

EXPERIMENTAL USE OF 60/70 PENETRATION
ASPHALT AS COMPARED TO 85/100
PENETRATION ASPHALT ON
U.S. ROUTE 302

INITIAL REPORT 85-1
JANUARY 1985

REPORTING ON WORK PLAN 82-B&R-21

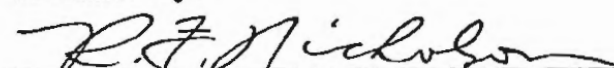
STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

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Date: 01-08-85

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TABLE OF CONTENTS

	Page
Abstract	1
Introduction	2
Project Description & Roadway Condition.	3
Location Map	4
Mix Production & Testing	5
Paving Operation	6
Plan View of Installation	7
Post Construction Observations	8
Summary.	11
Follow-Up	11
Appendices:	
A) Work Plan	12
B) Reports on Samples of Asphalt Cement	14
C) Asphalt Mixture Properties, Field Test Data	19
D) Laboratory Test Results on Core Samples	20
E) Mix Design.	22

ABSTRACT

Approximately 5700 tons of bituminous concrete mix using 60/70 penetration asphalt was produced and placed as a leveling and top course on U.S. Route 302 in Berlin, Vermont during September/October, 1982.

A small section of the roadway was paved with the standard 85/100 penetration asphalt to be monitored for a comparison of performance.

The mix designs were the same for both types of asphalt and no significant problems were encountered with the production or placement of either mix.

With the exception of reflective cracking, the areas with the two different grades of asphalt have performed and appear nearly identical through the first 24 months of service.

Monitoring will continue on the project in an attempt to determine if valid performance differences can be identified over an extended period of time.

INTRODUCTION

The purpose of this research investigation is to compare the field performance of bituminous concrete pavement using 60/70 penetration asphalt (60/70 mix) and 85/100 penetration asphalt (85/100 mix). The investigation was incorporated into a paving project consisting of a 1 inch leveling course and a 1 1/4 inch wearing course located on U.S. Route 302 in Berlin, Vermont.

The materials were placed in parallel test sections on the roadway. Detailed pavement surveys were conducted to document the condition of these test sections prior to construction. Evaluation includes periodic updating of the pavement surveys as a means of monitoring performance.

This report describes the production, placement and field performance of the 60/70 and 85/100 mixes through the first 24 months of service.

PROJECT DESCRIPTION & ROADWAY CONDITION

The project consisted of a 1.89 mile segment of U.S. Route 302 in the town of Berlin. Paving began at the Barre City line and proceeded westerly to the Montpelier City line. (See location map, page 4).

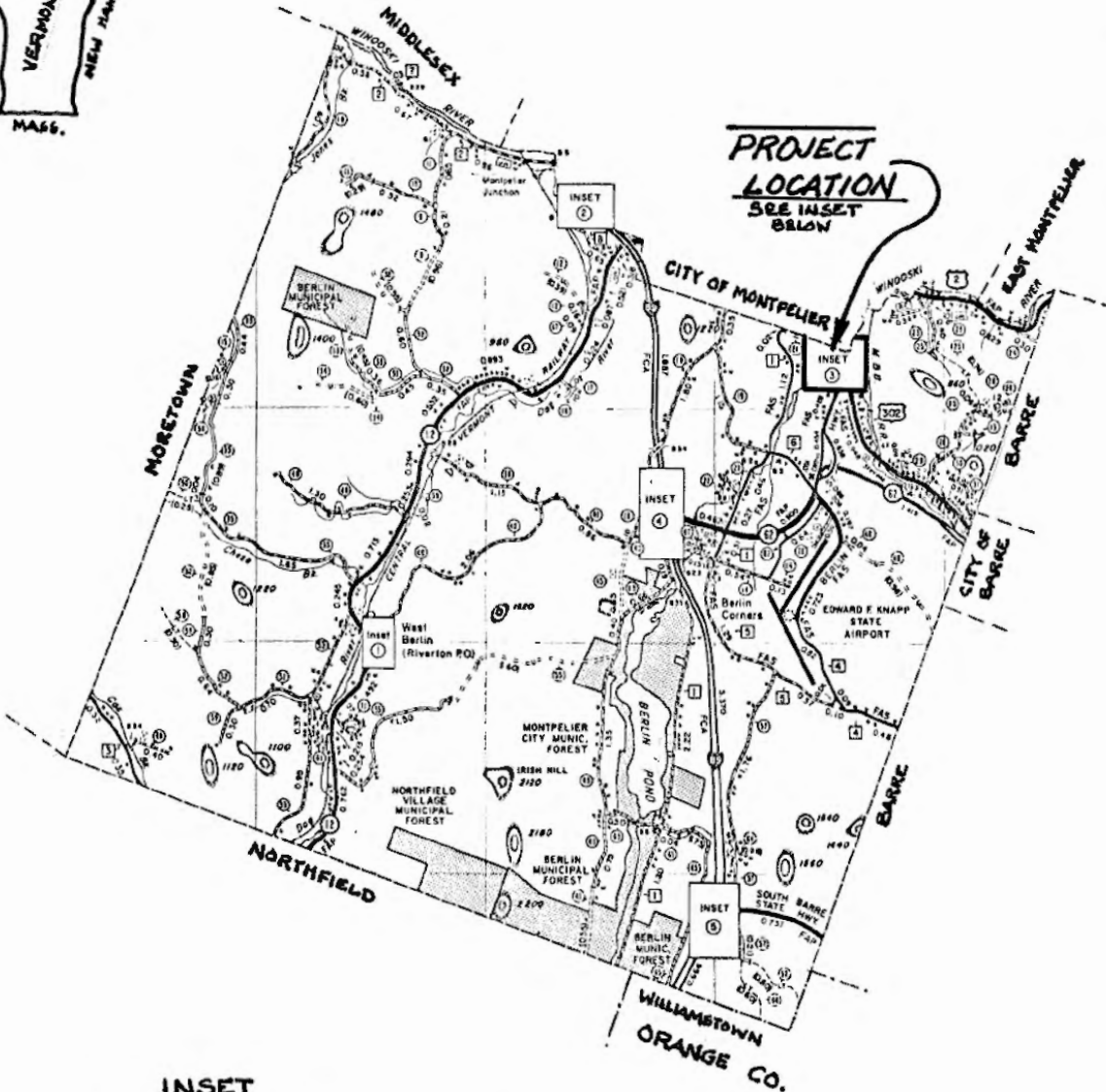
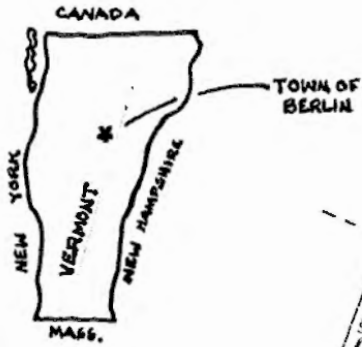
The existing roadway was constructed during the period 1924-1928 with a 24" sub-base and a 5" penetration macadam base topped with a roadway of 4" Portland Cement concrete. Additional retreatments include Portland Cement overlay in 1941 and a bituminous concrete overlay in 1954. During 1972-1973, the 1.89 mile segment of roadway was overlaid with bituminous concrete.

A detailed pavement condition survey was made on a 446' section on September 28, 1982 approximately 1 week before the new overlay was placed. The survey revealed an average of 424 linear feet of cracks per 100 linear feet of 30 foot wide roadway. Approximately 74% of all cracks were longitudinal and 16% were transverse from shoulder to shoulder. The pattern of the cracks appeared to be a reflective crack pattern of the underlying concrete slab roadway design. Longitudinal cracks ran parallel throughout the test section.

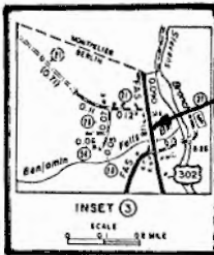
Average daily traffic on this section of U.S. Route 302 was 13690 vehicles in 1983, with 7% consisting of truck traffic.

LOCATION MAP

SEE INSET ③



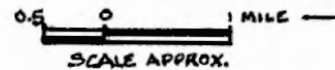
INSET



PROJECT
LOCATION

TOWN OF BERLIN

GENERAL HIGHWAY MAP



WASHINGTON COUNTY
VERMONT

MIX PRODUCTION & TESTING

A type III bituminous mix was produced for the project on October 2, 1982 at the Cooley Asphalt Paving Corporation batch plant in Berlin, Vermont. The 85/100 grade asphalt used on the project was supplied by BP of Canada, Montreal, P.Q., Canada. The 60/70 grade asphalt used on the project was supplied by Petro-Canada, Montreal, P.Q., Canada. The coarse aggregate consisted of crushed granite, and the fine aggregate included natural sand and stone screenings from crushed granite. The mixing procedures were the same for both of the mixes with 5700 ton of the 60/70 mix and 270 tons of the 85/100 mix produced. Copies of the mix designs can be seen in Appendix E.

Both mixes were tested during production on October 2, 1982 for asphalt content, gradation, air void content, stability, flow and unit weight. Extraction tests revealed an average of 6.6% asphalt content for both mixes while batch slip asphalt content was 6.3%. Test results for air voids on the 85/100 mix ran on the high side with an average of 4.6% and the 60/70 mix tested at 3.9%. The stability readings for the 85/100 mix averaged 1748, the 60/70 mix had an average stability of 2570.

Samples of 60/70 and 85/100 asphalt cement were taken from the transports and storage tank feed lines. The 22 samples of 60/70 asphalt cement were tested for penetration values, which ran on the high side averaging 70 and absolute viscosity averaged 2263. The same tests were

run on 6 samples of 85/100 with the penetration values averaging 87 and viscosity values averaging 1475.

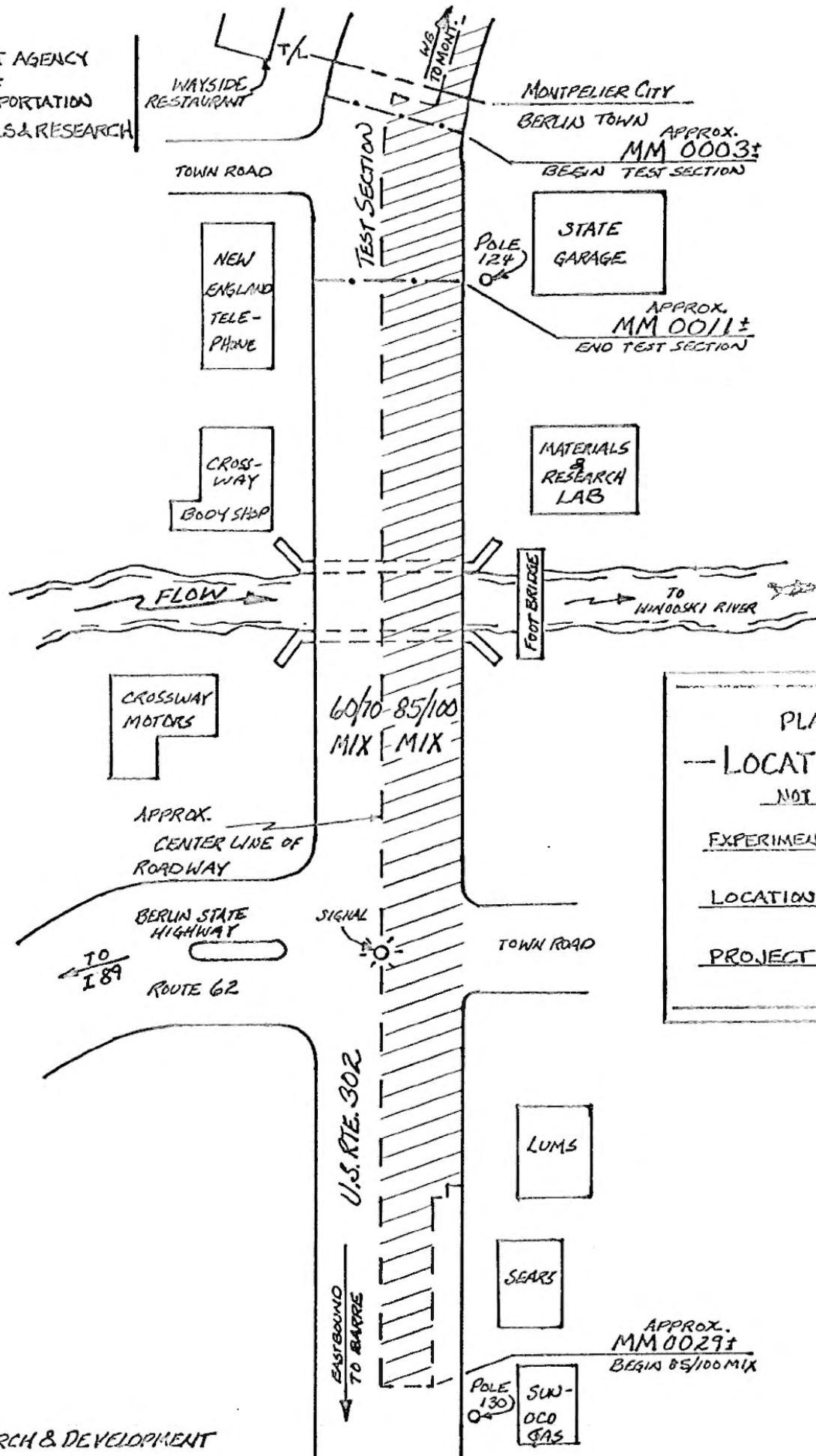
Samples of 60/70 asphalt cement taken the day the test section was paved resulted in a failing value of 72 and a second value of 70. Three samples of 85/100 asphalt cement taken the same day tested on the low side with two values at 88 and one failure at 82 (average equals 86). The differences in penetration, using the averages, between the two grades of asphalt used within the test section was 15 points. If the two asphalts had been at the midpoint of their ranges, a difference of 27.5 points would have been noted. Such results indicate the possibility that cross blending (contamination) of the two grades of asphalts has occurred.

Laboratory test results from samples taken the day the test section was paved can be seen in Appendix B & C.

Thin film oven tests performed on the residue disclosed penetration values ranging from 41 - 46 on the 60/70 grade asphalt. One test performed on the 85/100 grade asphalt resulted in a value of 49. A typical range for 85/100 grade is 48-52.

PAVING OPERATION

Paving began about 6:30 a.m. on October 2, 1982 under clear skies with the ambient temperature at 45°F and rising. Approximately 724 tons of 60/70 mix was produced prior to switching to the 85/100 mix which totaled 270 tons. A plan view of the installation can be seen on page 7.



The paving sequence proceeded from east to west with the 60/70 mix. The portion of roadway in the test section overlayed with 60/70 mix is 13' wide and the 85/100 mix covers a 17' wide area. Thickness of the overlay was approximately 1 1/2". Mix temperature sampled from trucks on the project ranged from 260° to 300°F.

POST CONSTRUCTION OBSERVATIONS

On November 22, 1982 five core samples of the 60/70 mix were taken throughout the project. Test results showed that compaction ranged from 91.7% (which is below the 95% compaction allowed by the specification) to 97.0%. The average for the project was 95.1%. See Appendix D for details.

On December 20, 1982, a Mays Ride Meter Surface Tolerance Run was made over the project area. The weather was cloudy with light rain and a temperature of 45°F. Vehicle speed was 40 mph±.

Readings were as follows:

<u>Lane</u>	<u>Reading Inches/Mile</u>	<u>Length</u>
Eastbound 60/70 mix	29" Avg.	1.890 mi.
Westbound 60/70 mix	33" Avg.	1.653 mi.
Westbound 85/100 mix	39" Avg.	0.237 mi.

On September 17, 1984, friction tests were taken on the project area by the Federal Highway Administration and State personnel using a locked wheel friction trailer under the control of Region 15 Demonstration Projects Division. The measurements, taken in the left wheel path at a speed of 40 mph, averaged 41 for the 85/100 mix and 43 for the 60/70 mix.

The test section was surveyed for cracks on January 26, 1983, April 6, 1983, and April 11, 1984. Results of these surveys can be seen on the following charts:

60/70
PENETRATION ASPHALT

DATE	TOTAL LINEAR FEET	AVG./100' OF ROADWAY	PERCENT REFLECTION
*9/28/82	912	15.7	
1/26/83	13	0.2	1.4
4/6/83	67	1.2	7.3
4/11/84	360	6.2	39.4

85/100
PENETRATION ASPHALT

DATE	TOTAL LINEAR FEET	AVG./100' OF ROADWAY	PERCENT REFLECTION
*9/28/82	980	12.9	
1/26/83	25	0.3	2.6
4/6/83	149	2	15.2
4/11/84	752	9.9	76.7

*Original, prior to construction.

Crack surveys show that longitudinal cracking is significantly higher in the 85/100 mix as compared to the 60/70 mix. We are unsure as to why this has occurred. In one case, the underlying concrete joint located in the right hand wheel path of the 60/70 mix has shown little reflective cracking, suggesting that the constant pounding of the traffic has kept the pavement "alive" or flexible. However, the adjacent underlying concrete joint located between the wheel paths in the adjacent lane also 60/70, has not reflected through either. On the other side of the roadway in the 85/100 mix, both the concrete joints are located outside the wheel path areas and both have reflected through.

The project was surveyed for rutting values in the test section and at the intersection of Route 302 and the Berlin State Highway. The highest values were found in the area of the intersection but there was no significant difference between the two mixes. Ten readings were taken in the 60/70 mix with a maximum of 8/16" recorded. The average for both the right and left wheel paths was 2/16". Eight readings were taken in the 85/100 mix with a maximum of 7/16" recorded. The average for the right wheel path was 2/16" and 3/16" for the left wheel path. The overall average of 2/16" was the same for both mixes.

SUMMARY

Tests on the liquid asphalts disclosed a difference in penetration values of only 15 points. Such results suggest the possibility that cross blending (contamination) of the two grades of asphalt may have occurred. With the exception of reflective cracking, the areas with two different grades of asphalt have performed and appear nearly identical. The results are as follows:

	<u>60/70</u>	<u>85/100</u>
*1) Reflective Cracking (%)	39	77
2) Rutting Values (inches)	2/16	2/16
3) Mays Meter (inches/mile)	31	39
4) Friction Values (@ 40 mph)	42	44

*Results from test section only, other data collected throughout project, including test section.

FOLLOW UP

Monitoring will continue on the project in an attempt to determine if valid performance difference can be identified over an extended period of time.

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

APPENDIX A-1

RESEARCH INVESTIGATIONWork Plan No. 82-B&R-21Subject Bituminous Concrete Pavement Using 60/70 Pen AsphaltInvestigation Requested By R.F. Nicholson, P.E. Date September 27, 1982Date Information Required At completion of field evaluationPurpose of Investigation To compare the performance of bituminous concrete pavements produced with 60/70 and 85/100 penetration grade asphalt cements.Materials to be placed on the Rte. 302 Berlin RS 0197(1) overlay project

Proposed Tests or Evaluation Procedure Compare the initial values and field performance of a 1 inch leveling course and a 1½ inch wearing course produced with 60/70 pen AC with that of adjacent courses produced with 85/100 pen AC.
The test section shall cover an area of approximately 1200 lineal feet lying between the intersection of the Berlin State Highway and the Montpelier City Line.

The evaluation shall include the following:

1. Document the condition of the existing pavement surface with a detailed crack survey
2. Conduct plant mix inspection on the 60/70 and 85/100 mixes for asphalt content, gradation, air voids, stability and flow

(con't. P.2)

Proposal Discussed With C. E. Jerd Projected Manpower Requirements 50 man daysInvestigation To Be Conducted By Bituminous & Research SubdivisionsProposed Starting Date 9/28/82 Estimated Completion Date 9/87Approval/Disapproval by Materials Engineer R.F. Nicholson 10/4/82Comments by Materials Engineer

Proposed Tests or Evaluation Procedure (con't.)

3. Monitor paving operation and record where the 60/70 and 85/100 mixes are placed.
4. Obtain field cores of the completed pavement for % compaction and recovered asphalt penetration values.
5. Obtain Mays Meter ride values and friction tests on the two mixes.
6. Monitor the test section until conclusions can be drawn on the performance of the two mixes with emphasis on the following areas:
 - a) Differences in the rate of reflective cracking
 - b) Development of new cracks not related to the underlying pavement
 - c) Retention of initial ride values
 - d) Retention of initial friction values (if equipment is available)
 - e) Retention of recovered penetration values
 - f) Rut development
 - g) Surface rippling in the area of the traffic lights

TA 187 Rev. 1M 10/80
1M 6/82
1M 9/82

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

6
Mason
CF
Jerd
Murphy
Phalen
Frascoia

REPORT ON SAMPLE OF ASPHALT CEMENT

Report 10-8, 19 82
Laboratory No. B82 1698 Tested By Stevens
Name 85/100 Asphalt Cement for 406.25
Identification Marks Job Sample Certification No. 5802
Submitted by DuBois, Title PFP Address _____
Sampled 10-2, 19 82 Received 10-4, 19 82 Testing Completed 10-6-82
Sample from Tank feed line #1 @ Cooley - Berlin
Quantity Represented _____ Lbs. Net @ 60° F = 250 Gals.
Source of Material BP Montreal
Location used or to be used Berlin RS 0197(1)
Examined for 702.01 85/100 Penetration

TEST RESULTS

Specific Gravity 25°C/25°C

Absolute Viscosity @ 140°F and 300 mm Hg Vacuum, poises

1461

Kinematic Viscosity @ 275°F, centistokes

353

Penetration @ 77°F, 100 gm. 5 sec.

85/10082

Flash Point (Cleveland Open Cup), °F.

Solubility in trichloroethylene, %

Tests on Residue

Loss on Heating, %

.11

Penetration of Residue, % of original

60 (49)

Absolute Viscosity @ 140°F, poises

4316

Kinematic Viscosity @ 275°F, centistokes

525

Absolute Viscosity Ratio, ATFO/BTFO

2.95 : 1

Penetration Ratio, ATFO/BTFO

1.7 : 1

Comments:

This material tests 3 points below minimum penetration for an 85/100 penetration grade asphalt for 702.01. Informed B. Murphy @ 11:30 am 10-4-82.

S. J. Gage, P.E., Chief Engineer

By:

R. F. Nicholson
R. F. Nicholson, P.E., Materials & Research Engineer

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1M 6/82
1M 9/82

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

6
Mason
CF
Jerd
Murphy
Phalen
Frascoia

REPORT ON SAMPLE OF ASPHALT CEMENT

Report 10-8, 19 82
Laboratory No. B82 1699 Tested By Stevens
Name 60/70 Asphalt Cement for 406.25
Identification Marks Job Certification No. 5779
Submitted by DuBois, Title PFP Address _____
Sampled 10-2, 19 82 Received 10-4, 19 82 Testing Completed 10-6-82
Sample from Tank feed line #2 @ Cooley - Berlin
Quantity Represented _____ Lbs. Net @ 60° F = 250 Gals.
Source of Material Petro - Montreal
Location used or to be used Berlin RS 0197(1)
Examined for 702.01 60/70 penetration

TEST RESULTS

Specific Gravity 25°C/25°C

Absolute Viscosity @ 140°F and 300 mm Hg Vacuum, poises

2112

Kinematic Viscosity @ 275°F, centistokes

415

Penetration @ 77°F. 100 gm. 5 sec.

60/7072

Flash Point (Cleveland Open Cup), °F.

Solubility in trichloroethylene, %

Tests on Residue

Loss on Heating, %

.11

Penetration of Residue, % of original

61 (44)

Absolute Viscosity @ 140°F, poises

8547

Kinematic Viscosity @ 275°F, Centistokes

675

Absolute Viscosity Ratio. ATFO/BTFO

4.0 : 1

Penetration Ratio, ATFO/BTFO

1.6 : 1

Comments:

This material tests 2 points above maximum penetration for a 60/70 penetration grade asphalt for 702.01. Informed B. Murphy of results @ 11:30 am on 10-4-82.

S. J. Gage, P.E., Chief Engineer

By:

R. F. Nicholson
R. F. Nicholson, P.E., Materials & Research Engineer

4
Mason
CF
Jerd
Murphy

TA 187 Rev. 1M 10/80
1M 6/82
1M 9/82

STATE OF VERMONT
AGENCY OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

REPORT ON SAMPLE OF ASPHALT CEMENT

Report 10-19, 19 82
Laboratory No. B82 1764 Tested By J. O'Donnell
Name 85/100 Asphalt Cement for 406,25
Identification Marks Job Certification No. _____
Submitted by DuBois Title PFP Address _____
Sampled 10-2, 1982 Received 10-4, 19 82 Testing Completed 10-13-82
Sample from Tank #1 @ Cooley - Berlin
Quantity Represented _____ Lbs. Net @ 60° F = 14,000 Gals.
Source of Material BP Montreal
Location used or to be used Berlin RS 0197(1)
Examined for 702.01 85/100 Penetration

TEST RESULTS

Specific Gravity 25°C/25°C

Absolute Viscosity @ 140°F and 300 mm Hg Vacuum, poises

1490

Kinematic Viscosity @ 275°F, centistokes

Penetration @ 77°F. 100 gm. 5 sec.

85/100

88

Flash Point (Cleveland Open Cup), °F.

Solubility in trichloroethylene, %

Tests on Residue

Loss on Heating, %

Penetration of Residue, % of original

Absolute Viscosity @ 140°F. poises

Absolute Viscosity Ratio. ATFO/BTFO

Penetration Ratio, ATFO/BTFO

Comments:

This material meets requirements for the tests indicated for item 702.01 (85/100)

ACCEPTED

S. J. Gago, P.E., Chief Engineer

By:

R. F. Nicholson 10/27
R. F. Nicholson, P.E., Materials & Research Engineer

(X)

TA 187 Rev. 1M 10/80
1M 6/82
1M 9/82

STATE OF VERMONT
AGENCY OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

4 APPENDIX B-4
Mason
CF
Jerd
Murphy

REPORT ON SAMPLE OF ASPHALT CEMENT

Report 10-19, 19 82
Laboratory No. B82 1766 Tested By J. O'Donnell
Name 85/100 Asphalt Cement for 406.25
Identification Marks Job Certification No.
Submitted by DuBoix, Title PFP Address
Sampled 10-2, 19 82 Received 10-4, 19 82 Testing Completed 10-13-82
Sample from Tank #1 @ COoley - Berlin
Quantity Represented Lbs. Net @ 60° F = 15,000 Gals.
Source of Material BP Montreal
Location used or to be used Berlin RS 0197(1)
Examined for 702.01 85/100 Penetration

TEST RESULTS

Specific Gravity 25°C/25°C

Absolute Viscosity @ 140°F and 300 mm Hg Vacuum, poises

1508

Kinematic Viscosity @ 275°F, centistokes

Penetration @ 77°F. 100 gm. 5 sec.

85/100 88

Flash Point (Cleveland Open Cup), °F.

Solubility in trichloroethylene, %

Tests on Residue

Loss on Heating, %

Penetration of Residue, % of original

Absolute Viscosity @ 140°F. poises

Absolute Viscosity Ratio. ATFO/BTFO

Penetration Ratio, ATFO/BTFO

Comments:

This material meets requirements for the tests indicated for item 702.01 (85/100)

ACCEPTED

S. J. Gage, P.E., Chief Engineer

By: R. F. Nicholson /RA7
R. F. Nicholson, P.E., Materials & Research Engineer

TA 187 Rev. 1M 10/80
1M 6/82
1M 9/82

STATE OF VERMONT
AGENCY OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

4 APPENDIX B-5
Mason
CF
Jerd
Murphy

REPORT ON SAMPLE OF ASPHALT CEMENT

Report 10-19, 19 82
Laboratory No. B82 1773 Tested By J. O'Donnell
Name 60/70 Asphalt Cement for 406.25
Identification Marks Job Certification No.
Submitted by DuBois, Title PFP Address
Sampled 10-2, 19 82 Received 10-4, 19 82 Testing Completed 10-13-82
Sample from Tank #2 @ Cooley - Berlin
Quantity Represented Lbs. Net @ 60° F = 14,000 Gals.
Source of Material Petro - Canada
Location used or to be used Berlin RS 0197(1)
Examined for 702.01 60/70 Penetration

TEST RESULTS

Specific Gravity 25°C/25°C

Absolute Viscosity @ 140°F and 300 mm Hg Vacuum, poises

2179

Kinematic Viscosity @ 275°F, centistokes

Penetration @ 77°F. 100 gm. 5 sec.

60/70

70

Flash Point (Cleveland Open Cup), °F.

Solubility in trichloroethylene, %

Tests on Residue

Loss on Heating, %

Penetration of Residue, % of original

Absolute Viscosity @ 140°F. poises

Absolute Viscosity Ratio. ATFO/BTFO

Penetration Ratio, ATFO/BTFO

Comments:

This material meets requirements for the tests indicated for item 702.01 (60/70)

ACCEPTED

S. J. Gage, P.E., Chief Engineer

R. F. Nicholson 1987

By: R. F. Nicholson, P.E., Materials & Research Engineer

Bituminous Concrete System FILE MAINTENANCE Control No. H616 Form No. 4 of 6 Form Date 10/1/79	Vermont Transportation Agency Materials & Research Division ASPHALT MIXTURE PROPERTIES - Field Test Data - (Items P401 or 406)	Sheet _____ of _____ Project _____ Code No. 820720 Mix _____ Design No. 22580
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 Project Name BERLIN Project No. RS 0197(1)

 Source of Mix 21 COOLEY BERLIN Ring No. 9389 Year 82

 Item No. 40625 Type of Mix 03 Sp. Gr. AC 1.020

(Note- Begin a new page if any of the prior fields change)

Line	Formula	Description	1	2	3	4	5
A		Lab No. <u>D82</u>	<u>1.758</u>	<u>1.759</u>	<u>1.760</u>	<u>1.761</u>	
B		Field Spec. No. <u>B</u>	<u>1.07</u>	<u>1.17</u>	<u>1.27</u>	<u>1.37</u>	
C		Test Date (mo.:day) <u>10/01</u>	<u>1.002</u>	<u>1.002</u>	<u>1.002</u>	<u>1.002</u>	
D3		% Passing 1"					
D4	<u>100</u>	" 3/4"	<u>1.000</u>	<u>1.000</u>	<u>1.000</u>	<u>1.000</u>	
D5	<u>95-100</u>	" 1/2"	<u>98.7</u>	<u>99.2</u>	<u>99.2</u>	<u>99.0</u>	
D6	<u>78-90</u>	" 3/8"	<u>82.5</u>	<u>86.6</u>	<u>83.5</u>	<u>82.7</u>	
D7	<u>56-68</u>	" #4	<u>59.4</u>	<u>62.0</u>	<u>66.3</u>	<u>61.6</u>	
D8	<u>43-51</u>	" #8	<u>46.6</u>	<u>44.8</u>	<u>51.5</u>	<u>48.7</u>	
D9	<u>31-39</u>	" #16	<u>36.2</u>	<u>33.0</u>	<u>38.3</u>	<u>37.2</u>	
D10	<u>20-28</u>	" #30	<u>25.7</u>	<u>23.0</u>	<u>26.2</u>	<u>25.7</u>	
D11	<u>11-19</u>	" #50	<u>14.5</u>	<u>13.3</u>	<u>14.5</u>	<u>14.2</u>	
D12	<u>2-5</u>	" #200	<u>2.8</u>	<u>3.4</u>	<u>3.1</u>	<u>2.7</u>	
E	<u>6.0-6.7</u>	Bitumen % (AC)	<u>6.24</u>	<u>6.29</u>	<u>6.29</u>	<u>6.27</u>	
F	<u>100(R-P)/R</u>	% Voids - Mix	<u>3.3</u>	<u>3.9</u>	<u>4.2</u>	<u>5.0</u>	
G	<u>100S/(S+F)</u>	" - Filled	<u>81.2</u>	<u>78.6</u>	<u>77.2</u>	<u>73.8</u>	
H	<u>P x 62.4</u>	Unit Wgt., lb/ft ³	<u>144.9</u>	<u>145.3</u>	<u>143.7</u>	<u>143.3</u>	
I		Stab.-Conv., lb.	<u>21.04</u>	<u>22.12</u>	<u>16.19</u>	<u>15.61</u>	
J		Marshall Flow Value	<u>14</u>	<u>13</u>	<u>12</u>	<u>10</u>	
K		Sample Thick., in.	<u>2.625</u>	<u>2.500</u>	<u>2.563</u>	<u>2.563</u>	
L		Wgt. in Air, gm.	<u>126.1</u>	<u>120.4</u>	<u>123.0</u>	<u>122.9</u>	
M		Wgt. in Water, gm.	<u>71.8</u>	<u>68.7</u>	<u>69.6</u>	<u>69.4</u>	
N		Wgt. surf. dry, gm.	<u>126.1</u>	<u>120.4</u>	<u>123.0</u>	<u>122.9</u>	
P	<u>L/(N-M)</u>	Sp. Gr. - Bulk	<u>2.322</u>	<u>2.329</u>	<u>2.303</u>	<u>2.297</u>	
R		Sp. Gr. - Max.	<u>2.400</u>	<u>2.424</u>	<u>2.404</u>	<u>2.417</u>	
S	<u>PxE/SpGrAc</u>	AC by Volume %	<u>14.21</u>	<u>14.36</u>	<u>14.20</u>	<u>14.12</u>	
T		Stab.-Measured, lb.	<u>2.24</u>	<u>2.19</u>	<u>1.67</u>	<u>1.61</u>	
U		Accept, Reject or N	<u>A</u>	<u>A</u>	<u>R</u>	<u>A</u>	

Field Notes:

TEST # 12 T 85-100 PEN
 TEST # 13 T 85-100 PEN
 TEST # 10 T 60-70 PEN
 TEST # 11 T 60-70 PEN

Inspector(s):

G. Dupuis

Office: Ymst Bldg

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

6
Mason
CF
Jerd
Murphy
Cookson
Phalen

REPORT ON MISCELLANEOUS SAMPLE

Report 12-2, 19 82

Laboratory No. F82 0518 Tested by Royce

Name Bituminous Concrete Pavement, Item 406.25

Identification Marks Final Core No. 1 thru 3, 5

Submitted by Cookson Title CLP Address _____

Sampled 11-22, 19 82 Received 11-22, 19 82

Sample from See Below

Quantity Represented _____

Source of Material Cooley - Berlin

Location used or to be used Berlin RS 0197(1)

Examined for Item 406 Depth & Compaction

TEST RESULTS

Core No.	M/M #	Offset	Lane	% Compaction	Lbs./Cu.Ft.	Depth	Outside Design Tolerance
1	0000	10' Rt.	EB	97.0	140.2	1 1/2"	
2	0069	10' Lt.	WB	95.3	138.3	1 1/8"	
3	0100	10' Rt.	EB	96.3	139.2	1 1/4"	
5	0000	6' Rt.	EB	95.3	138.2	1 1/4"	

which are all within the design tolerance allowed for this project.

Meets compaction requirements for 406.25.

ACCEPTED

S. J. Gage, P.E., Chief Engineer

By: R. F. Nicholson 1007
R. F. Nicholson, P.E., Materials & Research Engineer

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

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APPENDIX D-2

REPORT ON MISCELLANEOUS SAMPLE

Report 12-2, 19 82

Laboratory No. F82 0519 Tested by Royce

Name Bituminous Concrete Pavement Item 406.25

Identification Marks Final Core No. 4

Submitted by Cookson Title CLP Address _____

Sampled 11-22, 19 82 Received 11-22, 19 82

Sample from See Below

Quantity Represented _____

Source of Material Cooley - Berlin

Location used or to be used Berlin RS 0197(1)

Examined for Item 406. - Depth & Compaction

TEST RESULTS

Core No.	M/M #	Offset	Lane	% Compaction	Lbs./Cu.Ft.	Depth	Outside Design Tolerance
4	0159	6' Lt.	WB	91.7	133.0	1 1/8"	

which is within the design tolerance allowed for this project.

This core tests below the 95% compaction allowed by the specifications for 406.25.

S. J. Gage, P.E., Chief Engineer

By: R. F. Nicholson 10/27/82
R. F. Nicholson, P.E., Materials & Research Engineer

APPENDIX E-1

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - BITUMINOUS CONCRETE SUBDIVISION

No 2261

Design of Bituminous Concrete Mixtures

Town Montpelier

Project No. F 028-2(6)S

Gentlemen:

In accordance with the specification requirements for the above project I submit the following job mix formula:

Pavement Type 1.5 Produced By: Cooley Asphalt Paving Plant Location Berlin
Stockpile Gradations — % Passing

Size	% Used	1%	1½	1	%	½	%	4	8	16	30	50	200
Not Sand	27						100	92	80	67	46	23	4
Gr. Sand	27						100	96	76	53	34	18	3
3/8"	46						100	34	6				
Resultant	100						100	67	46	32	22	11	2

Hot Bin Gradation — % Passing

Bin	% Used	1%	1½	1	%	½	%	4	8	16	30	50	200
S	56							100	83	64	45	26	7
2	44						100	28	3				
3													
4													
5													
Resultant	100						100	68	47	35	25	14	2.9

Batch Weights	Bin S	Bin No. 2	Bin No. 3	Bin No. 4	Bin No. 5	AC	Total
	3430	3115				455	7,000

	1%	1½	1	%	½	%	4	8	16	30	50	200	AC
Job Mix Formula					100	98	68	46	34	24	13	3.5	6.5
Job Aim					100	95	63	42	30	20	9	2.5	6.1
Specification Limits					100	95	62	39	24	14	6	0	6
						100	80	60	45	35	24	5	8

Source of Materials

Aggregates	Asphalt
Coarse: <u>Cooley Asphalt Paving - Websterville</u>	AC-5:
Fine: <u>Granite Sand - Cooley - Websterville</u>	AC-10:
<u>Not. Sand - Thunder Road Pit</u>	
<u>Beane Town</u>	Other: <u>85-100 BP Casade - Montpelier</u>

Mixing Times — Dry: 5 Wet: 35 Total: 40 Temperature: 280°F ± 20°

Submitted by: Wilfred A. Layerade (signature) Date: 9-2-82

Company Cooley Asphalt Paving Corp. Title Treasurer

FOR STATE OF VERMONT USE ONLY

Approved ☒

Rejected ☐

Comments:

Mix satisfactorily produced on a previous project

Signature Charles E. Jerd Title Bituminous Concrete Supervisor

TA 556

22 Date Sept. 14, 1982



Design of Bituminous Concrete Mixtures

Town Berlin

Project No. RS 0197 (1)

Gentlemen:

In accordance with the specification requirements for the above project I submit the following job mix formula:

Pavement Type III Produced By: Cooley Asphalt Paving Plant Location Berlin
Stockpile Gradations — % Passing

Size	% Used	1%	1½	1	%	½	%	4	8	16	30	50	200
Nat. Sand	27.5						100	95	90	78	60	34	6
Gr. Sand	27.5						100	100	81	55	34	18	2
¾"	17						100	34	6				
½"	28				100	99	32	4					
Resultant	100				100	99	82	60	48	36	26	14	2

Hot Bin Gradation — % Passing

Bin	% Used	1%	1½	1	%	½	%	4	8	16	30	50	200
S	55							100	83	64	45	26	7
2	22						100	28	3				
3	23				100	99	50	3					
4													
5													
Resultant	100				100	99	84	62	47	36	25	15	3

Batch Weights	Bin S	Bin No. 2	Bin No. 3	Bin No. 4	Bin No. 5	AC	Total
	3557	1642	1360			441	7,000

	1%	1½	1	%	½	%	4	8	16	30	50	200	AC
Job Mix Formula				100	99	84	62	47	36	25	15	3.5	6.3
Job Aim				100	95	78	56	43	31	20	11	2	6.0
Specification Limits				100	95	78	54	39	24	14	6	0	6.7

Source of Materials

Aggregates	Asphalt
Coarse: <u>Cooley Asphalt Paving - Websterville</u>	AC-5:
Fine: <u>Granite Sand - Cooley - Websterville</u>	AC-10:
<u>Nat. Sand - Thunder Road Pit</u>	Other: <u>60-70 Petro-Can Montreal, P.Q.</u>
<u>Base Town</u>	

Mixing Times — Dry: 5 Wet: 35 Total: 40 Temperature: 280°F ± 20°

Submitted by: Wilfred A. Laprade (signature) Date: 9-2-82

Company Cooley Asphalt Paving Corp. Title Treasurer

FOR STATE OF VERMONT USE ONLY

Approved ☒

Rejected ☐

Comments: Trial drop required final acceptance contingent on mix producing proper asphalt contents and air voids between 30 and 50 %

Signature Charles E. Jerd Title Bituminous Concrete Supervisor

TA 556

23 Date Sept. 14, 1982

