6 - OR 19; Ochoco Hwy (Unit G)	6.1	100	97	90	74	40	19	6.1
Lakeshore Dr. - Greensprings Jct.; Lake of the Woods (Unit B)	6.8	100	89	80	67	36	17	7.0
US 97 - OR 39; Lower Klamath (Unit C)	7.7	100	94	83	71	40	21	6.6
Sprague River Rd.; Klamath Falls - Lakeview (Unit E)	6.7	100	94	86	74	40	18	8.8

* U.S. Standard Sieve

Table C.9 - Asphalt Properties for Field Cores (Fall 1986)

Project	Asphalt Content (%)	Penetration @ 77 F (dmm)	Absolute Viscosity @ 140 F (poises)	Kinematic Viscosity @ 275 F (cS)
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 88.45	6.3	20	13959	746
MP 18.0 - Powell Butte; Powell Butte Secondary (Unit C)	9.4	22	13507	664
Powell Butte - Prineville (HFE-150) (Unit D) Eastbound	6.6	13	32893	990
Powell Butte - Prineville (CMS-2S) (Unit D) Westbound	6.2	20	10924	611
Lakeshore Dr. - Greensprings Jct.; Lake of the Woods (Unit B)	6.4	7	100000+	1501
Sprague River Rd.; Klamath Falls - Lakeview (Unit E)	10.5	21	10491	548

Table C.10 - Asphalt Properties for Field Cores (Fall 1987)

Project	Asphalt Content (%)	Penetration @ 77 F (dmm)	Absolute Viscosity @ 140 F (poises)	Kinematic Viscosity @ 275 F (cS)
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 88.45	6.9	35	6420	579
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.4	6.4	29	10600	704
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 90.6	6.5	20	20400	926
MP 79.2 - Wasco Co.; Warm Springs (Unit A) MP 93.1	6.4	35	7430	631
Powell Butte - Prineville (HFE-150) (Unit D) Eastbound	6.3	23	9700	655
Powell Butte - Prineville (CMS-2S) (Unit D) Westbound	6.3	19	12700	690
MP 89.6 - OR 19; Ochoco Hwy (Unit G)	6.1	11	69600	1538
Lakeshore Dr. - Greensprings Jct.; Lake of the Woods (Unit B)	6.8	8	67290	1577
US 97 - OR 39; Lower Klamath (Unit C)	7.7	16	28120	1052
Sprague River Rd.; Klamath Falls - Lakeview (Unit E)	6.7	29	7090	480

APPENDIX D

LABORATORY PREPARED SAMPLE DATA

Table D.1 - Gravity Data for Laboratory Prepared Samples (Fall 1986)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Warm Springs	0.5/3.5	1G	2.190	2.609	16.1	Long-Term Modulus Sample
		1H	2.178	2.609	16.5	
		1I	2.150	2.609	17.6	
		2A	2.111	2.469	14.5	
		2B	2.094	2.469	15.2	
		2C	2.087	2.469	15.5	
		2D	2.192	2.469	11.2	
		2E	2.129	2.469	13.8	
		2F	2.172	2.469	12.0	
		2G	2.212	2.469	10.4	
		2H	2.185	2.469	11.5	
		2I	2.163	2.469	12.4	
		2J	2.205	2.469	10.7	
		2K	2.153	2.469	12.8	
		3A	2.075	2.469	16.0	
		3B	2.066	2.469	16.3	
		3C	2.064	2.469	16.4	Long-Term Modulus Sample
		3D	2.102	2.469	14.9	Long-Term Modulus Sample
		3E	2.045	2.469	17.2	
		3F	2.091	2.469	15.3	
		3G	2.110	2.469	14.5	
		3H	2.077	2.469	15.9	
		3K	2.107	2.469	14.7	
	1.0/3.0	1E2	2.327	2.550	8.7	
		1F2	2.330	2.550	8.6	
		1G2	2.294	2.550	10.0	Long-Term Modulus Sample
		1H2	2.366	2.550	7.2	Long-Term Modulus Sample
		2A2	2.312	2.550	9.3	
		2B2	2.202	2.550	13.6	
		2C2	2.290	2.550	10.2	
		2D2	2.293	2.550	10.1	
		2E2	2.322	2.550	8.9	
		2F2	2.332	2.550	8.5	
		2I2	2.265	2.550	11.2	
		2J2	2.232	2.550	12.5	
		3A2	2.233	2.548	12.4	
		3B2	2.150	2.548	15.6	
		3C2	2.169	2.548	14.9	
		3D2	2.187	2.548	14.2	
		3E2	2.146	2.548	15.8	
		3F2	2.215	2.548	13.1	
		3G2	2.156	2.548	15.4	
		3H2	2.149	2.548	15.7	
		3I2	2.192	2.548	14.0	Long-Term Modulus Sample

Table D.1 (continued) - Gravity Data for Laboratory Prepared Samples (Fall 1986)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Warm Springs	1.5/2.5	1E3	2.233	2.478	9.9	
		1F3	2.205	2.478	11.0	
		1G3	2.201	2.478	11.2	
		1H3	2.250	2.478	9.2	
		1I3	2.232	2.478	9.9	Long-Term Modulus Sample
		1J3	2.252	2.478	9.1	Long-Term Modulus Sample
		2A3	2.257	2.478	8.9	
		2B3	2.246	2.478	9.4	
		2C3	2.254	2.478	9.0	
		2D3	2.263	2.478	8.7	
		2E3	2.267	2.478	8.5	
		2F3	2.250	2.478	9.2	
		2H3	2.232	2.478	9.9	Long-Term Modulus Sample
		3A3	2.087	2.478	15.8	
		3B3	2.116	2.478	14.6	
		3C3	2.135	2.478	13.8	
		3D3	2.143	2.478	13.5	
		3G3	2.052	2.478	17.2	
		3H3	2.089	2.478	15.7	
		3I3	2.171	2.478	12.4	
		3J3	2.092	2.478	15.6	
		3K3	2.177	2.478	12.1	

Table D.1 (continued) - Gravity Data for Laboratory Prepared Samples (Fall 1986)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Lake of the Woods	1.4/2.6	1A	2.139	2.500	14.4	
		1B	2.096	2.500	16.2	
		1C	2.094	2.500	16.2	Long-Term Modulus Sample
		1D	2.073	2.500	17.1	Long-Term Modulus Sample
		1H	1.996	2.500	20.2	
		1I	1.966	2.500	21.4	
		2A	1.995	2.500	20.2	
		2B	2.002	2.500	19.9	
		2C	1.980	2.500	20.8	
		2D	1.991	2.500	20.4	
		2G	1.966	2.500	21.4	
		2H	2.107	2.500	15.7	
		2I	2.048	2.500	18.1	
		3A	2.036	2.500	18.6	
		3B	2.079	2.500	16.8	
		3C	2.033	2.500	18.7	
		3D	2.030	2.500	18.8	
		3F	2.042	2.500	18.3	Long-Term Modulus Sample
		3G	1.971	2.500	21.2	
		3H	2.033	2.500	18.7	
	1.4/3.1	1	2.087	2.500	16.5	
		2	2.126	2.500	15.0	
		3	2.060	2.500	17.6	
		4	2.065	2.500	17.4	
		5	2.003	2.500	19.9	
		6	2.105	2.500	15.8	
		7	2.012	2.500	19.5	
		8	1.989	2.500	20.4	
		9	2.087	2.500	16.5	
		10	2.048	2.500	18.1	
		11	2.101	2.500	16.0	
		12	2.018	2.500	19.3	
		13	2.034	2.500	18.6	
		14	2.170	2.500	13.2	
		15	1.998	2.500	20.1	
		16	2.050	2.500	18.0	
		19	2.115	2.500	15.4	
		20	2.009	2.500	19.6	
		21	2.167	2.500	13.3	Long-Term Modulus Sample
		22	1.994	2.500	20.2	Long-Term Modulus Sample
		25	2.002	2.500	19.9	Long-Term Modulus Sample

Table D.1 (continued) - Gravity Data for Laboratory Prepared Samples (Fall 1986)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Lake of the Woods	1.9/2.6	1	2.056	2.500	17.8	
		2	2.095	2.500	16.2	
		3	2.043	2.500	18.3	
		4	2.084	2.500	16.6	
		7	2.042	2.500	18.3	
		8	2.068	2.500	17.3	
		9	2.066	2.500	17.4	
		10	2.058	2.500	17.7	
		13	2.025	2.500	19.0	
		14	2.077	2.500	16.9	
		15	2.072	2.500	17.1	
		16	2.045	2.500	18.2	
		17	2.046	2.500	18.2	
		18	2.048	2.500	18.1	
		19	2.051	2.500	18.0	
		20	2.073	2.500	17.1	
		21	2.028	2.500	18.9	
		22	2.043	2.500	18.3	
		24	2.068	2.500	17.3	Long-Term Modulus Sample
		25	2.093	2.500	16.3	Long-Term Modulus Sample
		26	2.062	2.500	17.5	Long-Term Modulus Sample
	2.4/2.1	2	1.969	2.500	21.2	
		3	2.014	2.500	19.4	
		4	2.013	2.500	19.5	
		7	2.007	2.500	19.7	
		8	1.909	2.500	23.6	
		11	1.999	2.500	20.0	
		12	1.988	2.500	20.5	
		13	1.980	2.500	20.8	
		14	1.982	2.500	20.7	
		15	2.045	2.500	18.2	
		16	2.027	2.500	18.9	
		17	1.973	2.500	21.1	
		18	2.067	2.500	17.3	
		19	2.016	2.500	19.4	
		20	2.008	2.500	19.7	
		21	2.025	2.500	19.0	
		22	2.066	2.500	17.4	
		23	2.022	2.500	19.1	
		24	1.951	2.500	22.0	
		25	2.032	2.500	18.7	
		26	2.064	2.500	17.4	
		28	2.036	2.500	18.6	Long-Term Modulus Sample
		30	2.023	2.500	19.1	Long-Term Modulus Sample
		31	2.016	2.500	19.4	Long-Term Modulus Sample

Table D.2 - Gravity Data for Laboratory Prepared Samples (Fall 1987)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Warm Springs	0.5/3.5	1G	2.190	2.487	11.9	Long-Term Modulus Sample
		1H	2.222	2.487	10.7	Stability & Flow Sample
		1I	2.214	2.487	11.0	Modulus & Fatigue Sample
		2A	2.175	2.487	12.5	
		2B	2.128	2.487	14.4	
		2C	2.168	2.487	12.8	Stability & Flow Sample
		2D	2.248	2.487	9.6	Modulus & Fatigue Sample
		2E	2.207	2.487	11.3	
		2F	2.161	2.487	13.1	
		2G	2.259	2.487	9.2	
		2H	2.266	2.487	8.9	
		2I	2.206	2.487	11.3	
		2J	2.256	2.487	9.3	
		2K	2.203	2.487	11.4	Stability & Flow Sample
		3A	2.124	2.487	14.6	
		3B	2.119	2.487	14.8	
		3C	2.125	2.487	14.6	Long-Term Modulus Sample
		3D	2.147	2.487	13.7	Long-Term Modulus Sample
		3E	2.109	2.487	15.2	
		3F	2.165	2.487	12.9	
		3G	2.138	2.487	14.0	
		3H	2.164	2.487	13.0	
		3K	2.154	2.487	13.4	Modulus & Fatigue Sample
	1.0/3.0	1E2	2.360	2.549	7.4	
		1F2	2.340	2.549	8.2	
		1G2	2.312	2.549	9.3	Long-Term Modulus Sample
		1H2	2.386	2.549	6.4	Long-Term Modulus Sample
		2A2	2.340	2.549	8.2	
		2B2	2.249	2.549	11.8	
		2C2	2.314	2.549	9.2	Modulus & Fatigue Sample
		2D2	2.320	2.549	9.0	Stability & Flow Sample
		2E2	2.354	2.549	7.7	
		2F2	2.345	2.549	8.0	
		2I2	2.301	2.549	9.7	
		2J2	2.271	2.549	10.9	
		3A2	2.267	2.549	11.1	Stability & Flow Sample
		3B2	2.232	2.549	12.4	Modulus & Fatigue Sample
		3C2	2.224	2.549	12.8	
		3D2	2.214	2.549	13.1	
		3E2	2.201	2.549	13.7	Modulus & Fatigue Sample
		3F2	2.251	2.549	11.7	Stability & Flow Sample
		3G2	2.211	2.549	13.3	
		3H2	2.220	2.549	12.9	
		3I2	2.222	2.549	12.8	Long-Term Modulus Sample

Table D.2 (continued) - Gravity Data for Laboratory Prepared Samples (Fall 1987)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Warm Springs	1.5/2.5	1E3	2.240	2.478	9.6	
		1F3	2.244	2.478	9.4	
		1G3	2.217	2.478	10.5	
		1H3	2.250	2.478	9.2	
		1I3	2.248	2.478	9.3	Long-Term Modulus Sample
		1J3	2.265	2.478	8.6	Long-Term Modulus Sample
		2A3	2.279	2.478	8.0	Stability & Flow Sample
		2B3	2.272	2.478	8.3	Stability & Flow Sample
		2C3	2.260	2.478	8.8	
		2D3	2.263	2.478	8.7	
		2E3	2.284	2.478	7.8	
		2F3	2.257	2.478	8.9	
		2H3	2.244	2.478	9.4	Long-Term Modulus Sample
		3A3	2.120	2.478	14.4	
		3B3	2.140	2.478	13.6	
		3C3	2.108	2.478	14.9	
		3D3	2.157	2.478	13.0	
		3G3	2.104	2.478	15.1	Stability & Flow Sample
		3H3	2.079	2.478	16.1	Modulus & Fatigue Sample
		3I3	2.186	2.478	11.8	Modulus & Fatigue Sample
		3J3	2.119	2.478	14.5	Modulus & Fatigue Sample
		3K3	2.192	2.478	11.5	

Table D.2 (continued) - Gravity Data for Laboratory Prepared Samples (Fall 1987)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Lake of the Woods	1.4/2.6	1A	2.139	2.500	14.4	
		1B	2.096	2.500	16.2	
		1C	2.172	2.500	13.1	Long-Term Modulus Sample
		1D	2.155	2.500	13.8	Long-Term Modulus Sample
		1H	1.996	2.500	20.2	
		1I	1.989	2.500	20.4	Stability & Flow Sample
		2A	2.028	2.500	18.9	Stability & Flow Sample
		2B	2.001	2.500	20.0	Modulus & Fatigue Sample
		2C	1.980	2.500	20.8	
		2D	1.991	2.500	20.4	
		2G	1.966	2.500	21.4	
		2H	2.107	2.500	15.7	
		2I	2.048	2.500	18.1	Modulus & Fatigue Sample
		3A	2.036	2.500	18.6	
		3B	2.079	2.500	16.8	
		3C	2.033	2.500	18.7	
		3D	2.030	2.500	18.8	
		3F	2.100	2.500	16.0	Long-Term Modulus Sample
		3G	2.003	2.500	19.9	Stability & Flow Sample
		3H	2.071	2.500	17.2	Modulus & Fatigue Sample
	1.4/3.1	1	2.121	2.500	15.2	
		2	2.144	2.500	14.2	
		3	2.084	2.500	16.6	
		4	2.092	2.500	16.3	
		5	2.046	2.500	18.2	
		6	2.130	2.500	14.8	
		7	2.085	2.500	16.6	Stability & Flow Sample
		8	2.072	2.500	17.1	Modulus & Fatigue Sample
		9	2.119	2.500	15.2	Modulus & Fatigue Sample
		10	2.059	2.500	17.6	Stability & Flow Sample
		11	2.118	2.500	15.3	
		12	2.073	2.500	17.1	
		13	2.076	2.500	17.0	Modulus & Fatigue Sample
		14	2.193	2.500	12.3	Stability & Flow Sample
		15	2.053	2.500	17.9	
		16	2.101	2.500	16.0	
		19	2.127	2.500	14.9	
		20	2.042	2.500	18.3	
		21	2.055	2.500	17.8	Long-Term Modulus Sample
		22	2.071	2.500	17.2	Long-Term Modulus Sample
		25	2.060	2.500	17.6	Long-Term Modulus Sample

Table D.2 (continued) - Gravity Data for Laboratory Prepared Samples (Fall 1987)

Project	Oil/Water (%)	Sample ID	Bulk Sp.Gr.	Rice Sp.Gr.	Voids (%)	Notes
Lake of the Woods	1.9/2.6	1	2.105	2.500	15.8	
		2	2.112	2.500	15.5	
		3	2.074	2.500	17.0	
		4	2.107	2.500	15.7	
		7	2.092	2.500	16.3	
		8	2.101	2.500	16.0	
		9	2.100	2.500	16.0	
		10	2.106	2.500	15.8	
		13	2.049	2.500	18.0	
		14	2.112	2.500	15.5	
		15	2.082	2.500	16.7	
		16	2.089	2.500	16.4	
		17	2.074	2.500	17.0	Stability & Flow Sample
		18	2.081	2.500	16.8	Stability & Flow Sample
		19	2.077	2.500	16.9	Stability & Flow Sample
		20	2.082	2.500	16.7	Modulus & Fatigue Sample
		21	2.063	2.500	17.5	Modulus & Fatigue Sample
		22	2.075	2.500	17.0	Modulus & Fatigue Sample
		24	2.068	2.500	17.3	Long-Term Modulus Sample
		25	2.093	2.500	16.3	Long-Term Modulus Sample
		26	2.062	2.500	17.5	Long-Term Modulus Sample
	2.4/2.1	2	2.009	2.500	19.6	
		3	2.035	2.500	18.6	
		4	2.043	2.500	18.3	
		7	2.022	2.500	19.1	
		8	1.936	2.500	22.6	
		11	2.037	2.500	18.5	
		12	2.028	2.500	18.9	
		13	2.006	2.500	19.8	Modulus & Fatigue Sample
		14	1.992	2.500	20.3	Stability & Flow Sample
		15	2.084	2.500	16.6	
		16	2.058	2.500	17.7	
		17	2.020	2.500	19.2	Stability & Flow Sample
		18	2.083	2.500	16.7	Modulus & Fatigue Sample
		19	2.038	2.500	18.5	
		20	2.028	2.500	18.9	
		21	2.043	2.500	18.3	
		22	2.034	2.500	18.6	
		23	2.046	2.500	18.2	Modulus & Fatigue Sample
		24	1.979	2.500	20.8	Stability & Flow Sample
		25	2.056	2.500	17.8	
		26	2.092	2.500	16.3	
		28	2.061	2.500	17.6	Long-Term Modulus Sample
		30	2.058	2.500	17.7	Long-Term Modulus Sample
		31	2.055	2.500	17.8	Long-Term Modulus Sample

Table D.3 - Resilient Modulus and Fatigue Test Results for Laboratory Prepared Samples (Fall 1986)

Project	Emulsion/ Water (%)	Sample ID	Average Height (in.)	Resilient Modulus (ksi)	Fatigue Life (reps)
Warm Springs	0.5/3.5	1E	1.85	542	22891
		1F	2.04	507	15616
		1B	1.80	537	62165
	1.0/3.0	1I2	2.13	315	25958
		1J2	2.33	373	11963
		1D2	2.37	435	18097
	1.5/2.5	1C3	2.27	315	13228
		1D3	2.15	258	29485
		1B3	2.01	207	27872
Lake of the Woods	1.4/2.6	3I	2.20	452	56068
		1F	2.58	291	6987
		1G	2.32	406	43560
	1.4/3.1	18	2.10	508	63063
		17	2.41	442	83622
		*	2.19	448	127100
	1.9/2.6	30	2.31	347	47795
		11	2.25	535	43136
		12	2.16	488	27069
	2.4/2.1	10	2.38	395	153391
		27	2.28	562	144491
		1	2.19	266	54076

Table D.4 - Resilient Modulus and Fatigue Test Results for Laboratory Prepared Samples (Fall 1987)

Project	Emulsion/ Water (%)	Sample ID	Average Height (in.)	Resilient Modulus (ksi)	Fatigue Life (reps)
Warm Springs	0.5/3.5	1I	1.88	387	31373
		2D	2.15	342	40942
		3K	2.40	228	26925
	1.0/3.0	2C2	2.19	457	34348
		3B2	2.33	313	31943
		3E2	2.25	267	29050
	1.5/2.5	3H3	2.50	260	33179
		3I3	2.10	348	33775
		3J3	2.30	290	23352
Lake of the Woods	1.4/2.6	2B	2.14	346	16113
		2I	2.19	573	18903
		3H	2.07	614	30858
	1.4/3.1	8	2.24	472	66353
		9	1.95	812	86616
		13	2.33	530	31042
	1.9/2.6	20	2.28	686	74282
		21	2.04	575	29364
		22	2.06	547	74162
	2.4/2.1	13	2.42	340	23765
		18	2.21	506	72300
		23	2.28	464	78409

Table D.5 - Marshall Stability Test Results for Laboratory Prepared Samples (Fall 1987)

Project	Emulsion/ Water (%)	Sample ID	Average Height (in.)	Marshall Stability (lbs)	Flow (in/1000)
Warm Springs	0.5/3.5	1H	1.86	704.3	16.3
		2C	2.27	329.2	32.9
		22	2.25	289.4	32.5
	1.0/3.0	3A2	2.08	719.6	29.2
		2D2	2.00	777.4	19.6
		3F2	2.11	586.1	23.5
	1.5/2.5	2B3	2.35	629.9	23.5
		3G3	2.09	372.2	39.2
		2A3	2.32	752.9	41.3
Lake of the Woods	1.4/2.6	15	2.06	477.6	20.2
		2A	2.20	443.5	24.3
		3G	2.22	610.7	31.7
	1.4/3.1	7	2.17	736.3	21.5
		10	2.14	1101.6	24.7
		14	2.24	1643.6	20.8
	1.9/2.6	17	2.31	864.8	31.3
		18	2.35	841.5	32.9
		19	2.35	875.6	32.9
	2.4/2.1	14	2.45	422.3	31.7
		17	2.44	533.7	32.9
		24	2.26	398.3	32.1

Table D.6 - Resilient Modulus of the Long-Term Modulus Samples (Fall 1986)

Project	Emulsion/ Water (%)	Sample ID	Individual Modulus (ksi)	Average Modulus (ksi)
Warm Springs	0.5/3.5	1G	332	
		3C	232	265
		3D	230	
	1.0/3.0	1G2	344	
		1H2	476	370
		3I2	289	
	1.5/2.5	1I3	248	
		1J3	295	273
		1H3	277	
Lake of the Woods	1.4/2.6	1C	376	
		1D	328	365
		3F	390	
	1.4/3.1	21	380	
		22	447	387
		25	334	
	1.9/2.6	24	378	
		25	380	380
		26	381	
	2.4/2.1	28	404	
		30	393	386
		31	361	

Table D.7 - Resilient Modulus of the Long-Term Modulus Samples (Fall 1987)

Project	Emulsion/ Water (%)	Sample ID	Individual Modulus (ksi)	Average Modulus (ksi)
Warm Springs	0.5/3.5	1G	338	
		3C	252	279
		3D	246	
	1.0/3.0	1G2	430	
		1H2	527	441
		3I2	366	
	1.5/2.5	1I3	330	
		1J3	396	348
		1H3	319	
Lake of the Woods	1.4/2.6	1C	441	
		1D	371	438
		3F	501	
	1.4/3.1	21	475	
		22	516	481
		25	453	
	1.9/2.6	24	484	
		25	436	463
		26	467	
	2.4/2.1	28	522	
		30	499	488
		31	443	

APPENDIX E

CONSTRUCTION PROCEDURE AND SPECIFICATIONS

SPECIAL PROVISIONS AND SUPPLEMENTAL STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION

OREGON STATE HIGHWAY DIVISION
SALEM, OREGON

KIND OF WORK (CIR) Cold Inplace Recycled Asphalt Concrete

SECTION Various

HIGHWAY Various

COUNTY Various

PROPOSALS TO BE RECEIVED 1987

SECTION 420 - COLD INPLACE RECYCLED (CIR) ASPHALT CONCRETE PAVEMENT

Description

Subsection 420.01 Scope - This work shall consist of constructing Cold Inplace Recycled (CIR) asphalt concrete pavement using Class I and Class II recycling treatments in accordance with these specifications, and in reasonably close conformity to the lines, grades, thicknesses and cross sections shown on the plans or established by the Engineer.

Definitions

420.04 CIR Asphalt Concrete Pavement - CIR asphalt concrete pavement is a mixture of pulverized existing asphalt pavement (RAP), which has been removed and mixed with emulsified asphalt cement and water, then relayed and compacted in a continuous operation.

420.05 Class I Recycling Treatment - Class I recycling treatment is performed on a uniform pavement, designed and built to specifications. The CIR mixture produced under Class I is based on a rational mix design method.

420.06 Class II Recycling Treatment - Class II recycling treatment is performed on either a pavement with significant maintenance patches over a uniform pavement or a pavement with minimal design used in the original construction. The CIR mixture produced under Class II is less uniform than for Class I and is based on either a rational mix design method or mix design guidelines.

(Use following paragraph when single unit is allowed.)

420.07 Option A or B - Under these specifications the Contractor shall perform CIR work using either a recycling train (Equipment Option A) or a single processing unit (Equipment Option B) as hereinafter specified.

420.08 Prepaving Conference - The Contractor and the Contractor's supervisory personnel plus any subcontractors and their supervisory personnel who are to be involved in the recycle and paving work shall meet with the Engineer's representatives for a prepaving conference at a time mutually agreed upon. At this conference, the Contractor shall present the methods of accomplishing all phases of the recycle and paving work. The plan of the work, order of work and other details of performance shall meet with the approval of the Engineer.

New supervisory personnel replacing anyone engaged in the recycle and paving work, after the first conference, shall be required to attend a new prepaving conference prior to performing their duties on this project.

Materials

420.11 Asphalt - Emulsified asphalt shall be CMS-2S or HFE-150 as directed by the Engineer and shall meet the applicable requirements of Section 702.

420.12 Water - Water shall conform to the requirements of subsection 233.11.

(Use bracketed item when single unit option is allowed.)

420.13 Recycled Asphalt Pavement (RAP) - Recycled material removed from the existing asphalt pavement (using Equipment Option A) shall have a maximum size of 1-1/2-inch prior to entering the mixer unless otherwise directed by the Engineer. Any recycled material larger than 1-1/2-inch shall be separated by screening or other means, broken down by mechanical means to pass a 1-1/2-inch sieve and uniformly reincorporated with the balance of the recycled material.

(Use following paragraph when single unit option is allowed.)

Recycled material removed from the existing asphalt pavement using Equipment Option B shall have a maximum size of two inches. Incidental oversize may be allowed by the Engineer if it is not detrimental to the mixture or wearing surface. If the gradation is determined to be detrimental, the Contractor shall take such action necessary to correct the oversize problem. These actions may include reducing the milling speed, crusher, changing screen

420.08 Prepaving Conference - The Contractor and the Contractor's supervisory personnel plus any subcontractors and their supervisory personnel who are to be involved in the recycle and paving work shall meet with the Engineer's representatives for a prepaving conference at a time mutually agreed upon. At this conference, the Contractor shall present the methods of accomplishing all phases of the recycle and paving work. The plan of the work, order of work and other details of performance shall meet with the approval of the Engineer.

New supervisory personnel replacing anyone engaged in the recycle and paving work, after the first conference, shall be required to attend a new prepaving conference prior to performing their duties on this project.

Materials

420.11 Asphalt - Emulsified asphalt shall be CMS-2S or HFE-150 as directed by the Engineer and shall meet the applicable requirements of Section 702.

420.12 Water - Water shall conform to the requirements of subsection 233.11.

(Use bracketed item when single unit option is allowed.)

420.13 Recycled Asphalt Pavement (RAP) - Recycled material removed from the existing asphalt pavement (using Equipment Option A) shall have a maximum size of 1-1/2-inch prior to entering the mixer unless otherwise directed by the Engineer. Any recycled material larger than 1-1/2-inch shall be separated by screening or other means, broken down by mechanical means to pass a 1-1/2-inch sieve and uniformly reincorporated with the balance of the recycled material.

(Use following paragraph when single unit option is allowed.)

Recycled material removed from the existing asphalt pavement using Equipment Option B shall have a maximum size of two inches. Incidental oversize may be allowed by the Engineer if it is not detrimental to the mixture or wearing surface. If the gradation is determined to be detrimental, the Contractor shall take such action necessary to correct the oversize problem. These actions may include reducing the milling speed, crusher, changing screen size (when screens are used) or other such measures as may be necessary. Failure of the Contractor to be able to provide an acceptable product will cause a rejection of the equipment or processing equipment.

(Use the following paragraph when the Contractor will produce choke aggregate.)

420.14 Choke Aggregate - The material to be used as choke aggregate shall be either clean sand, crushed gravel or quarry rock free of clay, loam or other extraneous material and shall conform to the following:

Sieve Size	Percent Passing
3/8"	100
1/4"	95-100
40	20-40
100	0-5

(Use the following paragraph with State-furnished material.)

420.14 Choke Aggregate - Choke aggregate will be furnished by the State. Material to be used on this project is stockpiled on State-controlled property located on Highway _____ at Milepost _____.

420.15 Job Mix Formula - The CIR asphalt concrete mixture shall consist of RAP from the existing pavement, emulsified asphalt cement and water combined in the proportions designated by the Engineer. Variability in the composition of the RAP material may require changes in the proportions of the constituents, as directed by the Project Manager. Normally, the emulsified asphalt content will be between 0.3 and 2.5 percent, by weight, and water between 1.5 and 4.0 percent by weight.

420.16 Process Control Testing - Process control sampling and testing will be performed by the Engineer.

420.17 Acceptance of CIR Mixture - The CIR mixture will be accepted visually on the grade following initial compaction. Any mixture that ravels or does not provide any acceptable wearing surface shall be corrected. Any area showing an excess or deficiency of emulsified asphalt cement shall be reprocessed or

3/15

replaced. Replacement shall be by a method approved by the Engineer. Removal and replacement under these provisions shall be at the expense of the Contractor unless the Engineer determines that the defects, excesses or deficiencies are not caused by or the fault of the Contractor's operations.

Construction

420.31 Season and Weather Limitations - Inplace recycling of existing asphalt concrete pavement shall not begin until the pavement surface temperature is 70°F and rising. Pavement damaged by rain after placement shall be reprocessed, or other method approved by the Engineer, at the Contractor's expense. The construction of CIR asphalt concrete pavement will not be allowed before May 15 or after August 1, except the Engineer may approve a start-up before the pavement surface temperature is 70°F under the following conditions:

(1) The Contractor requests such an early start in writing;

(2) The Contractor assumes all financial responsibility for correction of raveling problems with the CIR mixture during the early start period. This includes, but is not limited to, the cost of complete recycling, additional choke, rollers, pilot cars and flaggers, etc. as determined by the Engineer.

If recycling and placement operations are not completed by August 1, the Contractor will not be allowed to resume operations until May 15 of the following year.

The Contractor shall stop milling work at the end of each day when the temperature of the mixture behind the paver drops below 90°F or three hours before sunset, whichever occurs first.

420.32 Rate of Progress and Scheduling - The Contractor shall plan and schedule the recycle operation in such a manner that the materials are removed, mixed, replaced and the area open to traffic immediately after initial compaction is completed.

All recycled areas shall be competely backfilled with reprocessed and compacted asphalt concrete materials so the area is open to two-way traffic during all hours of darkness.

replaced. Replacement shall be by a method approved by the Engineer. Removal and replacement under these provisions shall be at the expense of the Contractor unless the Engineer determines that the defects, excesses or deficiencies are not caused by or the fault of the Contractor's operations.

Construction

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(1) The Contractor requests such an early start in writing;

(2) The Contractor assumes all financial responsibility for correction of raveling problems with the CIR mixture during the early start period. This includes, but is not limited to, the cost of complete recycling, additional choke, rollers, pilot cars and flaggers, etc. as determined by the Engineer.

If recycling and placement operations are not completed by August 1, the Contractor will not be allowed to resume operations until May 15 of the following year.

The Contractor shall stop milling work at the end of each day when the temperature of the mixture behind the paver drops below 90°F or three hours before sunset, whichever occurs first.

420.32 Rate of Progress and Scheduling - The Contractor shall plan and schedule the recycle operation in such a manner that the materials are removed, mixed, replaced and the area open to traffic immediately after initial compaction is completed.

All recycled areas shall be competely backfilled with reprocessed and compacted asphalt concrete materials so the area is open to two-way traffic during all hours of darkness.

(Use bracketed item when single unit option is allowed.)

(Equipment Option A)

420.34 Recycling Train - (Under this option the) existing pavement shall be recycled using a recycling train consisting of the following major components: (a) Planing machine or grinder, (b) crusher and (c) pugmill mixer.

(a) Planning machine or grinder - The existing pavement shall be removed by a self-propelled planing machine having a minimum 144-inch wide rotary cutter and be capable of removing the existing pavement to a depth of four inches in a single pass.

The unit, also, shall be capable of accurately establishing profile grades within a tolerance of 0.02-foot by reference from either the existing pavement or from independent grade control and shall have a positive means for controlling cross slope elevations. The equipment shall incorporate a totally enclosed cutting drum with replaceable cutting teeth and shall have an effective means for removing excess material from the surface and for preventing dust from escaping into the air. The use of a heating device to soften the pavement will not be permitted.

The unit shall be equipped to discharge not less than 70 gallons of water per minute into the cutting chamber, with fully variable control and meter capable of measuring the rate of feed within five gallons per minute.

(b) Crusher - The crusher shall be of the portable type capable of reducing the oversized RAP materials to the specified size.

(c) Pug mill mixer - The CIR asphalt concrete mixture shall be mixed in a pug mill type plant capable of providing a mix of RAP, emulsified asphalt and water at a minimum rate of 700 tons/hour to uniform proportions as designated by the Engineer.

Mixing plants shall be equipped with a positive control linking the RAP, emulsified asphalt and water feed in a manner that will maintain a constant ratio of each constituent. The plant shall be equipped with facilities so that the Contractor can verify and calibrate the RAP, asphalt and water quantities by a method acceptable to the Engineer.

The RAP shall be measured by weight and the emulsified asphalt and water may be proportioned by either weight or volume. The equipment shall be capable of feeding and maintaining a constant rate of RAP feed within a tolerance of plus or minus 5% (by weight) or the designated amount and a constant rate of emulsified asphalt and water feeds within plus or minus 0.2% (by weight) of the designated amounts.

The mixing plant shall be equipped with positive displacement pumps and a computerized metering system which can accurately meter the amount of emulsified asphalt and water. The pumps shall be interlocked belt weighing system that measures the quantity of RAP material entering the mixing plant. The interlock shall be designed so that emulsified asphalt and water cannot be added until RAP material enters the mixer. Overrides of the interlock system shall be equipped with short duration timers to prevent their continuous use. Overrides shall be used only during start-up periods.

The belt weighing device and computerized-metering system shall have readouts that indicate the quantity in tons of RAP, water and emulsified asphalt being fed into the mixer at any given time. Totalizer readouts shall also be provided to allow determination of accumulative quantities of each constituent.

(Use following four paragraphs when single unit option is allowed.)

Equipment Option B - Single Processing Unit:

Under this option the existing pavement shall be processed using a planing machine meeting all of the requirements of a planing machine under "Equipment Option A".

In addition, the planing machine shall be capable of adding emulsified asphalt and water to the RAP in amounts directed by the Engineer to produce a uniform mixture.

Positive displacement pumps which can accurately meter the planned amount of emulsified asphalt and water into the pulverized asphalt concrete shall be used. The pumps shall be interlocked to the movement of the machinery used to apply the emulsified asphalt and water to provide that no emulsified asphalt or water can be added when the machinery is not moving.

The emulsified asphalt and water feeds shall have positive readout capabilities so that the amount of emulsified asphalt and water in tons incorporated into at any given time can be read directly. Totalizer readouts shall also be provided to allow determination of accumulative quantities of water and emulsified asphalt used in the mixture.

(d) Asphalt storage and heating tanks - Storage tanks shall be equipped with accurate volume measuring devices or manufactures calibration charts for each storage tank and a thermometer for measuring the temperature of tank's contents.

Between the storage tanks and the liquid asphalt mixing device or recycling equipment, a parallel piping filter system with at least one filter per line shall be used. Filters shall be capable of eliminating solid or semisolid particles from the emulsified asphalt liquid.

Each filtering line shall be equipped with on-off valves and changeable filter elements.

The emulsified asphalt cement shall be routed alternately through each filter line for a period of two to four hours, and alternate filters changed on the same frequency unless otherwise directed by the Engineer.

Loads of emulsified asphalt which break prematurely in the storage tanks or haul vehicles or which cause frequent plugging of the filters as determined by the Engineer will be rejected for use.

420.35 Asphalt Concrete Pavers - Pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of recycled asphalt concrete material in widths applicable to the specified typical sections, and to required thicknesses, lines, grades and cross sections.

Extensions added to the paver when used on traffic lanes shall have the same augering and screeding equipment as the rest of the paver.

The paver shall be equipped with a receiving and distribution system of sufficient capacity for a uniform spreading operation and capable of placing the mixture uniformly in front of the screed without segregation of materials.

The paver shall be designed to compensate for minor irregularities of the base on which it is supported so that such will not be reflected immediately in the surface of the layer being placed. The weight of the paver shall be supported on tracks or wheels, none of which shall contact the mixture being laid. The contact area of the screed or strike-off assembly shall be uniform over the entire width of the strip of mixture being placed.

Pavers shall be equipped with a paver control system which shall automatically control the layer of the mixture to specified cross slope and grade. The control system shall be automatically actuated from independent line and grade control references through a system of mechanical sensors and sensor-directed devices which shall automatically maintain the paver screed in proper position to provide specified results.

The screed of strike-off assembly shall produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

420.36 Compactors - Rollers shall be steel wheel, pneumatic tire, vibratory or a combination of these types as specified. They shall be in good condition and capable of reversing without backlash.

(a) Steel wheeled rollers - Steel wheeled rollers shall have a minimum gross static weight of 10 tons and a minimum static weight on the drive wheel of 250 pounds per inch of width.

(b) Vibratory rollers - Vibratory rollers shall be a tandem steel wheeled type having a minimum gross static weight of 8 tons and shall be equipped with amplitude and frequency controls and shall be specifically designed for compaction of asphalt concrete mixtures. The rollers shall be capable of frequencies of not less than 2,000 vibrations per minute.

(c) Pneumatic rollers - The pneumatic-tired rollers shall have a minimum static weight of 20 tons and shall be self-propelled, tandem or multiple axle, multiple wheel type with smooth-tread pneumatic tires of equal size staggered on the axles at such spacings and overlaps as will provide uniform capacting pressure for the full compacting width of the roller and shall be capable of exerting ground pressures of at least 80 pounds per square inch of tire contact area.

420.37 Preparation of Foundation - Just prior to windrowing the recycled pavement mixture, a tack coat conforming to Section 407 of these special provisions shall be applied to the entire profiled area including the vertical edges. Rates of application shall be as directed by the Engineer.

Care shall be taken to minimize the amount of fines on the milled surface that can be detrimental to a proper bond of the tack coat.

420.40 Heating Emulsified Asphalt Cement - The temperature of the emulsified asphalt cement prior to entry into the mixture shall be not less than 125°F nor more than 185°F.

420.41 Mixing - All the various required components of the asphalt concrete mixer shall be utilized and operated in a manner to assure compliance with this section.

The screed of strike-off assembly shall produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

420.36 Compactors - Rollers shall be steel wheel, pneumatic tire, vibratory or a combination of these types as specified. They shall be in good condition and capable of reversing without backlash.

(a) Steel wheeled rollers - Steel wheeled rollers shall have a minimum gross static weight of 10 tons and a minimum static weight on the drive wheel of 250 pounds per inch of width.

(b) Vibratory rollers - Vibratory rollers shall be a tandem steel wheeled type having a minimum gross static weight of 8 tons and shall be equipped with amplitude and frequency controls and shall be specifically designed for compaction of asphalt concrete mixtures. The rollers shall be capable of frequencies of not less than 2,000 vibrations per minute.

(c) Pneumatic rollers - The pneumatic-tired rollers shall have a minimum static weight of 20 tons and shall be self-propelled, tandem or multiple axle, multiple wheel type with smooth-tread pneumatic tires of equal size staggered on the axles at such spacings and overlaps as will provide uniform capacting pressure for the full compacting width of the roller and shall be capable of exerting ground pressures of at least 80 pounds per square inch of tire contact area.

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420.40 Heating Emulsified Asphalt Cement - The temperature of the emulsified asphalt cement prior to entry into the mixture shall be not less than 125°F nor more than 185°F.

420.41 Mixing - All the various required components of the asphalt concrete mixer shall be utilized and operated in a manner to assure compliance with this section.

The RAP, emulsified asphalt cement and water shall be measured and introduced into the mixer in the amounts specified in the "job mix formula" and as designated by the Engineer.

Mixing shall continue until the emulsified asphalt water have been distributed through the RAP to form a uniformly coated mixture.

420.43 Control of Line and Grade - The line and grade reference control shall be a floating beam device of adequate length and sensitivity to provide adequate control on either or both sides of the paver.

Manual control of line and grade for the paver will be permitted when approved by the Engineer.

420.44 Spreading - Except for unavoidable delay or breakdown, recycling and placing recycled pavement by the paving machine shall be at a rate sufficient to provide continuous operation of the paving machine. If paving operations result in excessive stopping of the paving machine, as determined by the Engineer, recycling and paving operations shall be suspended until the Contractor can synchronize the rate of recycle with the capacity of the paving machines.

(a) General - The mixture shall be laid on an approved surface, spread and struck off to established grade and elevation. Specified asphalt pavers shall be used to distribute the mixture.

The asphalt mixture shall be deposited in a windrow, then picked up and placed in the asphalt paver.

The loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine nor cause vibrations or other motions which could have a detrimental effect on the riding quality of the completed pavement. The loading equipment shall pick up substantially all of the material deposited on the roadbed and place it directly into the receiving hopper of the paving machine.

In areas where patching, irregularities or unavoidable obstacles make the use of specified equipment impracticable, the mixture may be spread with special hopper equipment with adjustable strike-off or by other equipment and means approved by the Engineer, provided the surface finish is within a tolerance of 0.01-foot of that hereinafter set forth.

(b) Drop-offs - Prior to any suspension of operations at the end of each shift, the full width of the area to be paved, including outside shoulders, shall be completed to the same elevation with no longitudinal drop-offs.

If unable to complete the pavement without longitudinal drop-offs as specified above, the Contractor shall, within the specified time constraints, construct and maintain a wedge of asphalt concrete at a slope of 10:1 or flatter along the exposed longitudinal joint located within the area to be paved. Longitudinal joints one inch or less will not require a wedge. The wedge shall be removed and disposed of prior to continuing paving operations. Construction, material, maintenance, removal and disposal of the temporary wedge shall be at the Contractor's expense.

Where allowable abrupt or sloped drop-offs occur within or at the edge of the paved surface the Contractor shall provide, at his expense, suitable warning signs as required under Section 111.

(c) Finishing and details - Special care shall be taken at longitudinal joints to provide positive bond and to provide density and finish to new mixture equal in all respects to the mixture against which it is placed.

420.45 Choke Aggregate Placement - Immediately prior to the last roller coverage during initial compaction as hereinafter specified and before opening to traffic, the Contractor shall place choke aggregate at a rate of approximately 0.001 to 0.003 cubic yard per square yard. Choke aggregate shall be spread by a method that provides uniform coverage across the CIR mat. Any piles, ridges or uneven distribution of choke aggregate shall be eliminated by spreading and/or removing with hand tools or mechanical means as the Contractor elects prior to the final roll or coverage.

If raveling of the CIR mixture occurs following placement, the Contractor shall provide traffic control for these areas immediately or as directed by the Engineer. When the Engineer determines that additional rolling of the raveled areas is required, the additional rolling will be paid as Extra Work.

420.46 Compaction:

(a) General - Immediately after the CIR asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted as hereinafter set forth.

(a-1) Surface repair - Any displacement of the mat regardless of thickness occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected. Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture.

If unable to complete the pavement without longitudinal drop-offs as specified above, the Contractor shall, within the specified time constraints, construct and maintain a wedge of asphalt concrete at a slope of 10:1 or flatter along the exposed longitudinal joint located within the area to be paved. Longitudinal joints one inch or less will not require a wedge. The wedge shall be removed and disposed of prior to continuing paving operations. Construction, material, maintenance, removal and disposal of the temporary wedge shall be at the Contractor's expense.

Where allowable abrupt or sloped drop-offs occur within or at the edge of the paved surface the Contractor shall provide, at his expense, suitable warning signs as required under Section 111.

(c) Finishing and details - Special care shall be taken at longitudinal joints to provide positive bond and to provide density and finish to new mixture equal in all respects to the mixture against which it is placed.

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(a) General - Immediately after the CIR asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted as hereinafter set forth.

(a-1) Surface repair - Any displacement of the mat regardless of thickness occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected. Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture.

When the rolling causes undue tearing, displacement, cracking or shoving the Contractor shall make changes in compaction equipment and/or rolling procedures necessary to alleviate the problem.

(a-2) Rolling - The CIR asphalt concrete mixture shall be compacted with rollers conforming to the requirements hereinbefore set forth. The type, number and weight of rollers shall be sufficient to compact the mixture.

Rollers shall move at a slow but uniform speed recommended by the manufacturer with the drive rolls or wheels nearest the paver. Vibratory rollers, when used in the vibratory mode, shall be operated at frequencies of at least 2,000 vibrations per minute. The maximum operating speed of pneumatic rollers shall be 5 MPH.

Normal rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping one-half the roller width, gradually progressing to the center. On superelevated curves the rolling shall begin at the low side and progress to the high side, each trip overlapping one-half the roller width. When paving is in echelon or when abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Rollers shall not make sharp turns on the course being compacted and they shall not be parked on the fresh CIR mixture. Alternate trips of a roller shall terminate in stops at least five feet distant longitudinally from adjacent preceding stops.

(b) Initial compaction - Compaction of the fresh CIR asphalt concrete mixture shall be performed with a minimum of two vibratory rollers meeting the requirements hereinbefore set forth. Rollers shall be operated in either vibratory or static mode as directed by the Engineer. The mixture shall be compacted with at least one coverage by each roller and such additional coverages as the Engineer may direct.

The overlapping of one-half of roller width on each trip by the rollers as required does not constitute two coverages on that particular area rolled.

(c) Recompaction - After initial compaction and prior to recompaction, the CIR asphalt concrete pavement shall be opened to public traffic and allowed to cure. Recompaction shall be performed between 3 and 15 days after laydown when directed by the Engineer. Rolling shall not be performed when the surface temperature is less than 90°F.

11/15

The entire recycled pavement area shall be recompacted with at least one steel wheeled roller and one pneumatic roller. Each roller shall make at least three coverages and such additional coverages as the Engineer may direct.

420.49 Pavement Smoothness:

(a) General - The top surface of CIR asphalt concrete pavement shall be tested with a 12-foot straightedge furnished and operated by the Contractor parallel to or perpendicular to the centerline, and shall not vary by more than 0.02-foot. The Engineer will observe this testing and may require additional testing.

When utility appurtenances such as manhole covers and valve boxes are located in the traveled way and they are not required to be adjusted or are required to be adjusted before paving, this tolerance will not apply.

(b) Corrective action - When tests show the pavement is not within the specified tolerance, the Contractor shall take immediate action to correct equipment or procedures in his paving operation to eliminate the unacceptable pavement roughness.

Any surface irregularities exceeding the specified tolerances shall be corrected by the Contractor within the period of 2 to 5 days following initial compaction using one of the following methods:

(1) Remove, replace or reprocess the surface course.

(2) Grind the pavement surface utilizing the planing machine or grinder as hereinbefore set forth to a maximum depth of 0.3-inch.

The cost of all corrective work, including traffic control and furnishing of materials, shall be performed at the Contractor's expense and no adjustment in contract time will be made for corrective work.

Measurement

420.81 Measurement - The number of square yards of recycled emulsified asphalt mixture shall be based on the paved widths and milled depths shown on the plans and the horizontal measurement along the centerline of the actural length of the pavement recycled.

The entire recycled pavement area shall be recompacted with at least one steel wheeled roller and one pneumatic roller. Each roller shall make at least three coverages and such additional coverages as the Engineer may direct.

420.49 Pavement Smoothness:

(a) General - The top surface of CIR asphalt concrete pavement shall be tested with a 12-foot straightedge furnished and operated by the Contractor parallel to or perpendicular to the centerline, and shall not vary by more than 0.02-foot. The Engineer will observe this testing and may require additional testing.

When utility appurtenances such as manhole covers and valve boxes are located in the traveled way and they are not required to be adjusted or are required to be adjusted before paving, this tolerance will not apply.

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The cost of all corrective work, including traffic control and furnishing of materials, shall be performed at the Contractor's expense and no adjustment in contract time will be made for corrective work.

Measurement

420.81 Measurement - The number of square yards of recycled emulsified asphalt mixture shall be based on the paved widths and milled depths shown on the plans and the horizontal measurement along the centerline of the actural length of the pavement recycled.

No allowance will be made for pavement recycled in excess of the paved width and milled depth shown on the plans unless directed by the Engineer.

No change in unit price per square yard will be made for depths deviating from plan depths unless the milled depth is deviated by more than plus or minus one-half inch from the nominal thickness called for by the plans and directed by the Engineer. Where the Engineer directs construction of recycled emulsified asphalt concrete to a thickness other than plus or minus of one-half inch from the nominal thickness specified, these areas will be adjusted by converting in one-half-inch increments to the equivalent number of square yards of nominal thickness on a proportionate volume basis above or below the specified tolerance limits.

For example, if the plans require a nominal depth of 1-1/2-inch and the Engineer directs a milling depth of 2-1/2 inches, the adjustment will be based on an additional 1/2-inch depth. (2-1/2"-1-1/2"-1/2" (tolerance) = 1/2" adjustment)

The quantity of emulsified asphalt in the recycled asphalt concrete mixture to be paid for will be the number of tons used in the accepted mixture measured as set forth in subsection 109.01 of the Standard Specifications.

The quantity of water used in the mixture will be measured as set forth in Section 233.

The quantity of choke aggregate to be paid for will be the number of cubic yards actually spread on the inplace recycled emulsified asphalt mixture at the rate specified, measured as set forth in subsection 109.01 of the Standard Specifications.

Payment

420.91 Payment - Payment when made at the contract unit price per square yard for the item "Recycled Emulsified Asphalt Pavement Mixture" will be full compensation for all equipment, labor and incidentals required to remove and pulverize the existing surfacing, and to mix the materials, place, compact and finish the work as specified.

Payment, when made at the contract unit price per ton for "Emulsified Asphalt in Recycled Mixture", will be full compensation for all costs of material, labor, tools and equipment necessary for the addition of the emulsion as specifed.

(Use word "furnish" when Contractor is to supply choke aggregate.)

Payment, when made at the contract unit price per cubic yard for "choke aggregate", will be full compensation for all costs to (furnish,) haul and place choke aggregate as specified.

Payment for water used in the CIR asphalt concrete mixture will be made as set forth in Section 233 and will comprise full compensation for the water used in connection with the recycle work.

SECTION 407 - ASPHALT TACK COAT

Delete Section 407 of the 1984 Standard Specifications and insert the following:

Description

407.01 Scope - This work shall consist of the furnishing of asphalt and the application thereof to a prepared asphalt concrete surface to ensure thorough bond between profiled asphalt cement surface and recycled emulsified asphalt mixture. The tack coat shall be applied on the areas designated by the Engineer in accordance with these specifications.

Materials

407.11 Asphalt - The asphalt to be used in the tack coat shall be CMS-2S and shall meet the applicable requirements of Section 702. The material may be conditionally accepted at the source or point of loading for transport to the project.

Emulsified asphalt in tack shall be diluted prior to application with 15-30 percent additional water conforming to the requirements of subsection 233.11, as determined by the Engineer.

Construction

407.31 General - The tack coat shall be applied to the milled surface prior to placement of the recycled emulsified asphalt mixture is placed in a berm into the profiled area.

The tack coat shall be applied to the entire milled surface including the vertical edges.

(Use word "furnish" when Contractor is to supply choke aggregate.)

Payment, when made at the contract unit price per cubic yard for "choke aggregate", will be full compensation for all costs to (furnish,) haul and place choke aggregate as specified.

Payment for water used in the CIR asphalt concrete mixture will be made as set forth in Section 233 and will comprise full compensation for the water used in connection with the recycle work.

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Emulsified asphalt in tack shall be diluted prior to application with 15-30 percent additional water conforming to the requirements of subsection 233.11, as determined by the Engineer.

Construction

407.31 General - The tack coat shall be applied to the milled surface prior to placement of the recycled emulsified asphalt mixture is placed in a berm into the profiled area.

The tack coat shall be applied to the entire milled surface including the vertical edges.

407.32 Distribution Equipment - The asphalt shall be spread by means of a pressure distribution system capable of applying the tack coat uniformly on surfaces having widths of up to 13 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.05 gallon per square yard.

Distribution system equipment shall include pressure gauges, accurate volume measuring devices or a calibrated tank and a thermometer for running temperature of tank contents. The distribution system shall have a power unit for the pump and a full circulation system for the tank and spray bar.

The spray bar shall be capable of being easily adjustable laterally.

407.33 Application Rate - Normally, the diluted emulsified asphalt shall be applied to the milled surface at a rate of 0.05-0.20 gallon/sq.yd. as directed by the Engineer.

Measurement

407.81 General - Asphalt used as directed in the asphalt tack coat will be measured by the ton as set forth in Section 109.

Payment

407.91 General - The accepted quantity will be paid for at the contract price per ton for the item "Asphalt in Tack Coat". The water in the tack coat will be measured and paid for in accordance with subsections 233.81 and 233.91 of the Standard Specifications.

APPENDIX F

WARM SPRINGS PROJECT FIELD REPORT

FIELD REPORT
PRELIMINARY PROJECT DATA

GENERAL: Unit "A"

Project Name: M.P. 79.2 - Wasco Co. Line M.P. 79.2 - M.P. 96.5

Warm Springs Jct - Wasco Co. Line Warm Springs Highway

Plan Recycle Depth: 1 1/2" Actual Recycle Depth: 1 1/2" - 2"

Date Started: 8/5/86 Date Completed: 8/14/86

Production Rate: 4.9 mi./day

Ambient Temp.(daytime): Avg.: 82 deg. F.; High: 105 F.; Low: 70 F.

Asphalt Supplier and Type: Chevron CMS-2S Emulsion.

PRELIMINARY INFORMATION FROM PAPER RESEARCH, CORES AND FIELD REVIEW:

25 Year old AC — & 17 Year old AC —

The paper research produced three prior projects. The first a Class "B" Mix constructed in 1961 titled West unit Warm Springs Jct. - Bear Springs. This was a widening and paving project, but no information could be found on the mix design or asphalt. The limits of this prior project were from mile point 62.1 to 96.5. The second prior project was a 1969 project titled Willow Creek - Simnasho Road. This was constructed with two lifts of Class "B" Mix using Union 85/100 asphalt. The existing lane width was 22 feet and was widened to 32 feet. The 10 feet of widening was the only area to get two lifts the remainder of the project received only one. The recycling will be encounter 2 feet of this widening in each lane. The job mix formula called for 7.3% asphalt to be used in the top lift. The limits of this prior project was from M.P. 78.9 - 84.9. The third prior project was Simnasho Road - Jefferson Co. Line. This prior project was constructed in May of 1971 using Douglas 60-70 in the top course and Shell/Douglas 85-100 in the base course. Again in this project the shoulder area received two lifts and the roadway only the wearing course. The job mix formula and the job averages for this project show 5.7% for the wearing surface. Under Extra Work Order, 3500 tons of Class "C" Mix were also placed under this contract, but the location was not recorded. During the field review the limits of the C mix were found from mile point 94.3 to 96.5.

15 YRS —

(?) In test section where we want 4" we were to base rock

The cores revealed a multiple lift existing pavement with a thickness varying from 6 inches to 10 inches. The cores contributed to and verified the information found during the field review.

Due to the uniformity of the existing surface throughout this unit, 6 test sections were constructed where depth and emulsion content were varied. Deflections were taken every 50 feet within these test sections and Mays ride information was gathered throughout the entire unit. Figure 1 shows the limits of the test sections along with add emulsion/water contents and treatment depths. Additionally, millings samples from the recycle train were taken from within the test sections prior to the addition of emulsion. The millings will be used to form 75

The mixing plant shall be equipped with positive displacement pumps and a computerized metering system which can accurately meter the amount of emulsified asphalt and water. The pumps shall be interlocked belt weighing system that measures the quantity of RAP material entering the mixing plant. The interlock shall be designed so that emulsified asphalt and water cannot be added until RAP material enters the mixer. Overrides of the interlock system shall be equipped with short duration timers to prevent their continuous use. Overrides shall be used only during start-up periods.

The belt weighing device and computerized-metering system shall have readouts that indicate the quantity in tons of RAP, water and emulsified asphalt being fed into the mixer at any given time. Totalizer readouts shall also be provided to allow determination of accumulative quantities of each constituent.

(Use following four paragraphs when single unit option is allowed.)

Equipment Option B - Single Processing Unit:

Under this option the existing pavement shall be processed using a planing machine meeting all of the requirements of a planing machine under "Equipment Option A".

In addition, the planing machine shall be capable of adding emulsified asphalt and water to the RAP in amounts directed by the Engineer to produce a uniform mixture.

Positive displacement pumps which can accurately meter the planned amount of emulsified asphalt and water into the pulverized asphalt concrete shall be used. The pumps shall be interlocked to the movement of the machinery used to apply the emulsified asphalt and water to provide that no emulsified asphalt or water can be added when the machinery is not moving.

The emulsified asphalt and water feeds shall have positive readout capabilities so that the amount of emulsified asphalt and water in tons incorporated into at any given time can be read directly. Totalizer readouts shall also be provided to allow determination of accumulative quantities of water and emulsified asphalt used in the mixture.

(d) Asphalt storage and heating tanks - Storage tanks shall be equipped with accurate volume measuring devices or manufactures calibration charts for each storage tank and a thermometer for measuring the temperature of tank's contents.

blow Marshall briquettes using the appropriate emulsion brand and content. Stability, Modulus, and Fatigue tests will be run on the briquettes at 3 mo., 6 mo., 12 mo. and 24 mo. intervals. These test results will be compared to results of the same tests performed on 4" dia. pavement cores from the test sections taken at the same time intervals.

There were four mix design areas designated for this unit. Figure 3 contains their descriptions by mile point, mix design sample locations, original asphalt data and a description of the pavement condition prior to recycle.

BINDER CONTENT:

Recommended add emulsion contents were determined using revised mix design criteria developed 7-29-86. In addition, a minimum of 1% add emulsion was specified to provide the necessary softening and coating for the millings. Figure 2 illustrates percents used, original mix design, and revised mix design contents. Note that the actual percents used were based on meter readings only and not extractions. Beginning with this report extraction test results will no longer be reported. They were erratic and misleading since it was uncertain whether all of the emulsifiers and solvents were being evaporated prior to extraction of the residual asphalt.

Note: I agree

INITIAL COMPACTION:

The initial compaction was accomplished with an Ingersoll Rand model DA-50 double drum vibratory roller using one pass vibratory and one pass static then a Hyster model C340B tandem steel roller using two passes.

As can be seen in figure 4 the initial compaction was generally in the high 70s to low 80s throughout the entire unit. This is slightly below the average compaction seen on most of the recycle projects this year. M.P. 81.8-84.9 Rt. was analyzed separately in Fig. 4 because this area experienced severe ravelling to the point that it had to be re-recycled. Note that initial compaction in this area was the lowest recorded. Although no well defined pattern in compaction developed which could be correlated to treatment depth or emulsion content, it does appear that a minimum initial compaction of 75% is required to prevent ravel.

SECOND COMPACTION:

Second compaction was accomplished with three passes each using a Raygo model C2A double drum vibratory in static mode and a Brothers model 1919 pneumatic roller. Figure 5 lists the construction variations that could have affected compaction along with the corresponding compaction achieved and the increase in density over first compaction. Note that for most of the second compaction a Rice Density of 150.9 lbs/ft^3 was used which was different than the Rice used on initial compaction.

FIELD OBSERVATIONS OF RECYCLED MIX AND LAYDOWN:

For the most part the recycle of this unit went well. This was the first unit recycled this Summer where the revised mix design criteria were used in their respective mix design areas with good success. This is encouraging because it shows we are learning how to make successful laboratory designs for cold in-place recycle pavements.

OBSERVATIONS OR SPECIAL PROBLEMS ON THIS UNIT:

From MP 79.2 to MP 84.85 Rt. there was intermittent ravelling 200 to 300 feet long. To correct this, add emulsion was increased from 1.1% to 1.3% and additional rolling was provided. This area is heavily forested and large areas are shaded part of the day. Additionaly, the ambient temperature when this section was recycled was approx. 15 degrees F. cooler than the ambient temperature during the previous week's work (low 80's vs. mid to high 90's) where 1% add emulsion was performing satisfactorily without ravelling. The cool temperatures created by the shade and weather reduced softening and cure of the recycle mat prior to placing high volume traffic onto the new pavement. From MP 83.8 to MP 84.85 Rt. ravelling was so severe that the pavement had to be re-recycled with 0.5% more emulsion added for a total add emulsion of 1.7%. Note that in this area loaded log truck traffic was pulling onto the recycle pavement from a side road and accelerating uphill. Another area that required re-recycling was from MP 88.3 to 88.75. The emulsion shipment used in this area contained 1% more naptha and emulsifiers than previous shipments. This may have caused the ravelling according to the project manager. An additional 0.3% to 0.5% emulsion was added in this section during re-recycling bringing the total add emulsion to 1.3% to 1.5%.

GENERAL COMMENTS:

The temperature sensitivity of recycle mixtures during initial cure was reemphasized during construction of this unit. Keep in mind that approximately 50% of this unit was recycled using only 1.0%-1.2% add emulsion which is an addition of only 0.7%-0.8% residual asphalt. While the daytime ambient temperatures were in the 90 degree F.--100 degree F. range there were no ravelling problems. As soon as the recycle train encountered areas of prolonged shade and/or reduced ambient temperatures ravelling was experienced. Of course an inspector's first reaction to this problem is to add more emulsion. This should be avoided, but if necessary should be kept to 0.1% to 0.2% adjustments and should never go above that emulsion content determined by mix design which would reduce stability after second compaction to a value less than 10. The addition of too much emulsion during cool temperatures will result in flushing and/or instabilities as soon as hot temperatures return. We have seen on previous recycles this Summer that cooler temperatures often lead to ravelling problems since softening of the existing asphalt and cure of the recycled pavement is retarded. But we know that softening and cure will progress though at a slower rate, and that if through careful piloting of traffic and additional rolling we can control the ravel the recycled pavement will eventually set up.

The test sections which were to be constructed on this unit to determine the effects of different recycle depths and different emulsion contents have been completed. Following is a description of their limits and how they were constructed:

TEST SECTIONS: WARM SPRINGS JCT.--WASCO CO. LN.

M.P. 88.0-88.09 (500')	Rt. & Lt. Lanes	Recycle Depth=2" Emul.%=1.0% H_2O%=2.4%
M.P. 88.09-88.17 (400')	Rt. & Lt. Lanes	Recycle Depth=2" Emul.%=1.9% H_2O%=2.4%
M.P. 88.17-88.26 (500')	Rt. & Lt. Lanes	Recycle Depth=2" Emul.%=1.6% H_2O%=2.4%
M.P. 88.28-88.47 (1000')	Rt. & Lt. Lanes	Recycle Depth=3" Emul.%=1.0% H_2O%=2.4%
M.P. 88.47-88.54 (400')	Lt. Lane Only	Recycle Depth=3" Emul.%=1.3% H_2O%=2.4%
M.P. 88.56-88.75 (1000')	Lt. Lane Only	Recycle Depth=4" Emul.%=1.0% H_2O%=2.4%

FIGURE 2

CRITICAL DESIGN PROPERTIES AT REVISED RECOMMENDATION:

MIX DES. AREA	M.P.	USED[1] Water/Emul	% EMUL. MIX DES. REC. Original	Revised	COATING	HVEEM STAB. (after 2nd compac.)	VOIDS after 2nd comp.	after 3rd comp.	PEN ADJ.	REMARKS
1	79.2-84.9	2.4%/1.2%	1.5%	1.0%	Dry-Suff.	33	9.9%	4.2%	0%	Pen of original asphalt =14 (Data Sht. A34401) >10 & <20 No pen adj. req'd.
2	84.9-94.3	2.4%/1.3% (test secs.) (not incl.)	1.5%	1.0%	Dry-Suff.	2	5.2%	4.9%	0%	Pen of original asphalt =25 (Data Sht A34402) Min. 1% add emul.
3	88.56-88.75	2.3%/1.0% (test sec.) (4" T.D. Lt.)	2.0%	1.0%	Dry-Suff.	4	8.1%	4.4%	0%	Pen of original asphalt =26 (Data Sht A34403) Min. 1% add emul.
4	94.3-96.5	2.3%/1.6% Rt. 3.0%/1.9% Lt.	2.5%	1.5%	Dry-Suff.	11	11.5%	5.7%	0%	Pen of original asphalt =7 (Data Sht A34404) This doesn't seem to fit with the stab. nos Normally w/ low pen nos., stab nos are high

[1]Water/Emulsion content based on meter readings.

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FIGURE 3

MIX DES. AREA	M.P.	SAMPLE LOCATIONS	ORIG. ASPH. PROPERTIES % Asph.	Pen. (cm./100)	Visc. (kinematic)	ORIGINAL SURFACE CONDITION
1	79.2-84.9	M.P. 83.4, 5.5'Lt. M.P. 83.2, 6' Rt. M.P. 83.6, 8' Lt.	5.5%	14	907	Thermal cracks spaced 15'-20' apart. Alligator cracking in wheel tracks. One sample taken from a patched area. 3 samples combined for mix design.
2	84.9-94.3	M.P. 88.1, 7' Rt. M.P. 89.2, 9.5' Lt.	5.8%	25	736	Thermal cracks spaced approx. 30' apart. 2 samples combined for mix design.
3	88.56-88.75	M.P. 88.7, 3' Rt.	6.3%	26	681	Test Sec. 4" treatment depth. Longitudinal and thermal cracks spaced 30'-50' apart.
4	94.3-96.5	M.P. 95.2, 9.5' Lt. M.P. 96.1, 2.5' Rt.	5.3%	7	1600	Alligatored and deformed in wheel tracks. Discontinuous thermal cracks 5'-10' long. 2 samples combined for mix design.

Figure 4

INITIAL COMPACTION

M.P.	Mean Bulk Density (In Lbs.)	Mean Rice Density (In Lbs.)	Mean % Compaction	Mean % Voids	Remarks
M.P. 79.2-81.8 Rt. & M.P. 79.2-84.9 Lt. Mix Design Area #1	118.3 (8 tests)	154.0	76.8	23.2	1.2% Emul 2.4 Water 1.5" Avg. Treatment Depth
M.P. 81.8-84.9 Rt. Area Re-recycled Mix Design Area #1	103.8 (4 tests)	144.5	71.8	28.2	1.7% Emul 2.4 Water 1.5" Avg. Treatment Depth
M.P. 84.9-94.3 Lt. & Rt. Mix Design Area #2	122.8 (16 tests)	154.3	79.6	20.4	1.3% Emul 2.4 Water 1.6" Avg. Treatment Depth
M.P. 94.3-96.5 Rt. Mix Design Area #4	128.2 (3 tests)	150.9	85.0	15.0	1.6% Emul 2.3% Water 1.5" Avg. Treatment Depth
M.P. 94.3-96.5 Lt. Mix Design Area #4	134.8 (2 tests)	156.9	85.9	14.1	1.9% Emul 3.0% Water 1.5" Avg. Treatment Depth
M.P. 88.0-88.09 Rt. & Lt. Test Section	(No tests)				1.0% Emul 2.4 Water 2" Treatment Depth
M.P. 88.09-88.17 Rt. & Lt. Test Section	125.5 (1 test)	158.3	79.3	20.7	1.9% Emul 2.4 Water 2" Treatment Depth
M.P. 88.17-88.26 Rt. & Lt. Test Section	128.5 (1 test)	158.3	81.2	18.8	1.6% Emul 2.4 Water 2" Treatment Depth
M.P. 88.28-88.47 Rt. & Lt. Test Section	121.5 (1 test)	158.3	76.8	23.2	1.0% Emul 2.4 Water 3" Treatment Depth
M.P. 88.47-88.54 Lt. Test Section	121.5 (1 test)	158.3	76.8	23.2	1.3% Emul 2.4 Water 3" Treatment Depth
M.P. 88.56-88.75 Lt. Test Section	125.0 (1 test)	158.3	79.0	21.0	1.0% Emul 2.4 Water 4" Treatment Depth

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Figure 5

SECOND COMPACTION

M.P.	Mean Bulk Density (in Lbs)	Mean Rice Density (In Lbs)	Mean % Compaction	Mean % Voids	Mean Density Change (In Lbs.)	Remarks
M.P. 79.2-81.8 Rt. & M.P. 79.2-84.9 Lt. Mix Design Area #1	123.3 (50 tests)	150.2	82.1	17.9	5.0	1.2% Emul 2.4 Water 1.5" Avg. Treatment Depth
M.P. 81.8-84.9 Rt. Area Re-recycled Mix Design Area #1	124.3 (18 tests)	150.9	82.4	17.6	20.5	1.7% Emul 2.4 Water 1.5" Avg. Treatment Depth
M.P. 84.9-94.3 Lt. & Rt. Mix Design Area #2	134.5 (63 tests)	152.8	88.0	12.0	11.7	1.3% Emul 2.4 Water 1.6" Avg. Treatment Depth
M.P. 94.3-96.5 Rt. Mix Design Area #4	137.9 (15 tests)	150.9	91.4	8.6	9.7	1.6% Emul 2.3% Water 1.5" Avg. Treatment Depth
M.P. 94.3-96.5 Lt. Mix Design Area #4	129.2 (16 tests)	154.0	83.9	16.1	-5.6	1.9% Emul 3.0% Water 1.5" Avg. Treatment Depth
M.P. 88.0-88.09 Rt. & Lt. Test Section	135.5 (2 tests)	150.9	89.8	10.2		1.0% Emul 2.4 Water 2" Treatment Depth
M.P. 88.09-88.17 Rt. & Lt. Test Section	144.5 (2 tests)	150.9	95.8	4.2	19.0	1.9% Emul 2.4 Water 2" Treatment Depth
M.P. 88.17-88.26 Rt. & Lt. Test Section	139.0 (2 tests)	150.9	92.1	7.9	10.5	1.6% Emul 2.4 Water 2" Treatment Depth
M.P. 88.28-88.47 Rt. & Lt. Test Section	143.5 (1 test)	150.9	95.1	4.9	22.0	1.0% Emul 2.4 Water 3" Treatment Depth
M.P. 88.47-88.54 Lt. Test Section	134.5 (2 tests)	150.9	89.1	10.9	13.0	1.3% Emul 2.4 Water 3" Treatment Depth
M.P. 88.56-88.75 Lt. Test Section	136.5 (2 tests)	150.9	90.5	9.5	11.5	1.0% Emul 2.4 Water 4" Treatment Depth

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

PRELIMINARY COLD RECYCLE MIX DESIGN

Laboratory No. ____
Data Sheet No. A-34401
E.A. C102-18
Laboratory charge $510.00

Project Region 4 Recycle: MP79.2 - Wasco Co. Line
Highway Warm Springs   Unit A Design #1
Contractor J. C. Compton
Date received 4/10/86
Submitted by Dan Olson   Unit Code # 8041
Date reported ____
Source of Material MP 83.2, MP 83.4, MP 83.6
Date sampled 4/8/86
Sampled or inspected at Roadway
To be used In Place Cold Recycle A/C
Sampled or inspected by R & R Team
Quantity represented ____

*Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100   P. 3/8 - 74   P. #40 - 6
P. 3/4" - 96   P. 1/4 - 53   P. #200 - 1.6
P. 1/2" - 85   P. #10 - 20   * Milling report 86-4646

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.5; Pen - 14)

% Water / % Emulsion CMS-2S @ 67% Residual	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	62	62	56	49
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	23	18	12	7
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	33	4	2	1
Bulk Specific Gravity - 1st Comp.	2.18	2.22	2.24	2.26
Bulk Specific Gravity - 2nd Comp.	2.19	2.24	2.25	2.28
Bulk Specific Gravity - 3rd Comp.	2.33	2.35	2.37	2.35
Percent Voids @ 3rd Comp.	4.2	2.4	1.0	1.1
Rice Method Real Gravity	2.431	2.407	2.394	2.376
Asphalt Film Thickness	Dry-Suff.	Suff	Suff	Thick
Unconditioned Resilient Modulus ($x 10^3$) -	536.6	573.3	589.5	585.2
Vac. Sat. Resilient Modulus ($x 10^3$) -	312.9	380.3	384.1	479.0
Freeze-Thaw Resilient Modulus ($x 10^3$) -	107.7	186.8	275.5	311.9
M_R Ratio 1 (Vac. Sat./Uncond.) -	58%	66%	65%	82%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	20%	33%	47%	53%

Recommended water addition (Based on milling dry weight) - 4.0%
" Emulsion content " " " " " - 1.5%

REPORT TO:

- ☐ F.H.W.A.
- ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- ☐ Region Engineer
- ☐ Project Manager
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- ☐ Materials, Eugene
- ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design criteria - 1.0% CMS-2S

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LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

PRELIMINARY COLD RECYCLE MIX DESIGN

Laboratory No. ______
Data Sheet No. A34402
E. A. C10218
Laboratory charge $510.00

Project: Region 4 Recycle - MP 79.2 - Wasco Co. Line
Highway: Warm Springs Unit A Design #2
Contractor: J.C. Compton — Date received 4/10/86
Submitted by Dan Olson — Unit Code # 8041 — Date reported ______
Source of Material: Mixdesign area #2 — Date sampled 4/8/86
Sampled or inspected at: Roadway — To be used: In place cold recycle AC
Sampled or inspected by: R & R Team — Quantity represented ______

Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" – 100 | P. 3/8" – 74 | P. #40 – 5
P. 3/4" – 97 | P. 1/4" – 54 | P. #200 – 1.6
P. 1/2" – 86 | P. #10 – 18 | * Milling report #86-4647

Resistance to Deformation and Cohesion: AASHTO – T-246 & 247 (A/C – 5.8; Pen – 25)

% Water / % Emulsion CMS-2S @ 67% Residual	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	60	36	21	16
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	15	4	1	1
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	2	1	0.7	0.5
Bulk Specific Gravity - 1st Comp.	2.41	2.45	2.47	2.49
Bulk Specific Gravity - 2nd Comp.	2.43	2.46	2.48	2.49
Bulk Specific Gravity - 3rd Comp.	2.45	2.47	2.49	2.51
Percent Voids @ 3rd Comp.	6.0	3.7	2.3	0.3
Rice Method Real Gravity	2.606	2.565	2.548	2.518
Asphalt Film Thickness	Dry	Suff	Suff	Suff-Thick
Unconditioned Resilient Modulus (x 10^3) -	527.7	480.6	391.9	321.8
Vac. Sat. Resilient Modulus (x 10^3) -	497.0	464.5	389.7	308.4
Freeze-Thaw Resilient Modulus (x 10^3) -	195.5	244.7	261.2	201.1
MR Ratio 1 (Vac. Sat./Uncond.) -	94%	97%	99%	96%
MR Ratio 2 (Freeze-Thaw/Uncond.) -	37%	51%	67%	62%

Recommended water addition (Based on milling dry weight) – 4.0%
" Emulsion content " " " " " – 1.5%

REPORT TO:

F.H.W.A.
Construction Engineer
Maintenance Engineer
Bridge Engineer
Region Engineer
Project Manager
Dist. Maintenance Supervisor
Materials, Portland
Materials, Eugene
Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design criteria – 1.5% CMS-2S

LABORATORY RECORD
HIGHWAY DIVISION — MATERIALS SECTION

PRELIMINARY COLD RECYCLE MIX DESIGN

Laboratory No.
Data Sheet No. A34403
E. A. C10218
Laboratory charge $ 510.00

Project: Region 4 Recycle - MP 79.2 - Wasco Co. Line
Highway: Warm Springs Unit A Design #3
Contractor: J.C. Compton
Date received: 4/10/86
Submitted by: Dan Olson
Unit Code #: 8041
Date reported:
Source of Material: MP 88.1, MP 89.2
Date sampled: 4/8/86
Sampled or inspected at: Roadway
To be used: In Place Cold Recycle A/C
Sampled or inspected by: R & R Team
Quantity represented:

* Test Gradation: of Pavement grindings calculated to 100% Passing 1"

- P. 1" –
- P. 3/8" –
- P. #40
- P. 3/4" –
- P. 1/4" –
- P# 200
- P. 1/2" –
- P#10 –

*Milling report #86 - 4648

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 6.3%; Pen - 26)

% Water / % Emulsion CMS-2S @ 67% Residual	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	53	52	26	17
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	18	13	6	2
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	4	1	0.5	0.5
Bulk Specific Gravity - 1st Comp.	2.18	2.25	2.27	2.29
Bulk Specific Gravity - 2nd Comp.	2.22	2.28	2.30	2.32
Bulk Specific Gravity - 3rd Comp.	2.32	2.34	2.36	2.38
Percent Voids @ 3rd Comp.	6.1	4.4	2.4	1.1
Rice Method Real Gravity	2.471	2.447	2.417	2.407
Asphalt Film Thickness	Dry	Dry Suff	Dry-Suff	Dry-Suff
Unconditioned Resilient Modulus ($x 10^3$) -	427.5	468.9	457.7	440.8
Vac. Sat. Resilient Modulus ($x 10^3$) -	220.5	354.8	378.8	371.8
Freeze-Thaw Resilient Modulus ($x 10^3$) -	42.8	77.6	108.9	111.2
M_R Ratio 1 (Vac. Sat./Uncond.) -	52%	76%	83%	84%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	10%	17%	24%	25%

Recommended water addition (Based on milling dry weight) - 4.0%
" Emulsion content " " " " " - 2.0%

REPORT TO:

- ☐ F.H.W.A.
- ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- ☐ Region Engineer
- ☐ Project Manager
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland —
- ☐ Materials, Eugene
- ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria - 1.5% CMS-2S

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

PRELIMINARY COLD RECYCLE MIX DESIGN

Laboratory No. ______

Data Sheet No. A-34404

E. A. C10218

Laboratory charge $510.00

Project Region 4 Recycle - MP79.2 - Wasco Co. Line

Highway Warm Springs Unit A Design #4

Contractor JC Compton

Date received 4/10/86

Submitted by Dan Olson Unit Code # 8041

Date reported ______

Source of Material MP 95.2, MP 96.1,

Date sampled 4/8/86

Sampled or inspected at Roadway

To be used In Place Cold Recycle A/C

Sampled or inspected by R&R Team

Quantity represented ______

*Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100	P. 3/8 - 73	P. #40 - 6
P. 3/4" - 96	P. 1/4" - 58	P. #200 - 2.0
P. 1/2" - 83	P. #10 - 24	* Milling report 86-4649

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.3; Pen - 7)

% Water / % Emulsion CMS-2S @67% Residual	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	50	43	32	14
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	20	19	13	5
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	16	7	1	0.5
Bulk Specific Gravity - 1st Comp.	2.19	2.25	2.27	2.31
Bulk Specific Gravity - 2nd Comp.	2.22	2.28	2.30	2.34
Bulk Specific Gravity - 3rd Comp.	2.36	2.38	2.40	2.42
Percent Voids @ 3rd Comp.	6.6	4.7	3.0	1.1
Rice Method Real Gravity	2.526	2.496	2.473	2.447
Asphalt Film Thickness	Dry	Dry Suff	Suff	Suff
Unconditioned Resilient Modulus (x 10^3) -	362.0	433.4	544.8	423.4
Vac. Sat. Resilient Modulus (x 10^3) -	177.0	352.4	465.5	362.7
Freeze-Thaw Resilient Modulus (x 10^3) -	58.6	145.9	264.8	209.6
M_R Ratio 1 (Vac. Sat./Uncond.) -	49%	81%	85%	86%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	16%	34%	49%	49%

Recommended water addition (Based on milling dry weight) - 4.0%

" Emulsion content " " " " " - 2.5%

REPORT TO:

- ☐ F.H.W.A.
- ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- ☐ Region Engineer
- ☐ Project Manager
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- ☐ Materials, Eugene
- ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Criteria - 2.0% CMS-2S

ASPHALT LABORATORY RECORD

HIGHWAY DEPARTMENT for Pavement Grindings for Recycle (Millings)
(ASPHALT BRAND and TYPE)

PROJECT: Region 4 Recycle Projects (Unit A)	LABORATORY NO.: 86 4646
HIGHWAY: Various (Warm Springs) — COUNTY: Wasco	DATA SHEET NO.: A34401
CONTRACTOR: J.C. Compton	EA NO.: C10218
PROJECT MANAGER: Dan Olsen — UNIT CODE NO.: 8027	F.A. PROJECT NO.:
SUBMITTED BY: " " — UNIT CODE NO.: "	DATE RECEIVED: 4-10-86 — DATE REPORTED:
SOURCE OF MATERIAL:	LABORATORY CHARGES: see page one
SAMPLED OR INSPECTED AT: Mix Design Area #1 — TO BE USED: Recycled Pavement	
SAMPLED OR INSPECTED BY: Randy Davis, D. Foster — DATE SAMPLED: 4-8-86	QUANTITY REPRESENTED:

SAMPLE NO. TEST RESULTS

PAVING ASPHALT

- T 73 Flash point, closed cup ______ °F
- T 44 Solubility in CHCL: CCL2 ______ %
- T 49 Penetration at 77F/39.2 ______ cm/100
  Penetration ratio 39.2/77 F ______
- T201 Viscosity, Kinematic 275 F ______ C.S.
- T202 Viscosity, Absolute 140 F ______ P.

T240 **Paving Asphalt RTF (c) Residue**

- T 47 Loss on heating ______ %
- T201 Viscosity, Kinematic 275 F ______ C.S.
- T202 Viscosity, Absolute 140 F, 30cm Hg., Vac. ______ P.
- T 49 Penetration at 77 F ______ cm/100
  % of orig. penetration ______ %
- T 51 Ductility at 77 F ______ cm.
  Ductility at 45 F ______ cm.

Emulsified Asphalt

- T 59 Viscosity, S.F. at ___ F ______ sec.
- T 59 Sieve test ______ %
- T 59 Residue by distillation to 500 F ______ %
- T 59 Oil distillate in ______ %
- T 49 Penetration of Res. at 77 F ______ cm/100
- T 44 Solubility in CHCL:CCL2 ______ %
- T 51 Ductility at 77 F ______ cm.

T170 **Modified Abson Recovery of Asphalt**

- T201 Viscosity, Kinematic 275 F 907 C.S.
- T202 Viscosity, Absolute 140 F, 30 cm Hg. Vac. 25,828 P.
- T 49 Penetration of Res. at 77 F 14 cm/100
  "C" value ______

Liquid Asphalt

- T 48 Flash point, open cup ______ °F
- T201 Viscosity, Kinematic at 140 F ______ C.S.
- T 78 Distillation (% of total distillate to 680 F)
  - To 374 F ______ %
  - To 437 F ______ %
  - To 500 F ______ %
  - To 600 F ______ %
  - Residue from distillation to 680 F Volume by difference ______ %
  - Water ______ %

Liquid Asphalt Residue

- T 49 Penetration at 77 F ______ cm/100
- T 44 Solubility in CHCL:CCL2 ______ %
- T 51 Ductility at 77 F ______ cm.
- T202 Viscosity ABS. at 140 F ______ P.

M180 **Pipe Coating (Bituminous)**

- T 44 Solubility in CHCL:CCL2 ______ %
- T 49 Penetration at 77 F ______ cm/100
- T 47 Loss on heating at 325 F ______ %
- T 49 Penetration of Res. at 77 F ______ % of orig.

informational only

REPORT TO:

- ☐ F.H.W.A.
- ☐ CONSTRUCTION ENGINEER
- ☐ MAINTENANCE ENGINEER
- ☐ PAVING QUALITY COORDINATOR
- ☐ REGION ENGINEER
- ☐ PROJECT MANAGER
- ☐ DISTRICT SUPERVISOR
- ☐ FILE

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

ENGINEER OF MATERIALS

Oregon Department of Transportation HIGHWAY DIVISION

SAMPLE DATA and LABORATORY TEST REPORT

[X] AGGREGATE [ ] BITUMINOUS MIXTURE

LABORATORY REPORT NO. 86 4646
DATA SHEET NO. A34401

PROJECT: Region 4 Recycle Projects (Unit A)
HIGHWAY: Various(Warm Springs) COUNTY: Various(Wasco)
CONTRACTOR: J.C. Compton Contractor
PROJECT MANAGER: Dan Olsen AGY-ORG.UNIT 8027
SUBMITTED BY: Dan Olsen AGY-ORG.UNIT 8027

EXP. ACCT/SUB JOB C10218
DATE RECEIVED 4-10-86
F.A. PROJECT NO.
DATE REPORTED 5-16-86
BID ITEM NO. 12
LAB CHARGES $372.00

SAMPLE NO.
NO. OF BOXES
NO. OF BAGS 6
QUANTITY REPRESENTED (YARDS, TONS, ETC.)
[X] MIX DESIGN [ ] RECORD [ ] QUALIFYING [ ] CHECK
FIELD CONTROL TEST NO. [ ] TM 204 [ ] TM 205

AGGREGATE SIZE: Pavement Grindings
BRAND & GRADE ASPHALT:
TYPE MIX: Recycle
MIX DESIGN NO.
INTENDED USE: Recycle Pavement
SOURCE NO.
QUARRY [ ] GRAVEL [ ]
SOURCE NAME OR LOCATION:
SAMPLED AT: Mix Desgin Area #1
DATE SAMPLED: 4-8-86
REMARKS, INSTRUCTIONS:

		SIEVE SIZE	PERCENT PASSING
10/¼	%		
40/10	%		
200/10	%		
FRACTURE	%		
PI			
LL			
S.E.			
MOISTURE	%		
RETENTION	%		
EXTRACTED A/C	%		
TOTAL A/C	%		

CHECK "BOX" FOR TEST REQUIRED: USE SEPARATE DATA SHEET FOR EACH SAMPLE. LIST ADDITIONAL PROJECTS SEPARATELY.

[X] TM 204 DRY SIEVE
[ ] TM 205 WET SIEVE
3 [X] TM 309 A/D EXTRAC.

SIEVE SIZE	PERCENT PASSING	PERCENT PASSING
	As Rec	Avg. of 3 ext.
2	100	
1½	95	
1	89	
¾	85	100
½	76	94
⅜	66	85
¼	47	70
4	37	60
10	18	37
40	5	20
200	1.4	8.1

TM 205 P200
10/¼ % 200/10 %
40/10 %
FINENESS FACTOR
1½, ¾, ⅜, 4, 8, 16, 30, 50, 100
MOISTURE 1.29 %
EXTRACTED A/C 5.5 % (Avg. of 3)
RETENTION %
TOTAL ASPHALT %

[ ] TM 101 S.E.
[ ] TM 102 L.L.
[ ] TM 103 P.I.
[ ] TM 201 UNIT WEIGHT
LOOSE COMPACT
COMBINE % THIS LAB NO. WITH %
OF LAB NO. COMBINED
[ ] TM 202 FINE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 203 COARSE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 206 SODIUM SULFATE LOSS
2½-1½ % 1½-¾ %
RIP RAP AVERAGE %
C.A. 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. 4-8 % 8-16 %
16-30 % 30-50 %
[ ] TM 208A COARSE DEGRADE
HT. IN P20 %
REF HT. IN P20 %
[ ] TM 208B FINE DEGRADE
HT. IN P20 %

[ ] TM 209 ASPHALT STRIPPING
BRAND & GRADE
COATED %
[ ] TM 211 ABRASION
GRADING WEAR %
[ ] TM 212 ORGANIC PLATE NO.
[ ] TM 213 FRACTURE %
[ ] TM 221 FRIABLE PARTICLES
WEIGHTED AVG. — %
1½-¾ % ¾-⅜ %
⅜-4 % 4-16 %
[ ] TM 222 LIGHTWEIGHT PIECES
C.A. % F.A. %
[ ] TM 225 WOODWASTE %
[ ] TM 227 CLEANNESS CV
[ ] TM 228 DMSO
C.A. % 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. % 4-8 % 4-16 %
16-30 % 30-50 %
[ ] TM 229 ELONGATED PIECES %
[X] TM 314A
[X] TM 314B

NOTED R. D. SHARTNER

MATERIAL REPRESENTED BY THIS SAMPLE [ ] DOES, [ ] DOES NOT COMPLY WITH SPECIFICATIONS.
LAB COMMENTS informational only

x FILES
FHWA
x CSL
x CONSTRUCTION ENG.
x REGION ENG. 4 RAS
x PROJECT MANAGER Dan Olson
DISTRICT ENG.
x REGION GEOLOGIST RJ VanCleave
x CONTRACTOR JC Compton Co.

Jack Sullivan
ENGINEER OF MATERIALS

INSTRUCTION: FORWARD WHITE ORIGINAL TO MATERIALS LABORATORY SALEM, CANARY TO PROJECT MANAGER, ORIGINATOR RETAIN PINK

15/20
1 of 2

Oregon Department of Transportation HIGHWAY DIVISION

SAMPLE DATA and LABORATORY TEST REPORT

[X] AGGREGATE [ ] BITUMINOUS MIXTURE

LABORATORY REPORT NO. '86 4647
DATA SHEET NO. A34402

PROJECT: Region 4 Recycle Projects (Unit A)
EXP. ACCT/SUB JOB: C10218
DATE RECEIVED: 4-10-86
HIGHWAY: Various(Warm Springs) COUNTY: Various(Wasco)
F.A. PROJECT NO.:
DATE REPORTED: 5-21-86
CONTRACTOR: J.C. Compton Contractor
PROJECT MANAGER: Dan Olsen ACY-ORG-UNIT 8027
BID ITEM NO. 12
LAB CHARGES 372.00
SUBMITTED BY: Dan Olsen ACY-ORG-UNIT 8027

SAMPLE NO.: NO. OF BOXES: NO. OF BAGS: 8
QUANTITY REPRESENTED (YARDS, TONS, ETC.):
[X] MIX DESIGN [ ] RECORD [ ] QUALIFYING [ ] CHECK
FIELD CONTROL TEST NO. [ ] TM 204 [ ] TM 205

AGGREGATE SIZE: Pavement Grindings
BRAND & GRADE ASPHALT:
TYPE MIX: Recycle
MIX DESIGN NO.:
INTENDED USE: Recycle Pavement
SOURCE NO.:
QUARRY [ ] GRAVEL [ ]
SOURCE NAME OR LOCATION: Mix Design Area #2
SAMPLED AT:
DATE SAMPLED: 4-8-86
REMARKS, INSTRUCTIONS:

		SIEVE SIZE	PERCENT PASSING
10/14	%		
40/10	%		
200/10	%		
FRACTURE	%		
PI			
LL			
S.E.			
MOISTURE	%		
RETENTION	%		
EXTRACTED A/C	%		
TOTAL A/C	%		

CHECK "BOX" FOR TEST REQUIRED: USE SEPARATE DATA SHEET FOR EACH SAMPLE. LIST ADDITIONAL PROJECTS SEPARATELY.

[X] TM 204 DRY SIEVE
[ ] TM 205 WET SIEVE
3 [X] TM 309 EXTRAC.

SIEVE SIZE	PERCENT PASSING	PERCENT PASSING
2	100	
1½	100	
1	99	
3/4	96	100
1/2	85	97
3/8	73	91
1/4	53	81
4	42	72
10	18	46
40	5	24
200	1.6	13.3

TM 205 P200
10/14 % 200/10 %
40/10 %
FINENESS FACTOR
1½, ¾, ⅜, 4, 8, 16, 30, 50, 100
MOISTURE 0.64 %
EXTRACTED A/C 5.8 %
RETENTION — %
TOTAL ASPHALT 5.8 %

[ ] TM 101 S.E.
[ ] TM 102 L.L.
[ ] TM 103 P.I.
[ ] TM 201 UNIT WEIGHT
LOOSE COMPACT
COMBINE % THIS LAB NO. WITH %
OF LAB NO. COMBINED
[ ] TM 202 FINE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 203 COARSE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 206 SODIUM SULFATE LOSS
2½-1½ % 1½-¾ %
RIP RAP AVERAGE %
C.A. 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. 4-8 % 8-16 %
16-30 % 30-50 %
Ave. of 3
[ ] TM 208A COARSE DEGRADE
HT. IN P20 %
REF HT. IN P20 %
[ ] TM 208B FINE DEGRADE
HT. IN P20 %

[ ] TM 209 ASPHALT STRIPPING
BRAND & GRADE
COATED %
[ ] TM 211 ABRASION
GRADING WEAR %
[ ] TM 212 ORGANIC PLATE NO.
[ ] TM 213 FRACTURE %
[ ] TM 221 FRIABLE PARTICLES
WEIGHTED AVG. — %
1½-¾ % ¾-⅜ %
⅜-4 % 4-16 %
[ ] TM 222 LIGHTWEIGHT PIECES
C.A. % F.A. %
[ ] TM 225 WOODWASTE %
[ ] TM 227 CLEANNESS CV
[ ] TM 228 DMSO
C.A. % 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. % 4-8 % 4-16 %
16-30 % 30-50 %
[ ] TM 229 ELONGATED PIECES %
[X] TM 325 AS
TM 314R

2x FILES
FHWA
x CSL
x CONSTRUCTION ENG.
REGION ENG. 4 RAS
PROJECT MANAGER Dan Olson
DISTRICT ENG.
x REGION GEOLOGIST ~~RJ VanCleave~~
x CONTRACTOR JC Compton Co.
3x J. WIlson, G. Boyle, G. Hicks

NOTED
MATERIAL REPRESENTED BY THIS SAMPLE [ ] DOES, [ ] DOES NOT COMPLY WITH SPECIFICATIONS.
LAB COMMENTS

Jack Sullivan
ENGINEER OF MATERIALS

INSTRUCTION: FORWARD WHITE ORIGINAL TO MATERIALS LABORATORY SALEM, CANARY TO PROJECT MANAGER, ORIGINATOR RETAIN PINK

734-3660 (1-86)

ASPHALT LABORATORY RECORD

HIGHWAY DEPARTMENT for Pavement Grindings for Recycle (ASPHALT BRAND and TYPE)

LABORATORY NO.	'86 4647
PROJECT: Region 4 Recycle Projects (Unit A)	DATA SHEET NO.: A34402
HIGHWAY: Various (Warm Springs) — COUNTY: Wasco	EA NO.: C10218
CONTRACTOR: J.C. Compton	F.A. PROJECT NO.
PROJECT MANAGER: Dan Olsen — UNIT CODE NO.: 8027	
SUBMITTED BY: " " — UNIT CODE NO.: "	DATE RECEIVED: 4-10-86 — DATE REPORTED:
SOURCE OF MATERIAL	LABORATORY CHARGES: see page 1
SAMPLED OR INSPECTED AT: Mix Design Area #2	TO BE USED: Recycled Pavement
SAMPLED OR INSPECTED BY: Randy Davis, D. Foster — DATE SAMPLED: 4-8-86	QUANTITY REPRESENTED

SAMPLE NO. — TEST RESULTS

PAVING ASPHALT

T 73	Flash point, closed cup		°F
T 44	Solubility in CHCL: CCL2		%
T 49	Penetration at 77F/39.2		cm/100
	Penetration ratio 39.2/77 F		
T201	Viscosity, Kinematic 275 F		C.S.
T202	Viscosity, Absolute 140 F		P.

T240 Paving Asphalt RTF (c) Residue

T 47	Loss on heating		%
T201	Viscosity, Kinematic 275 F		C.S.
T202	Viscosity, Absolute 140 F, 30cm Hg., Vac.		P.
T 49	Penetration at 77 F		cm/100
	% of orig. penetration		%
T 51	Ductility at 77 F		cm.
	Ductility at 45 F		cm.

Emulsified Asphalt

T 59	Viscosity, S.F. at _____ F		sec.
T 59	Sieve test		%
T 59	Residue by distillation to 500 F		%
T 59	Oil distillate in		%
T 49	Penetration of Res. at 77 F		cm/100
T 44	Solubility in CHCL:CCL2		%
T 51	Ductility at 77 F		cm.

T170 Modified Abson Recovery of Asphalt

T201	Viscosity, Kinematic 275 F	736	C.S.
T202	Viscosity, Absolute 140 F, 30 cm Hg. Vac.	11,469	P.
T 49	Penetration of Res. at 77 F	25	cm/100
	"C" value		

Liquid Asphalt

T 48	Flash point, open cup		°F
T201	Viscosity, Kinematic at 140 F		C.S.
T 78	Distillation (% of total distillate to 680 F)		
	To 374 F		%
	To 437 F		%
	To 500 F		%
	To 600 F		%
	Residue from distillation to 680 F Volume by difference		%
	Water		%

Liquid Asphalt Residue

T 49	Penetration at 77 F		cm/100
T 44	Solubility in CHCL:CCL2		%
T 51	Ductility at 77 F		cm.
T202	Viscosity ABS. at 140 F		P.

M190 Pipe Coating (Bituminous)

T 44	Solubility in CHCL:CCL2		%
T 49	Penetration at 77 F		cm/100
T 47	Loss on heating at 325 F		%
T 49	Penetration of Res. at 77 F		% of orig.

REPORT TO:

- ☐ F.H.W.A.
- ☐ CONSTRUCTION ENGINEER
- ☐ MAINTENANCE ENGINEER
- ☐ PAVING QUALITY COORDINATOR
- ☐ REGION ENGINEER
- ☐ PROJECT MANAGER
- ☐ DISTRICT SUPERVISOR
- ☐ FILE

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

ENGINEER OF MATERIALS

SAMPLE DATA and LABORATORY TEST REPORT

Oregon Department of Transportation HIGHWAY DIVISION

[X] AGGREGATE [ ] BITUMINOUS MIXTURE

LABORATORY REPORT NO. 86 4648
DATA SHEET NO. A34403

PROJECT: Region 4 Recycle Projects (Unit A)
EXP. ACCT/SUB JOB: C10218
DATE RECEIVED: 4-10-86
HIGHWAY: Various(Warm Springs) COUNTY: Various(Wasco)
F.A. PROJECT NO.
DATE REPORTED: 5-21-86
CONTRACTOR: J.C. Compton Contractor
PROJECT MANAGER: Dan Olsen AGY-ORG.UNIT 8027
BID ITEM NO. 12
LAB CHARGES $372.00
SUBMITTED BY: Dan Olsen AGY-ORG.UNIT 8027
SAMPLE NO. NO. OF BOXES NO. OF BAGS 3
QUANTITY REPRESENTED (YARDS, TONS, ETC.)
[X] MIX DESIGN [ ] RECORD [ ] QUALIFYING [ ] CHECK
FIELD CONTROL TEST NO. [ ] TM 204 [ ] TM 205

AGGREGATE SIZE: Pavement Grindings
BRAND & GRADE ASPHALT:
TYPE MIX: Recycle
MIX DESIGN NO.
INTENDED USE: Recycle Pavement
SOURCE NO.
QUARRY [ ] GRAVEL [ ]
SOURCE NAME OR LOCATION: Mix Design Area #3
SAMPLED AT:
DATE SAMPLED: 4-8-86
REMARKS, INSTRUCTIONS:
NOTED R. D. SHARP
NOTED R. D. SHARP

		Sieve Size	Percent Passing
10/¼	%		
40/10	%		
200/10	%		
FRACTURE	%		
PI			
LL			
S.E.			
MOISTURE	%		
RETENTION	%		
EXTRACTED A/C	%		
TOTAL A/C	%		

CHECK "BOX" FOR TEST REQUIRED: USE SEPARATE DATA SHEET FOR EACH SAMPLE. LIST ADDITIONAL PROJECTS SEPARATELY.

[X] TM 204 DRY SIEVE
[ ] TM 205 WET SIEVE
3 [X] TM 309 EXTRAC.

SIEVE SIZE	PERCENT PASSING	PERCENT PASSING
	As Rec.	Ave of 3
1½	100	extraction
1	98	↓
3/4	96	100
½	89	96
3/8	82	88
¼	71	78
4	62	70
10	34	48
40	8	24
200	0.3	10.4

TM 205 P200
10/¼ % 200/10 %
40/10 %
FINENESS FACTOR
1½, ¾, ⅜, 4, 8, 16, 30, 50, 100
MOISTURE 1.28 %
EXTRACTED A/C 6.3 % Ave of 3
RETENTION — %
TOTAL ASPHALT 6.3 %

[ ] TM 101 S.E.
[ ] TM 102 L.L.
[ ] TM 103 P.I.
[ ] TM 201 UNIT WEIGHT
LOOSE COMPACT
COMBINE % THIS LAB NO. WITH %
OF LAB NO. COMBINED
[ ] TM 202 FINE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 203 COARSE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 206 SODIUM SULFATE LOSS
2½-1½ % 1½-¾ %
RIP RAP AVERAGE %
C.A. 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. 4-8 % 8-16 %
16-30 % 30-50 %
[ ] TM 208A COARSE DEGRADE
HT. IN P20 %
REF HT. IN P20 %
[ ] TM 208B FINE DEGRADE
HT. IN P20 %

[ ] TM 209 ASPHALT STRIPPING
BRAND & GRADE
COATED %
[ ] TM 211 ABRASION
GRADING WEAR %
[ ] TM 212 ORGANIC PLATE NO.
[ ] TM 213 FRACTURE %
[ ] TM 221 FRIABLE PARTICLES
WEIGHTED AVG. — %
1½-¾ % ¾-⅜ %
⅜-4 % 4-16 %
[ ] TM 222 LIGHTWEIGHT PIECES
C.A. % F.A. %
[ ] TM 225 WOODWASTE %
[ ] TM 227 CLEANNESS CV
[ ] TM 228 DMSO
C.A. % 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. % 4-8 % 4-16 %
16-30 % 30-50 %
[ ] TM 229 ELONGATED PIECES %
[X] TM 314A
[X] TM 314B

2x FILES
FHWA
x CSL
x CONSTRUCTION ENG.
REGION 4 RAS
PROJECT MANAGER Dan Olson
DISTRICT ENG.
x REGION GEOLOGIST RJ VanCleave
x CONTRACTOR JC Compton Co
3x J. Wilson, G. Boyle, G. Hicks

MATERIAL REPRESENTED BY THIS SAMPLE [ ] DOES, [ ] DOES NOT COMPLY WITH SPECIFICATIONS.
LAB COMMENTS

Jack Sullivan
ENGINEER OF MATERIALS

INSTRUCTION: FORWARD WHITE ORIGINAL TO MATERIALS LABORATORY SALEM, CANARY TO PROJECT MANAGER, ORIGINATOR RETAIN PINK

18/20
2 of 2

ASPHALT LABORATORY RECORD

HIGHWAY DEPARTMENT for Pavement Grindings for Recycle
(ASPHALT BRAND and TYPE)

LABORATORY NO.	86 4648
PROJECT: Region 4 Recycle Projects (Unit A)	DATA SHEET NO.: A34403
HIGHWAY: Various (Warm Springs) — COUNTY: Wasco	EA NO.: C10218
CONTRACTOR: J.C. Compton	F.A. PROJECT NO.:
PROJECT MANAGER: Dan Olsen — UNIT CODE NO.: 8027	
SUBMITTED BY: " " — UNIT CODE NO.: "	DATE RECEIVED: 4-10-86 — DATE REPORTED:
SOURCE OF MATERIAL:	LABORATORY CHARGES: see page one
SAMPLED OR INSPECTED AT: Mix Design Area #3 — TO BE USED: Recycled Pavement	
SAMPLED OR INSPECTED BY: Randy Davis, D. Foster — DATE SAMPLED: 4-8-86	QUANTITY REPRESENTED:

SAMPLE NO. — TEST RESULTS

PAVING ASPHALT

- T 73 Flash point, closed cup ______ °F
- T 44 Solubility in CHCL: CCL2 ______ %
- T 49 Penetration at 77F/39.2 ______ cm/100
  - Penetration ratio 39.2/77 F ______
- T201 Viscosity, Kinematic 275 F ______ C.S.
- T202 Viscosity, Absolute 140 F ______ P.

T240 **Paving Asphalt RTF (c) Residue**

- T 47 Loss on heating ______ %
- T201 Viscosity, Kinematic 275 F ______ C.S.
- T202 Viscosity, Absolute 140 F, 30cm Hg., Vac. ______ P.
- T 49 Penetration at 77 F ______ cm/100
  - % of orig. penetration ______ %
- T 51 Ductility at 77 F ______ cm.
  - Ductility at 45 F ______ cm.

Emulsified Asphalt

- T 59 Viscosity, S.F. at ____ F ______ sec.
- T 59 Sieve test ______ %
- T 59 Residue by distillation to 500 F ______ %
- T 59 Oil distillate in ______ %
- T 49 Penetration of Res. at 77 F ______ cm/100
- T 44 Solubility in CHCL:CCL2 ______ %
- T 51 Ductility at 77 F ______ cm.

T170 **Modified Abson Recovery of Asphalt**

- T201 Viscosity, Kinematic 275 F 681 C.S.
- T202 Viscosity, Absolute 140 F, 30 cm Hg. Vac. 11,694 P.
- T 49 Penetration of Res. at 77 F 26 cm/100
  - "C" value ______

Liquid Asphalt

- T 48 Flash point, open cup ______ °F
- T201 Viscosity, Kinematic at 140 F ______ C.S.
- T 78 Distillation (% of total distillate to 680 F)
  - To 374 F ______ %
  - To 437 F ______ %
  - To 500 F ______ %
  - To 600 F ______ %
  - Residue from distillation to 680 F Volume by difference ______ %
  - Water ______ %

Liquid Asphalt Residue

- T 49 Penetration at 77 F ______ cm/100
- T 44 Solubility in CHCL:CCL2 ______ %
- T 51 Ductility at 77 F ______ cm.
- T202 Viscosity ABS. at 140 F ______ P.

M190 **Pipe Coating (Bituminous)**

- T 44 Solubility in CHCL:CCL2 ______ %
- T 49 Penetration at 77 F ______ cm/100
- T 47 Loss on heating at 325 F ______ %
- T 49 Penetration of Res. at 77 F ______ % of orig.

ORT TO:

- ☐ F.H.W.A.
- ☐ CONSTRUCTION ENGINEER
- ☐ MAINTENANCE ENGINEER
- ☐ PAVING QUALITY COORDINATOR
- ☐ REGION ENGINEER
- ☐ PROJECT MANAGER
- ☐ DISTRICT SUPERVISOR
- ☐ FILE

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

ENGINEER OF MATERIALS [redacted]

Oregon Department of Transportation HIGHWAY DIVISION

SAMPLE DATA and LABORATORY TEST REPORT

LABORATORY REPORT NO. '86 4649
DATA SHEET NO. A34404

[X] AGGREGATE [ ] BITUMINOUS MIXTURE

PROJECT: Region 4 Recycle Projects (Unit A)
EXP. ACCT/SUB JCU: C10218
DATE RECEIVED: 4-10-86
HIGHWAY: Various(Warm Springs) COUNTY: Various(Wasco)
F.A. PROJECT NO.:
DATE REPORTED: 5-21-86
CONTRACTOR: J.C. Compton Contractor
PROJECT MANAGER: Dan Olsen ACY-ORG.UNIT 8027
BID ITEM NO. 12
LAB CHARGES $ 372.00
SUBMITTED BY: Dan Olsen ACY-ORG.UNIT 8027
SAMPLE NO.: NO. OF BOXES: NO. OF BAGS: 5
QUANTITY REPRESENTED (YARDS, TONS, ETC.):
[X] MIX DESIGN [ ] RECORD [ ] QUALIFYING [ ] CHECK
FIELD CONTROL TEST NO. [ ] TM 204 [ ] TM 205
AGGREGATE SIZE: Pavement Grindings
BRAND & GRADE ASPHALT:
TYPE MIX: Recycle
MIX DESIGN NO.:
INTENDED USE: Recycle Pavement
SOURCE NO.:
QUARRY [ ] GRAVEL [ ]
SOURCE NAME OR LOCATION: Mix Design Area #4
SAMPLED AT:
DATE SAMPLED: 4-8-86
REMARKS, INSTRUCTIONS:

		SIEVE SIZE	PERCENT PASSING
10/¼	%		
40/10	%		
200/10	%		
FRACTURE	%		
PI			
LL			
S.E.			
MOISTURE	%		
RETENTION	%		
EXTRACTED A/C	%		
TOTAL A/C	%		

CHECK "BOX" FOR TEST REQUIRED: USE SEPARATE DATA SHEET FOR EACH SAMPLE. LIST ADDITIONAL PROJECTS SEPARATELY.

[X] TM 204 DRY SIEVE
[ ] TM 205 WET SIEVE
3 [X] TM 309 EXTRAC.

SIEVE SIZE	PERCENT PASSING	PERCENT PASSING
	AS REC	Ave of 3 extraction
2½	100	
2	97	↓
1½	96	
1	95	
¾	91	100
½	79	98
⅜	69	90
¼	55	77
4	46	67
10	23	43
40	6	20
200	1.9	10.1

TM 205 P200
10/¼ % 200/10 %
40/10 %
FINENESS FACTOR
1½, ¾, ⅜, 4, 8, 16, 30, 50, 100
MOISTURE 0.64 %
EXTRACTED A/C 5.3 % Ave. of 3
RETENTION — %
TOTAL ASPHALT 5.3 %

[ ] TM 101 S.E.
[ ] TM 102 L.L.
[ ] TM 103 P.I.
[ ] TM 201 UNIT WEIGHT
LOOSE COMPACT
COMBINE % THIS LAB NO. WITH %
OF LAB NO. COMBINED
[ ] TM 202 FINE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 203 COARSE BULK GRAVITY
BULK SSD
APP. ABS.
[ ] TM 206 SODIUM SULFATE LOSS
2½-1½ % 1½-¾ %
RIP RAP AVERAGE %
C.A. 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. 4-8 % 8-16 %
16-30 % 30-50 %
[ ] TM 208A COARSE DEGRADE
HT. IN P20 %
REF HT. IN P20 %
[ ] TM 208B FINE DEGRADE
HT. IN P20 %

[ ] TM 209 ASPHALT STRIPPING
BRAND & GRADE
COATED %
[ ] TM 211 ABRASION
GRADING WEAR %
[ ] TM 212 ORGANIC PLATE NO.
[ ] TM 213 FRACTURE %
[ ] TM 221 FRIABLE PARTICLES
WEIGHTED AVG. — %
1½-¾ % ¾-⅜ %
⅜-4 % 4-16 %
[ ] TM 222 LIGHTWEIGHT PIECES
C.A. % F.A. %
[ ] TM 225 WOODWASTE %
[ ] TM 227 CLEANNESS CV
[ ] TM 228 DMSO
C.A. % 1½-¾ % ¾-⅜ %
⅜-4 %
F.A. % 4-8 % 4-16 %
16-30 % 30-50 %
[ ] TM 229 ELONGATED PIECES %
[X] TM 314A
[X] TM 314B

NOTED
R. D. SHARTNER

MATERIAL REPRESENTED BY THIS SAMPLE [ ] DOES, [ ] DOES NOT COMPLY WITH SPECIFICATIONS.
LAB COMMENTS

2x FILES
FHWA
x CSL
x CONSTRUCTION ENG.
x REGION ENG. 4 RAS
x PROJECT MANAGER Dan Olson
DISTRICT ENG.
x REGION GEOLOGIST RJ VanCleave
x CONTRACTOR JC Compton Co
x J. Wilson, G. Boyle, G. Hicks

Jack Sullivan
ENGINEER OF MATERIALS

INSTRUCTION: FORWARD WHITE ORIGINAL TO MATERIALS LABORATORY SALEM, CANARY TO PROJECT MANAGER, ORIGINATOR RETAIN PINK

734-3880 (1-86)

ASPHALT LABORATORY RECORD

HIGHWAY DEPARTMENT for Pavement Grindings for Recycle (ASPHALT BRAND and TYPE)

LABORATORY NO.	86 4649
PROJECT	Region 4 Recycle Projects (Unit A)
DATA SHEET NO.	A34404
HIGHWAY	Various (Warm Springs)
COUNTY	Wasco
EA NO.	C10218
CONTRACTOR	J.C. Compton
F.A. PROJECT NO.	
PROJECT MANAGER	Dan Olsen
UNIT CODE NO.	8027
SUBMITTED BY	" "
UNIT CODE NO.	"
DATE RECEIVED	4-10-86
DATE REPORTED	
SOURCE OF MATERIAL	
LABORATORY CHARGES	see page one
SAMPLED OR INSPECTED AT	Mix Design Area #4
TO BE USED	Recycled Pavement
SAMPLED OR INSPECTED BY	Randy Davis, D. Foster
DATE SAMPLED	4-8-86
QUANTITY REPRESENTED	

SAMPLE NO.

TEST RESULTS

PAVING ASPHALT

Test	Description	Result	Unit
T 73	Flash point, closed cup		°F
T 44	Solubility in CHCL: CCL2		%
T 49	Penetration at 77F/39.2		cm/100
	Penetration ratio 39.2/77 F		
T201	Viscosity, Kinematic 275 F		C.S.
T202	Viscosity, Absolute 140 F		P.

T240 Paving Asphalt RTF (c) Residue

Test	Description	Result	Unit
T 47	Loss on heating		%
T201	Viscosity, Kinematic 275 F		C.S.
T202	Viscosity, Absolute 140 F, 30cm Hg., Vac.		P.
T 49	Penetration at 77 F		cm/100
	% of orig. penetration		%
T 51	Ductility at 77 F		cm.
	Ductility at 45 F		cm.

Emulsified Asphalt

Test	Description	Result	Unit
T 59	Viscosity, S.F. at ____ F		sec.
T 59	Sieve test		%
T 59	Residue by distillation to 500 F		%
T 59	Oil distillate in		%
T 49	Penetration of Res. at 77 F		cm/100
T 44	Solubility in CHCL:CCL2		%
T 51	Ductility at 77 F		cm.

T170 Modified Abson Recovery of Asphalt

Test	Description	Result	Unit
T201	Viscosity, Kinematic 275 F	1600	C.S.
T202	Viscosity, Absolute 140 F, 30 cm Hg. Vac.	83,437	P.
T 49	Penetration of Res. at 77 F	7	cm/100
	"C" value		

Liquid Asphalt

Test	Description	Result	Unit
T 48	Flash point, open cup		°F
T201	Viscosity, Kinematic at 140 F		C.S.
T 78	Distillation (% of total distillate to 680 F)		
	To 374 F		%
	To 437 F		%
	To 500 F		%
	To 600 F		%
	Residue from distillation to 680 F Volume by difference		%
	Water		%

Liquid Asphalt Residue

Test	Description	Result	Unit
T 49	Penetration at 77 F		cm/100
T 44	Solubility in CHCL:CCL2		%
T 51	Ductility at 77 F		cm.
T202	Viscosity ABS. at 140 F		P.

M190 Pipe Coating (Bituminous)

Test	Description	Result	Unit
T 44	Solubility in CHCL:CCL2		%
T 49	Penetration at 77 F		cm/100
T 47	Loss on heating at 325 F		%
T 49	Penetration of Res. at 77 F		% of orig.

REPORT TO:

- ☐ F.H.W.A.
- ☐ CONSTRUCTION ENGINEER
- ☐ MAINTENANCE ENGINEER
- ☐ PAVING QUALITY COORDINATOR
- ☐ REGION ENGINEER
- ☐ PROJECT MANAGER
- ☐ DISTRICT SUPERVISOR
- ☐ FILE

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.