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I-90 Snoqualmie Pass

Improved Joint Sealant Materials For Concrete Pavements

WA-RD 110-1

April1987

Washington State Department of Transportation
Planning, Research and Public Transportation Division
In Cooperation with
United States Department of Transportation
Federal Highway Administration

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

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Initial inspecitons indicate very good performance for all three materials although problems with one area of the silicon sealant test section required a modification of the standard installation procedures to produce a satisfactory final product.

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IMPROVED JOINT SEALANT MATERIALS FOR CONCRETE PAVEMENTS

I-90, Snoqualmie Pass

by
Keith W. Anderson
Research Specialist for Materials

Post Construction Report
FHWA Experimental Project No. 8

Prepared for
Washington State Department of Transportation
and in cooperation with
U.S. Department of Transportation
Federal Highway Administration

April, 1987

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ABSTRACT

Three joint sealant materials were installed in a special test section of a Portland cement concrete pavement rehabilitation project located on I-90 near Hyak, Washington. The three materials: (1) Dow Corning 888 Silicon; (2) Crafco RoadSaver 231; and (3) Crafco RoadSaver 221 will be monitored for a period of three years to determine their service life and cost-effectiveness.

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INTRODUCTION

The experimental evaluation of joint sealant materials is an important element in WSDOT's first Portland cement concrete pavement rehabilitation project. Three sealant materials of varying composition and cost were installed in a special test section. They will be monitored for a period of three years under FHWA Experimental Project No. 8 funding. The results from the study will be reported as a part of this national effort to obtain service life and cost-effectiveness data on the joint sealant products now on the market.

SCOPE

The work plan for the experimental installation specified that a 2 mile segment of the project be divided into three 3500 foot test sections. Each sealant product would be installed in the transverse and longitudinal joints of one of the test segments. The sealant products used were: (1) Dow Corning 888 Silicon; (2) Crafco RoadSaver 231; and (3) Crafco RoadSaver 221. The shoulder to lane joint was also sealed, but only the two Crafco products were used with half of the 2 mile section sealed with each type. The Dow Corning silicon was not used on the shoulder-lane joint due to its reported inability to bond to asphalt surfaces. A sketch of the project layout is shown in Figure 1.

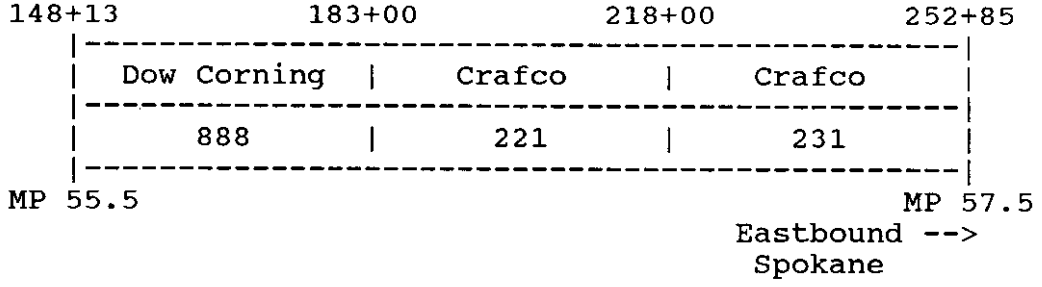


Figure 1. Project Layout

STUDY SITE

The rehabilitation project containing the three sealant test section was Contract 2956, Gold Creek to Cabin Creek, F.A.Proj.No.IR-90-2(145) and (147). This contract included the improvement of SR 90 between MP 55.51 and MP 63.95 which is located just east of the summit of Snoqualmie Pass. A portion of the state highway map is reproduced in Figure 2 showing the site in relationship to the location of Seattle and Tacoma. Detailed

information on the project site is included in Appendix A, General Construction Information.

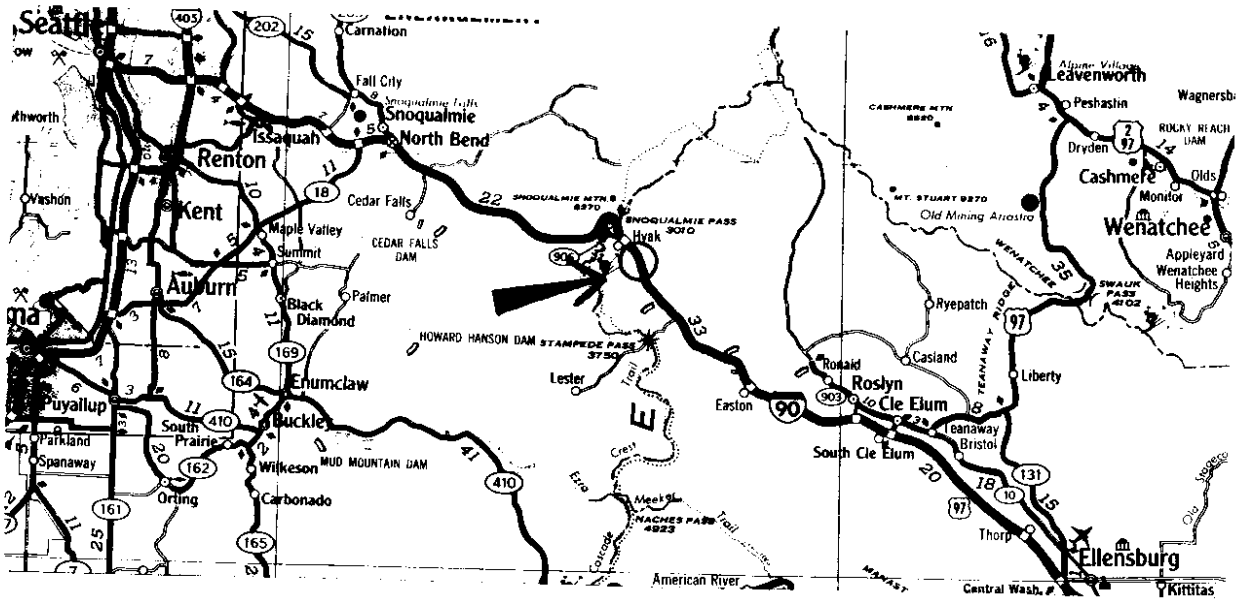


Figure 2: Study Site

SEALANT INSTALLATION

The work of preparing the joints and installing the sealants was done by Eagle Crest Construction Company of Marysville, Washington under subcontract to SeaCon Associates of Woodinville, Washington, the prime contractor. The joint sealant work was the last activity on the project which included: the repair or replacement of distressed panels; the selective replacement of portions of the asphalt shoulders; and the full width grinding of both lanes to provide a 7 inches per mile longitudinal profile index.

The Special Provisions of the contract contained the special instructions for the preparation of the joints and the installation of the three sealant products. Briefly, they called for diamond sawing of all existing joints to a width of 1 inch and a depth of 2 inches for the Dow Corning silicon and a width of 1 inch and a depth of 1-1/8 inches for the two Crafco sealants. For joints in the new panels a width of 1/2 was called for with depths of 1-1/4 inches and 5/8 inch for the Dow Corning and Crafco sealants, respectively. The cutting operation effectively removed all of the old sealant material; provided new faces on both sides of the joint ; and created a reservoir with the sealant suppliers' recommended width to depth ratio. Sandblasting and several passes with a nozzle blowing compressed air removed any dust from the joint faces and debris from the bottom of the joints.

The actual filling of the joints was preceded by another cleaning with compressed air followed by drying with propane heated compressed air. Placement of a backer was the next step for the silicon sealant whereas the next step for the Crafco sealants was the actual filling of the joint. This was accomplished very simply through the use of a melter-applicator unit which pumped the sealant through a wand into the joint. Pumping was continued until the level of the sealant in the joint reached the desired 1/8 inch below the pavement surface. In the case of the silicon sealant the placement of the backer rod was followed by the pumping of the sealant into the joint using a wand and special compressed air pump which attached directly to the 5-gallon pails which contained the sealant. After the sealant was pumped into the joint a round headed tool was drawn down the length of the joint to force the sealant against the faces of the joint and to form the required 1/4 inch recess below the pavement surface.

The sealants were placed in September and October of 1985. A detailed description of the construction related information is found in Appendix B.

TEST RESULTS

The work plan for the experimental project includes a visual condition survey of the joints. Thirty joints were chosen as a sample from each sealant material with an additional sample selected from the Dow Corning material where it was installed in new panels. It was thought that the performance of the sealant in the new pavement might be significantly different due to the variance in pavement age and narrower joint width in this section. The joints are rated in the categories of sealing, debris intrusion, and weathering on a scale of 1 to 5, with 5 being the best. The ratings for each category are averaged for the sample and multiplied by a weighting factor for each category which is 3 for sealing, 2 for debris intrusion , and 1 for weathering. These are added together and divided by 6 to get the overall rating for the sample.

All of the samples showed ratings close to a perfect 5 for the initial inspection in June of 1968, except the Dow Corning silicon in the new panels. The average rating for this sample was 2.95 which is borderline between the Good and Poor ranges. Inadequate sealing was the primary defect noted with some joints missing entire sections of the silicon material. This condition was brought to the attention of Dow Corning by the project engineer and a reinstallation of the failed portions of the material was completed in October of 1986. The replacement of the sealant required the application of a primer not used in the initial installations to ensure that a good bond would be achieved. A letter describing the revised installation procedures is found in Appendix C.

The second inspection of the sealants was conducted on March 30, 1987, 17 months after the original installation. All of the sealants were in very good to excellent condition as shown in Table 2. The Dow Corning 888 in new panels which was replaced in

October of 1986 was found to be in excellent condition as was the same material in the old panels. Heavy accumulations of dirt, sand, and gravel in the joints made accurate rating of the debris intrusion and weathering characteristics impossible, but close inspections of select parts of a representative number of the 30 joints indicated that these characteristics had not changed since the installation. The two Crafco test sections were rated slightly lower than the Dow Corning sections due to evidence of debris intrusion between the sealant and the joint walls. Sand, dirt, and small particles of gravel were found between the sealant and the joint walls to a depth of 1/4 inch. The Crafco sealants did not show any deterioration due to weathering and no lose of sealant was recorded for any of the joints surveyed. Joint width measurements taken during the second survey indicated no change in this dimension since construction in any of the test sections.

Table 2. Joint Sealant Survey Ratings.

Date	Dow Corning New Panels	Dow Corning Old Panels	Crafco 221	Crafco 231
6/02/86	2.95*	4.82	5.00	5.00
3/30/87	5.00+	5.00+	4.67	4.67

* Sealant replaced in this section on 10/9/86.

\+ Sand, dirt, and gravel made accurate rating of debris intrusion and weathering difficult.

ECONOMICS

A cost breakdown for materials and labor is shown in Table 1. These figures do not include the cost of Traffic control or the costs incurred by the State for the redoing of the joints where the sealant failed.

Table 1. Sealant cost breakdown.

	Cost Per Lineal Foot			
	Sealant	Backer Rod	Labor	Total
Crafco RoadSaver 221	$0.36	-	$1.70	$2.06
Crafco RoadSaver 231	$0.42	-	$1.70	$2.12
Dow Corning 888	$1.10	$0.01	$3.60	$4.71

CONCLUSIONS

The conclusions which can be drawn from the information generated during the installation and initial visual condition survey are listed below.

1. The silicon sealant (Dow Corning 888) was more sensitive to joint preparation and installation procedures then the petroleum based sealants (Crafco).

2. The silicon sealants's service life will have to be more than double that of either of the two petroleum based sealants due to its installed cost which was more than twice that of the other products.

APPENDIX A

General Project Information

APPENDIX A

General Project Information

Crafco RoadSaver 231

State or Highway Agency: Washington State Dept. of Transportation

Route No.: Interstate 90

Month/Year Pavement Built: 1956

Project Location/Length: Hyak Vic., MP 56.8 to MP 57.5, Eastbound

No. of Lanes, Type Highway: 4 lane interstate

Terrain: mountainous Percent Grade (%): zero

Sealant used for this study: Crafco RoadSaver 231

Manufacturer from which sealant was obtained: Crafco

Trade Name and/or Identification No.: RoadSaver 231

Quantity used in Gallons: 2185 lbs.

Specifications:

a) Give specification number if standard specifications are used:

None

b) Include as attachment, supplemental specification or special provisions, if used.

Joint Spacing in Feet and Skew: 15', 2' in 12' counterclockwise

Present Traffic Volume (ADT): 8192

Present Percent Trucks: 18

Annual Moisture: 22.65 inches

Annual Temperature Range: -12 to 97 degrees F

APPENDIX A (cont.)

General Project Information

Crafco RoadSaver 221

State or Highway Agency: Washington State Dept. of Transportation

Route No.: Interstate 90

Month/Year Pavement Built: 1956

Project Location/Length: Hyak Vic., MP 56.2 to MP 56.8, Eastbound

No. of Lanes, Type Highway: 4 lane interstate

Terrain: mountainous Percent Grade (%): zero

Sealant used for this study: Crafco RoadSaver 221

Manufacturer from which sealant was obtained: Crafco

Trade Name and/or Identification No.: RoadSaver 221

Quantity used in Gallons: 2230 lbs.

Specifications:

a) Give specification number if standard specifications are used:

None

b) Include as attachment, supplemental specification or special provisions, if used.

Joint Spacing in Feet and Skew: 15', 2' in 12' counterclockwise

Present Traffic Volume (ADT): 8192

Present Percent Trucks: 18

Annual Moisture: 22.65 inches

Annual Temperature Range: -12 to 97 degrees F

APPENDIX A (cont.)

General Project Information

Dow Corning 888 Silicon Highway Joint Sealant

State or Highway Agency: Washington State Dept. of Transportation

Route No.: Interstate 90

Month/Year Pavement Built: 1956

Project Location/Length: Hyak Vic., MP 55.5 to MP 56.2, Eastbound

No. of Lanes, Type Highway: 4 lane interstate

Terrain: mountainous Percent Grade (%): zero

Sealant used for this study: Dow Corning 888 Silicon

Manufacturer from which sealant was obtained: Dow Corning

Trade Name and/or Identification No.: Dow Corning 888

Quantity used in Gallons: 283 gallons

Specifications:

a) Give specification number if standard specifications are used:

None

b) Include as attachment, supplemental specification or special provisions, if used.

Joint Spacing in Feet and Skew: 15', 2' in 12' counterclockwise

Present Traffic Volume (ADT): 8192

Present Percent Trucks: 18

Annual Moisture: 22.65 inches

Annual Temperature Range: -12 to 97 degrees F

APPENDIX B

Construction Information

APPENDIX B

Construction Information

Dow Corning 888

Approximate Temperature when Project Sealed: 35 to 65 degrees F

List any previous sealants used on this section and year work done: product unknown, placed in 1956 at time of construction

Pavement Condition when Project Sealed:

Severity Levels	Low	Medium	High
Spalling	X		
Faulting	X		
D-Cracking	X		
Blow-ups	X		
Transverse cracking	X		
Pumping	X		
Other			

Attach a detail with dimensions of a typical joint, joint reservoir and any load transfer devices as constructed and as now in place for this study.

Equipment and methods used in the following operations:

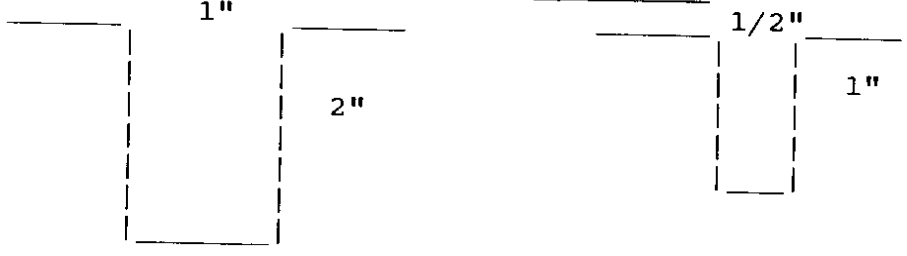
1. Removal of old sealant: None to remove after cutting and removing PCC from joint

2. Construction of joint reservoir: Diamond saw with two blades spaced 1 inch apart at outside edges

3. Removal of incompressibles, dust, dirt, etc., from joint faces: Air compressor and sandblasting

4. Drying of joint faces: Propane heated compressed air

5. Placement of sealant: Compressed air used to pump sealant out of 5-gal. pails. Wand used to place sealant in joint. Round wooden rod used to force sealant into contact with joint faces and form recess below pavement surface of 1/4 inch.



Old Panels

New Panels

APPENDIX B (cont.)

Construction Information

Crafco RoadSaver 221

Approximate Temperature when Project Sealed: 35 to 65 degrees F

List any previous sealants used on this section and year work done: product unknown, placed in 1956 at time of construction

Pavement Condition when Project Sealed:

Severity Levels	Low	Medium	High
Spalling		X	
Faulting	X		
D-Cracking	X		
Blow-ups	X		
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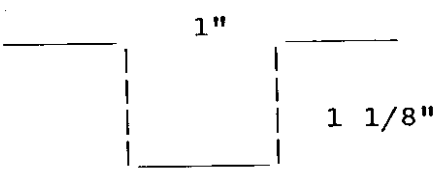
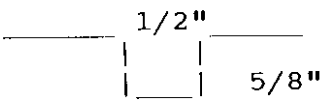
4. Drying of joint faces: Propane heated compressed air

5. Placement of sealant: Crafco BC-220-4 melter-applicator with wand.



Old Panels



New Panels

Construction Information

Crafco RoadSaver 231

Approximate Temperature when Project Sealed: 35 to 65 degrees F

List any previous sealants used on this section and year work done: product unknown, placed in 1956 at time of construction

Pavement Condition when Project Sealed:

Severity Levels	Low	Medium	High
Spalling	X		
Faulting	X		
D-Cracking	X		
Blow-ups	X		
Transverse cracking	X		
Pumping	X		
Other			

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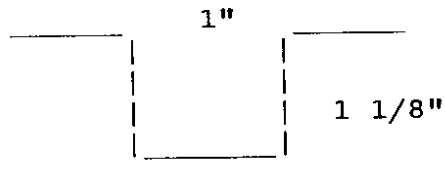
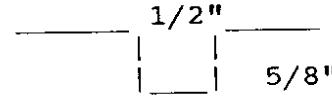


Old Panels



New Panels

APPENDIX C

Project Correspondence

DOT FORM 700-008
Revised 11/82

Washington State
Department of Transportation

INTRA-DEPARTMENTAL COMMUNICATION

DATE: June 25, 1986

FROM: Guy Couture
PHONE: scan: 453-3926

SUBJECT: Contract 2956, SR-90, Gold Creek to Cabin Creek

TO: Del Vandehey/Ed Schlect

THRU: C.W. Beeman/Jim Buss

As you are aware the eastbound lanes from Station LE148+13 to LE252+80 are a special test area for the evaluation of the performance of several joint sealant materials. Some failure of the joint material has occurred. The following is a brief recap of the various sections together with our recommendations for correcting the failed areas:

A. Test Section #1 LE148+13 to LE183+00(Dow Corning 888 Silicon Highway Joint Sealant)

The material has pulled out and failed in the new concrete areas. The width and depth of joint is per the special provisions.

In the existing concrete the majority of the material is still in place.

We are in the process of contacting the Dow Corning representative to show him the condition. I feel we should try and have them redo the failed areas at their expense. If we are unable to persuade them, I suggest the area be resealed with Sealtight 164 at the states expense.

B. Test Section #2 LE183+00 to LE218+00(Crafco Road Saver 221)

This section appears to be performing satisfactorily.

C. Test Section #3 LE218 to LE252+85(Crafco Road Saver 231)

This section appears to be performing satisfactorily.

D. Shoulder joints LE148+13 to LE 200+50(Crafco Road Saver 221)

From LE 148+13 to LE 159+50 on the right, the material has failed. The new shoulder at the edge of concrete in this area has settled due to truck traffic running on it. Also the shape factor of the joint has been destroyed. I suggest the joint be reshaped and resealed with sealtight 164 at the states expense.

The remaining joints in this section have not been sealed. The joint will be reshaped and sealed with Crafco Road Saver 221.

E. Shoulder joints LE 200+50 to LE 252+85 (Crafco Road Saver 231)

Joints that have been sealed appear to be performing satisfactorily. The joints that have not been sealed will be reshaped and sealed with Crafco Road Saver 231.

F. Remaining Joints.

These joints have been or will be sealed with Sealtight 164. This material appears to be performing satisfactorily.

Please advise us as soon as possible if you agree with our recommendations or if you feel some other alternative should be considered.

The Contractor should finish with the reamining sealing within the next week.

If you have any questions, please call me.

GC:tg
cc: Dist. Const.
file

5. Some of the tranverse joints and the longitudinal joints had large spalls (3 to 5 inches). Typically, these spalls are repaired prior to sealing. When the sealant and backer rod were installed in these areas, they were installed at the joint bottom; thus, not filling these spalled areas with sealant and exposing it to traffic.

6. Upon reviewing the original installation, factors indicate that the original installation was not per our recommendations. Indications are that cleaning (residual hot pour sealant) was left on the joint walls. Also, the sealant did not have the "hour glass" shape indicating little or no tooling was performed.

7. Finally, a primer was recommended on this project because we have been informed that slush (water from melting snow) can remain on the pavement for extended periods of time; thus, placing the silicone sealant in a continuously submerged or partially submerged condition for prolonged time periods.

Dow Corning feels it has the best product on the market for long term performance in sealing concrete joints. This particular test site illustrates the need for some modified procedures to demonstrate the capabilities of our product. We feel that by using these modified procedures in this particular situation, long term performance will be demonstrated. Thus, we believe that this test site will demonstrate to the State of Washington that DOW CORNING® 888 Silicone Highway Joint Sealant will out-perform other competitive products.

We are looking forward to working with the State of Washington in the future on their highway needs. Should you have any questions or concerns about DOW CORNING® 888 Silicone Highway Joint Sealant, please feel free to give me a call. I look forward to being of service to you.

Regards

David Y. Bennett
Sales Representative
Construction Products

cc: Newton C. Jackson, Pavement Design Engineer, Washington State D.O.T., P.O. Box 167, Olympia, WA 98504
Robert Graul, Dow Corning Corp., Irvine

DOW CORNING

[redacted]

November 11, 1986

Guy Couture
WASHINGTON STATE D.O.T.
P.O. Box 637
Ellensberg, WA 98926

Dear Mr. Couture

This letter is in reference to that portion of Washington State Highway specified in the Washington State Department of Transportation Gold Creek to Cabin Creek contract #2956, specifically station 148+13 to station 183+00.

On October 9, 1986, representatives from Dow Corning observed the installation of DOW CORNING® 888 Silicone Highway Joint Sealant on the referenced project above by Eagle Crest Construction.

During our visit to this installation, several of our standard recommendations had to be modified in order to install the sealant. These modifications, the reasons for these modifications, and general comments are as follows:

1. The installation was generally slow because of the large number of irregularities on this project--joint width and joint depth. These irregularities, present on the original project, resulted in a number of adjustments and slow production.

2. This test site has concrete from approximately 20 years ago (passing lane) and concrete placed the summer of 1985 (right lane). The sealant in the right lane was to be recessed deeper to avoid problems with surface raveling.

3. Sealant was generally recessed deeper than the typical 1/8" to 1/4" to minimize or prevent damage caused by truck chains in the winter months. In some instances, this was not possible because the original saw cut was not deep enough to accommodate the backer rod and sealant with proper recess.

4. In a few areas of the longitudinal joint, no backer rod was installed because the original joint was not deep enough.

DOW CORNING CORPORATION, P.O. BOX 5121, 910 AUBURN COURT, FREMONT, CALIFORNIA 94538
TELEPHONE: (415) 490-9302