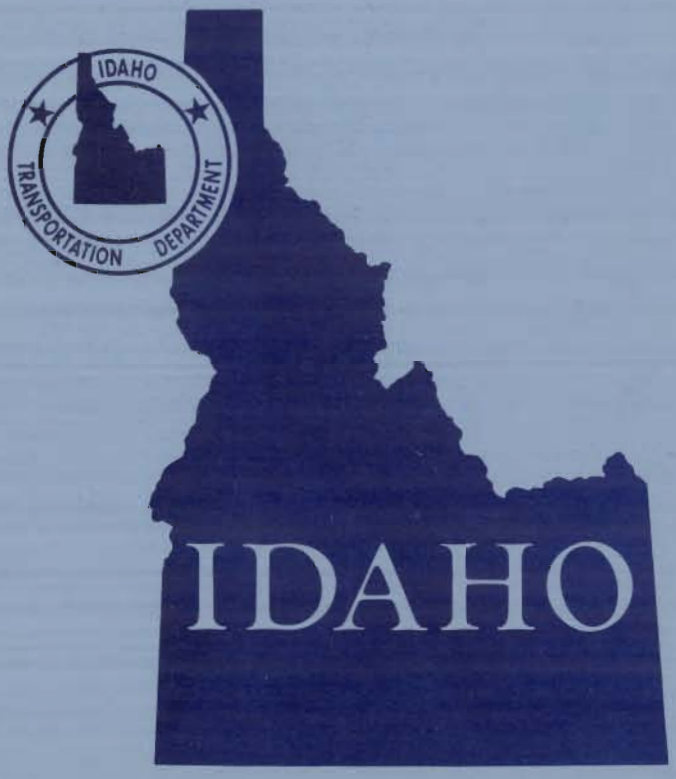
# TRANSPORTATION DEPARTMENT
# DIVISION OF HIGHWAYS

FIELD STUDY OF SEAL COATS

NOVEMBER 1974

RESEARCH PROJECT NO. 64




## MATERIALS and RESEARCH SECTION

# FIELD STUDY OF SEAL COATS

NOVEMBER 1974

RESEARCH PROJECT NO. 64

By

Boyd Rood
Associate Construction Engineer

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# INTRODUCTION

Although chip seal coats have been a necessary construction and maintenance treatment for highways in Idaho for many years, this phase of construction has not always been completely successful. Seal coat failures result in surface conditions with poor skid resistance which can become hazardous when wet or ice covered. Correcting these failures is costly, time-consuming and not always successful on the first attempt.

In the spring of 1972, the Division of Highways began a study of the conditons related to successful and failing seal coats. The objective of this research has been to determine and establish the control parameters which will insure successful seal coats. The study involves all projects over one mile in length constructed by contract and State maintenance forces throughout the State during the 1972 construction season.

Although conditions which can affect the success of a seal coat are numerous, it was felt that the most important could be recorded on a two-page form during construction. Form DH-2264, Daily Seal Coat Construction Record, as shown in the Appendix, was developed for this purpose. Since conditions can vary considerably throughout a single project, the second sheet of the form was designed to tie these changes to the time of day and location on the project.

In order to evaluate each project and to coordinate the good or bad performance with records kept during construction, Form DH-2265, Post Seal Coat Evaluation Report, was devised and is also shown in the Appendix. Three or four evaluations were made on each project since its completion and continuing through the next summer after construction in order to provide at least one full year of exposure to traffic and weather extremes. The first evaluation was generally made about one week after construction. The second investigation was made in the fall prior to any snow removal operations. A third evaluation was made the next spring after snow removal operations had stopped. A final evaluation was made after the hot weather and heavy traffic had subsided in the fall, 14 to 18 months after construction.

One or two men in each of the six operating districts made all of the evaluations of projects within their district and submitted the reports. Two to six photos were usually taken during each evaluation and at the same location in order to assist in determing the performance of the project. These photos included both close-up and general views.

Some additional information was asked of the districts in a letter from the Construction Division dated June 22, 1972, and this is also included in the Appendix.

Because some critical information was omitted on some of the Daily Seal Coat Construction Records or post seal coat evaluations were omitted, not all of the projects over one mile in length were studied. A total of 58 projects covering 502.3 miles is included in the statewide study and is the majority of the projects intended for study. These include 21 projects by contract and 37 constructed by State maintenance forces.

## RECOMMENDATIONS

1. Seal coats should be applied by contract or else impose comparable controls on projects constructed by State forces. The areas needing improvement by maintenance are:

   (a) Avoid sealing after September 1 and preferably after August 15.

   (b) Avoid sealing when the pavement temperature is below 60°F or above 120°F.

   (c) Better maintenance of the fresh seal coats by traffic control for a longer period and by always having rejects on the job for use if bleeding develops.

   (d) Use Idaho T-60 or the test patch method to determine application rates.

   (e) Use Idaho T-80 to test distributor spread rate.

2. Seal coating in the colder areas of the State should not be done after August 15. This could be handled by special provisions. Shortening of the seal coating season may require separate seal coat contracts 1 or 2 years after new pavement construction.

3. Rubberized asphalt should be used in preference to conventional cut-back asphalts. Not enough information is available statewide to compare emulsion seal coats with rubberized seals, but the success with emulsions in Districts 4 and 5 shows that it should be tried on some south Idaho projects.

4. Establish a minimum pavement temperature of 60°F and a maximum pavement temperature of 120°F in the specifications.

5. Slag aggregate should be used in preference to gravel in southeastern Idaho whenever possible.

6. The test patch method should be adopted and used as a standard test method.

7. Additional rolling should be required on low traffic volume roads (1000 ADT or less).

8. Provide for either MC or RC asphalts to be bid and then use the one most suited for the pavement temperatures expected at time of application in accordance with the Construction Manual.

## EVALUATION

The DH-2264, Daily Seal Coat Construction Record, contains information concerning the conditions at the time the seal coat was placed. The DH-2265, Post Seal Coat Evaluation Report is quite simple in comparison to the DH-2264, but was intended to point out any changes or deficiencies which developed after construction. These changed conditions were then checked back to the Daily Seal Coat Construction Record in an effort to tie down the reason for success or failure.

A simple visual rating of the seal was employed and recorded as excellent, good, fair, and poor. An excellent seal is considered to have a uniform surface with full chip retention and no visible flushing. A good seal has almost full chip retention with possibly slight flushing in the wheel paths, but very serviceable. A fair seal has considerable chip loss, flushing in the wheel paths, or both. A poor seal coat has severe chip loss, severe flushing, or both, resulting in loss of skid resistance and can also be considered a failure. Illustrated in the Appendix are typical examples of excellent, good, fair, and poor seal coats. These ratings are expressed in terms of three variables: bleeding, drilling, and chip loss.

Various parameters which might contribute to the success of a seal coat were evaluated as follows:

### 1. Time of Year When Constructed

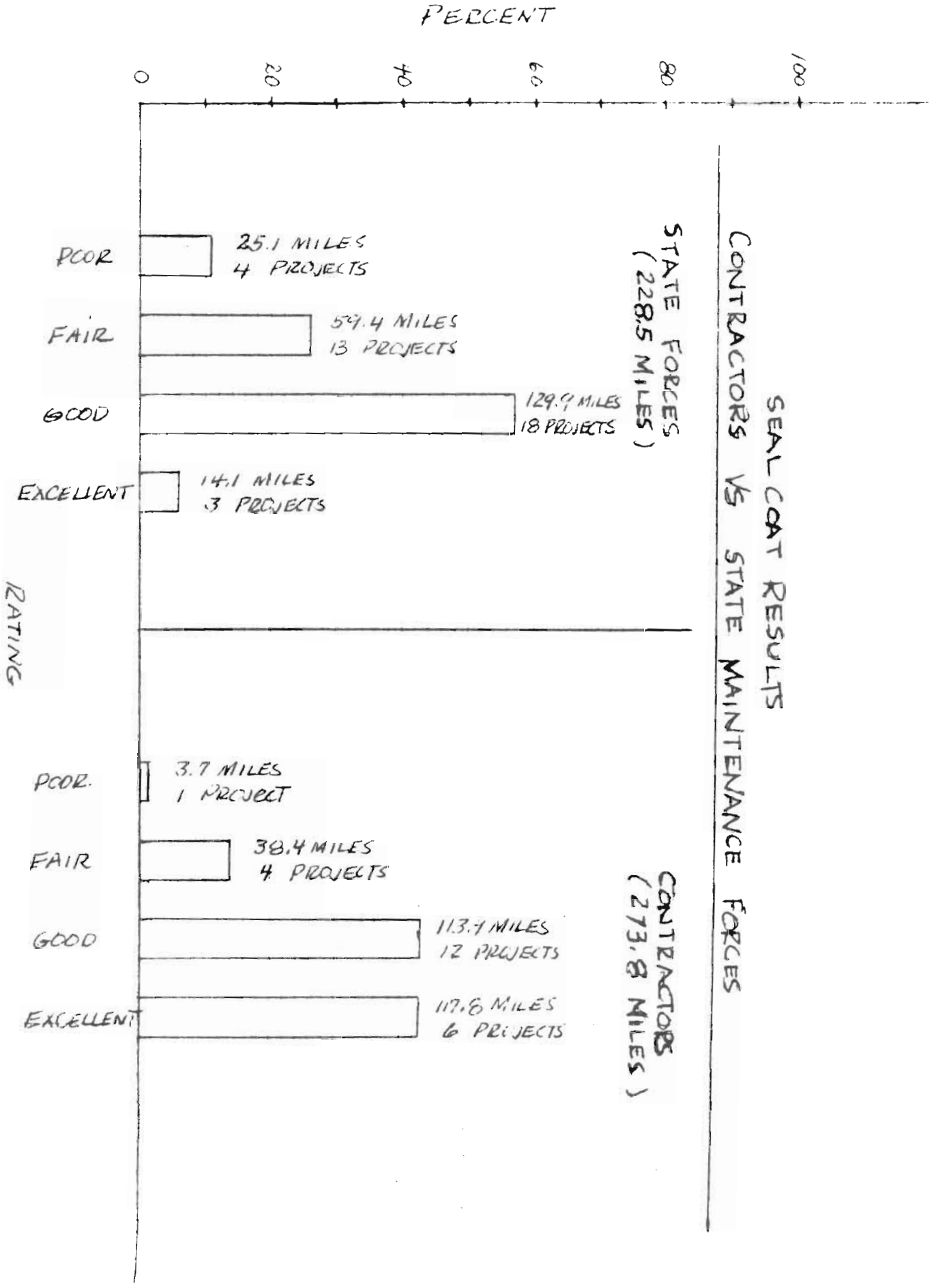
The Standard Specifications require seal coats to be constructed between June 15 and September 1, unless otherwise permitted. Of the 502.3 miles studied, 90.2 miles were placed between June 15 and July 15. 259.5 miles were constructed during July 15 and August 15. 152.6 miles were constructed during the last 2 weeks of the season or during an approved extension of the season--all after August 15. The study shows that construction after August 15 will result in more fair and poor seal coats since approximately 1/3 of the seals completed after that date fell in those two categories. This compared to about 1/4 for June 15-July 15 and 1/5 for July 15-August 15. This would also indicate that the best chance of success would be from projects sealed between July 15 and August 15, where about 80% were good or excellent.

### 2. Placed by Contractor or State Maintenance Forces

Contractors sealed 21 projects for a total of 273.7 miles and State Maintenance Forces sealed 37 projects for a total of 228.6 miles. Bar Graph on the following page shows a much better success ratio when the work was done by contract. Of the contract projects, 231.6 miles or 85% were good or excellent, compared to 144.1 or 63% of the State Maintenance projects.

### 3. Cover Coat Material

Type 2 CCM was used for nearly all of the projects so the effects of gradation can't be determined by this study. The success of seal


SEAL COAT RESULTS
CONTRACTORS VS STATE MAINTENANCE FORCES
PERCENT
0
20
40
60
80
100
RATING
STATE FORCES (228.5 MILES)
POOR
25.1 MILES
4 PROJECTS
FAIR
54.4 MILES
13 PROJECTS
GOOD
129.9 MILES
18 PROJECTS
EXCELLENT
14.1 MILES
3 PROJECTS
CONTRACTORS (273.8 MILES)
POOR
3.7 MILES
1 PROJECT
FAIR
38.4 MILES
4 PROJECTS
GOOD
113.4 MILES
12 PROJECTS
EXCELLENT
117.6 MILES
6 PROJECTS

coats in Districts 4 and 5, where a majority of the material was quarry rock, and in District One, where a majority was produced from slag, possibly can be attributed somewhat to nearly 100% fractured material.

4. Application Rate of CCM and Asphalt

Of the 21 contract projects, the application rate was determined by Idaho T-60 on 8, test patch on 7; and experience was used for 6. The 37 projects constructed by State Maintenance Forces were determined by experience on 30 projects, short trial strips on 4, T-60 for 2 and Test Patch on one. Application by test patch seemed most successful.

Cover Coat Material was dampened on 18 of 21 contract projects and 36 of 37 maintenance force projects. This is necessary for safety in reducing dust while applying and does not seem to be harmful.

5. Asphalt Grade

RC-3000 was used on the most projects and accounted for 326 miles, RC-3000 DN was used on 92.8 miles, MC-3000 on 13.5, RC-800 DN for 23.2 and CRS-2 on 45.8 miles. RC-3000 DN asphalt had the largest proportional mileage in the excellent category, with the rest of the asphalts being about equal in results.

It was not obvious that the asphalt company made any difference in the success or failure of the projects.

6. Distributor Spread

The distributor spread rate was checked by T-80 on 19 of 21 construction projects. Only 4 of the 37 maintenance projects tested the distributor by T-80. This could have had considerable bearing on the lower percentage of successful maintenance seal coats and could account for some of the chip loss or bleeding due to uneven distribution.

7. Rollers

Two or more pneumatic-tire rollers were used on most of the projects with no steel wheel rollers used at all. A scattering of steel wheel roller usage along with pneumatic tire rollers was reported and one district uses the steel wheel roller on nearly every project. The results do not show any difference in the types of rollers used.

8. Maintenance Rejects

Maintenance rejects were used while 9 of the 21 construction projects were active. The rejects were used on 7 of 37 maintenance projects. From observing some of these projects during construction, the prompt use of rejects no doubt prevented some of the seal coats from becoming only Fair or Poor. Some maintenance projects had no rejects within several miles of the project. When a trouble spot developes in a situation like this, the damage is done by the time rejects reach the project.

9. Traffic Volume

The projects were studied for the affects of traffic volume by grouping according to less than 1000 ADT, 1000-2500 ADT and over 2500 ADT. 135.0 miles were constructed on highways with less than 1000 ADT, with 63.0 miles classified as fair or poor. 158.9 miles were constructed under conditions of 1000-2500 ADT with only 12.7 miles falling into the fair or poor classification. The heavy volume routes had 208.4 miles constructed with over 2500 ADT conditions. 50.9 miles were classified as fair or poor. Loss of chips on 57.1 miles was the big factor in the 63 miles of fair or poor seal coats on highways under 1000 ADT. There were almost twice as many miles with flushing problems compared with chip loss on the high volume highway mileage classified as fair or poor.

10. Anti-Strip Additive

It is difficult to determine if the use of anti-strip had any pronounced affect on the seal coat. The use of 1% anti-strip seemed to be associated with more successful seals than 0.5% anti-strip.

11. Surface Condition Prior to Sealing

Old pavements had a considerable amount of variation in the surface condition such as patches, flushed, rutted or open textures. In general, very little effort is made to adjust asphalt application rates for these conditions except where test patches were used in one district. This method was especially effective for these varied conditions.

12. Temperatures

Asphalt appeared to be applied at the recommended temperature in most cases.

The Specifications do not place controls on air or pavement temperatures. Research from other agencies caused the Construction Division to recommend no sealing when pavement temperatures are below 60°F or above 120°F. It was also recommended that RC asphalts be used when the pavement temperature is above 90°F and MC used when the pavement temperature is below 80°F. Between 80°F and 90°F they are considered about equal.

These guidelines were not published in the Construction Manual until January 1, 1973 and were not available when the seal coats of this study were applied. In checking the temperatures recorded during this study, the 120° maximum suggested pavement was seldom exceeded. However, a significant amount of sealing was done when the pavement temperature was below 60°F. Some sealing was done as low as 40°F, and these low temperatures most likely contributed to the poor seal coat.

Forty-three percent of the poor or fair projects were constructed when the minimum air temperature recorded during application was below 70°F. On a cool day, clouds, shady areas and wind can contribute greatly to dropping the temperature.

## CONCLUSIONS

1. Seal coats applied between July 15 and August 15 have the best chance of success and approximately 80% of the seal coats constructed during this period were good or excellent.

2. Much better success was achieved on contract projects compared with State Maintenance projects. Eighty-five percent of the contract projects were good or excellent while only 63% of the State Maintenance projects were classified in this manner. This can be attributed to more rigid control exercised on contract projects in determining application rates, checking equipment, constructing during ideal weather and better maintenance after the application.

3. Aggregate gradation was not studied since nearly all projects used Type 2 Cover Coat Material. Some of the most successful seal coats were in District 1 where a large amount of slag is used and in Districts 4 and 5 where a majority of the material is quarry rock. These materials are 100% fractured and do not seem to strip like some of the southern Idaho gravels.

4. Application rate was more carefully controlled on the 21 contract projects as all but 6 used Idaho T-60 or the test patch method to determine the rate of asphalt and chips. Of the 37 projects constructed by State Maintenance Forces, the application rates depended upon the experience of the foreman or maintenance superintendent. This control of application rates seemed to definitely contribute to the higher success ratio on contract projects. Application by test patch seemed to be the most successful.

5. RC-3000 DN asphalt produced the highest proportion of seal coats in the excellent category. The rest of the asphalts, RC-3000, MC-3000, RC-800 DN, and CRS-2 seemed to be about equal.

6. Another control used on contract seal coats was checking the distributor spread rate by T-80. This was done on 19 of the 21 contract projects, but only 4 of the 37 maintenance projects used the test. This check also helped produce a higher success ratio on contract projects. There was no drilling noticed on the contract seals while some of the maintenance seals had some severe drilling.

7. Most of the projects used only pneumatic tire rollers. The study does not show any conclusive results in regard to rollers. It is important to get the chips rolled in as soon as possible and controlled traffic seems to be beneficial as the low volume roads with poor chip retention may not have had enough rolling in some cases.

8. Maintenance rejects were used more often on contract projects than they were on State Maintenance projects. This practice very likely prevented some seal coats from becoming only fair or poor.

9. Traffic volume had some affect on success and the best seal coats were on highways with 1000-2500 ADT. The poorest success was on highways with less than 1000 ADT, where chip loss was the big factor, indicating insufficient rolling to properly stick the chips. More flushing occurred on the high volume roads.

10. The affect of anti-strip additive is inconclusive.

11. On varied surface conditions, the test patch method is the most successful way to determine application rates.

12. Forty-three percent of the poor or fair projects were constructed when the minimum air temperature recorded during application was below 70%F. A significant amount of sealing was done when pavement temperatures were below 60°F. Some sealing was even done on pavement with temperature as low as 40°F.

# A P P E N D I X

DH-2264 5-72

Research Project 64, Authority 99054

DAILY SEALCOAT CONSTRUCTION RECORD

Date_____ Sheet_____ of_____

Hwy. Route No._____, Location_____, Proj. No._____

Contractor_____, State Maintenance Forces_____

Weather: Cloudy_____, Scattered Clouds_____, Clear_____

Cover Coat Material, Type_____, Matls. Source No._____, Cleanness Value_____

Ave. Gradation:_____

Application Rate Determined By: T-60_____,

Test Patch_____, Other_____.

Was CCM dampened prior to placing on roadway? Yes No

Asphalt Grade_____, Asphalt Co._____

Application Rate Determined By: T-60_____

Test Patch_____, Other_____.

Distributor checked by T-80: Yes No

Calculated application rate (Asphalt used - area covered)_____

Type of Rollers_____

Number of Coverages_____

Maintenance Rejects used while this portion of project was active? Yes No

Traffic Volume_____ADT, Traffic Control Used_____

Traffic Problems_____

Estimated % Chips retained_____%. Estimated % Embedment_____%.

Close-up Photo Taken_____Feet Left of M.P._____, Date_____

(Continued on Back of Sheet)

## Instructions

1. Fill in front and back of a new sheet for each day.
2. Fill in information on the chart below for any change in surface conditions, application rates, temperatures or wind velocity. Note mat temperature for shaded areas.
3. Record Mile Posts to nearest .01 if possible.
4. Describe the existing surface condition by placing the numbers of one or more of the following descriptions in the surface condition column:

### Existing Surface Condition

1. Bleeding, 2. Flushed, 3. Patched, 4. Rutted, 5. Old Seal, 6. Road Mix, 7. Plant Mix, 8. Other - explain in remarks.

| Time | Sta.-Sta. or M.P.-M.P. | Surf. Cond. | Application Rate | | Temperature °F | | | | | | Wind Vel. MPH | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Asph. | Chips | Asph. | Min. Mat | Max. Mat | Min. Air | Max. Air | Shade Mat | | |
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Project Inspector/Maintenance Foreman _____

DH-2265 5-72

Research Project 64, Authority 99054

POST-SEALCOAT EVALUATION REPORT

Date _____ Sheet _____ of _____

Hwy. Route No. _____, Location, MP _____ to MP _____, Proj. No. _____

Seal Coat Construction Dates _____ to _____

Evaluation Made _____ (days) after completion.

General Weather Condition since completion:

Hot and Dry _____ % (80 plus)

Warm and Dry _____ % (60 - 80 )

Cool and Rainy _____ % (40 - 60 )

Cold and Snowy _____ % (40 Minus)

Snow or ice covered _____ %

Visual Appraisal of Seal:

Excellent _____ Fair _____

Good _____ Poor _____

Specific Problems: Bleeding, MP _____ MP _____ Lane _____

Tracking, MP _____ MP _____ Lane _____

Loss of Chips, MP _____ MP _____ Lane _____

Other _____

Maintenance required since construction: _____

_____

_____

Estimated % Embedment _____ %.

Photos taken this date at following M.P. Locations: _____

_____

_____

Evaluated By: _____

DH-500 4-65

STATE OF IDAHO
**DEPARTMENT OF HIGHWAYS**

**Intra-Department Correspondence**

**To:** DISTRICT ENGINEER
DISTRICTS ONE THROUGH SIX

**Date:** JUNE 22, 1972

**From:** CONSTRUCTION DIVISION

**By:** W B Rood
W. B. ROOD, P.E.
ASSOCIATE CONSTRUCTION ENGINEER

**Subject:** DH-2264, DAILY SEALCOAT CONSTRUCTION RECORD.

**Project:** RESEARCH 64

Some suggestions for improving our record form for the sealcoat research were offered by the Districts during our recent meetings.

The form is somewhat crowded but some important information was omitted and should be collected for each project:

1. Indicate if anti-strip additive was used and, if so, the percentage used.

2. Indicate the sample number of the asphalt and as nearly as possible the mile post limits where asphalt represented by the sample was placed on the roadway. This will allow failing sample placements to be evaluated in the post sealcoat study.

3. Show when brooming was done.

4. If different application rates were applied to parallel lanes, this should be noted.

5. Curves and grade may have quite an effect on the success of the project and these conditions could be noted.

6. Asphalt application rates recorded will be hot gallons.

7. The time column on the back of the form is meant to cover a period of time, i.e., 10:00-12:00 A.M., and not an instant of time for each changed condition.

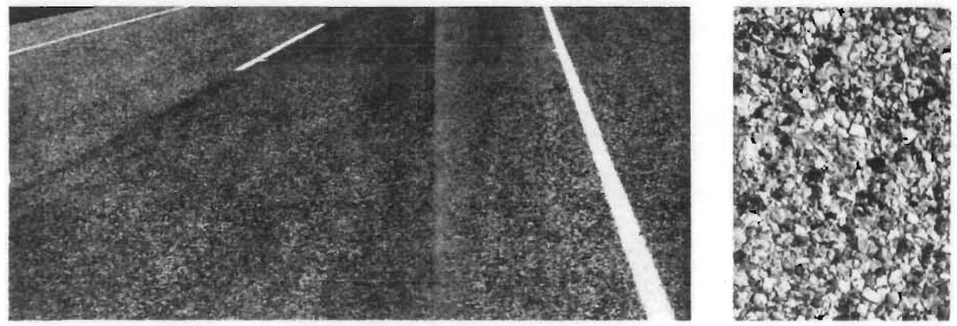
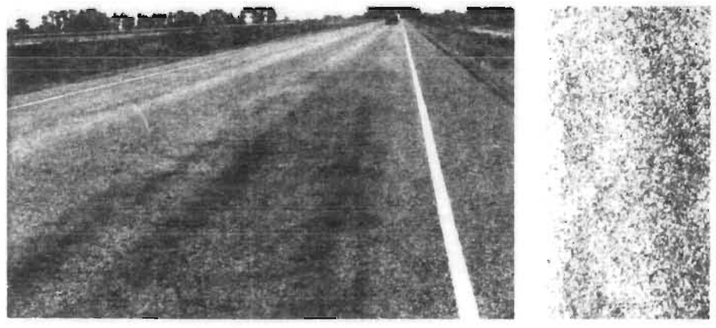
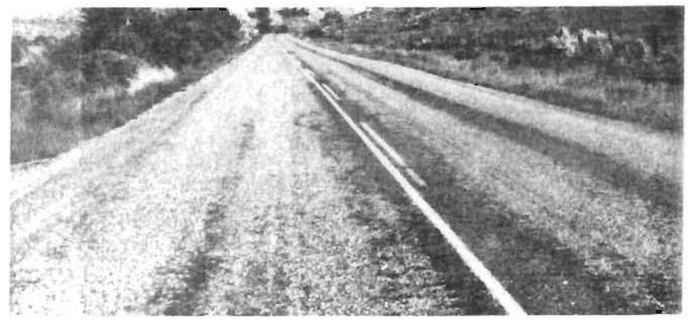
Other information should be recorded on the form if the recorder believes that it will help this study.

The above information and cooperation received by the Districts is appreciated.

ho
cc: A.S.H.E., Operations
A.S.H.E., Engineering
Materials & Research Engineer
Dist. Materials Engineers, Dist. 1 thru 6

# SEAL COAT RATING ILLUSTRATION



| | BLEEDING | DRILLING | CHIP LOSS |
|---|---|---|---|
| EXCELLENT |  | | |
| GOOD |  |  |  |
| FAIR |  |  |  |
| POOR |  |  |  |