NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

Experimental Study ND 96-03

Modified Chip Seal Surface Treatments vs. Conventional Chip Seal Surface Treatments

Final Report

Projects SS-3-003(018)224 & SNH-6-002(050)337

January 2002

Prepared by

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FEDERAL HIGHWAY ADMINISTRATION

EXPERIMENTAL PROJECT REPORT

EXPERIMENTAL PROJECT

EXPERIMENTAL PROJECT NO. (1): STATE: ND | YEAR: 96 | NUMBER: 03 | SURF:

CONSTRUCTION PROJ NO (8): SS-3-003(018)224 & SNH-6-002(050)337

LOCATION (28): Rolette & Grand Forks Counties

EVALUATION FUNDING (48): 1 X HP&R; 2 CONSTRUCTION; 3 DEMONSTRATION; 4 IMPLEMENTATION

NEEP NO. (49):

PROPRIETARY FEATURE? (51): Yes / X No

SHORT TITLE

TITLE (52): **Modified Chip Seal Surface Treatments Vs. Conventional Chip Seal Surface Treatments**

THIS FORM

DATE (140): MO. 1 - YR. 2002

REPORTING: 1 INITIAL; 2 ANNUAL; 3 X FINAL

KEY WORDS

KEY WORD 1 (145): **Sealcoat**

KEY WORD 2 (167): **Surfacetreatments**

KEY WORD 3 (189):

KEY WORD 4 (211):

UNIQUE WORD (233):

PROPRIETARY FEATURE NAME (255):

CHRONOLOGY

DATE WORK PLAN APPROVED: (277)	DATE FEATURE CONSTRUCTED: (281)	EVALUATION SCHEDULED UNTIL: (285)	EVALUATION EXTENDED UNTIL: (289)	DATE EVALUATION TERMINATED: (293)
01-96	08-96	10-01		

QUANTITY AND COST

QUANTITY OF UNITS (297): 109864

UNITS (305):

1	LIN. FT	5	TON
2	SY	6	LBS
3	SY-IN	7	EACH
4	CY	8 X	LUMP SUM

UNIT COST (*Dollars, Cents*) (306):

AVAILABLE EVALUATION REPORTS

(315): X CONSTRUCTION; X PERFORMANCE; X FINAL

EVALUATION

CONSTRUCTION PROBLEMS (318)		PERFORMANCE (****)	
1	NONE	1	EXCELLENT
2	SLIGHT	2	GOOD
3 X	MODERATE	3 X	SATISFACTORY
4	SIGNIFICANT	4	MARGINAL
5	SEVERE	5	UNSATISFACTORY

APPLICATION

(320)

1	ADOPTED AS PRIMARY STANDARD	4	PENDING
2	PERMITTED ALTERNATIVE	5	REJECTED
3	ADOPTED CONDITIONALLY	6	NOT CONSTRUCTED

(Explain in remarks if 3, 4, 5, or 6) is checked)

REMARKS

(321)

It is recommended that an oil application rate of 0.40-0.42 gal/SY followed by an application of chips (crushed - 20% to 40% passing the No. 4 sieve) at 22-25 lbs/SY, followed by an application of Class 45 sand at a rate of 7-10 lbs/SY be used for future surface treatments. The material retained on the No. 40 sieve and above should a minimum of 50% fractured faces on one side.

(700)

Experimental Study ND 96-03

Modified Chip Seal Surface Treatments vs. Conventional Chip Seal Surface Treatments

FINAL REPORT

Projects SS-3-003(018)224 & SNH-6-002(050)337

January 2002

Written by
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Disclaimer

The contents of this report reflect the views of the author or authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not reflect the official views of the North Dakota Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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MODIFIED CHIP SEAL SURFACE TREATMENTS
VS
CONVENTIONAL CHIP SEAL SURFACE TREATMENTS

Objective

Surface treatments have long been used as standard asphalt pavement maintenance and rehabilitation procedures. A chip seal surface treatment provides a new aggregate exposed to the traffic, which can furnish better durability and wear characteristics, improve surface friction, and reduce the rate of deterioration of the original surface.

The current chip seal surface treatment, which consists of a layer of asphalt material followed by a layer of stone chips has been presenting some problems such as poor bonding of the aggregate to the asphalt material. This causes some of the aggregate to break away as soon as normal traffic commences. With the loss of aggregate from the surface, the roadway loses its wear characteristics as well as surface friction.

Scope

The scope of this study was to evaluate modified types of chip seal surface treatments and to compare these modifications to the conventional chip seal surface treatments currently used on North Dakota roadways.

The Materials and Research Division of the North Dakota Department of Transportation monitored and evaluated the following items:

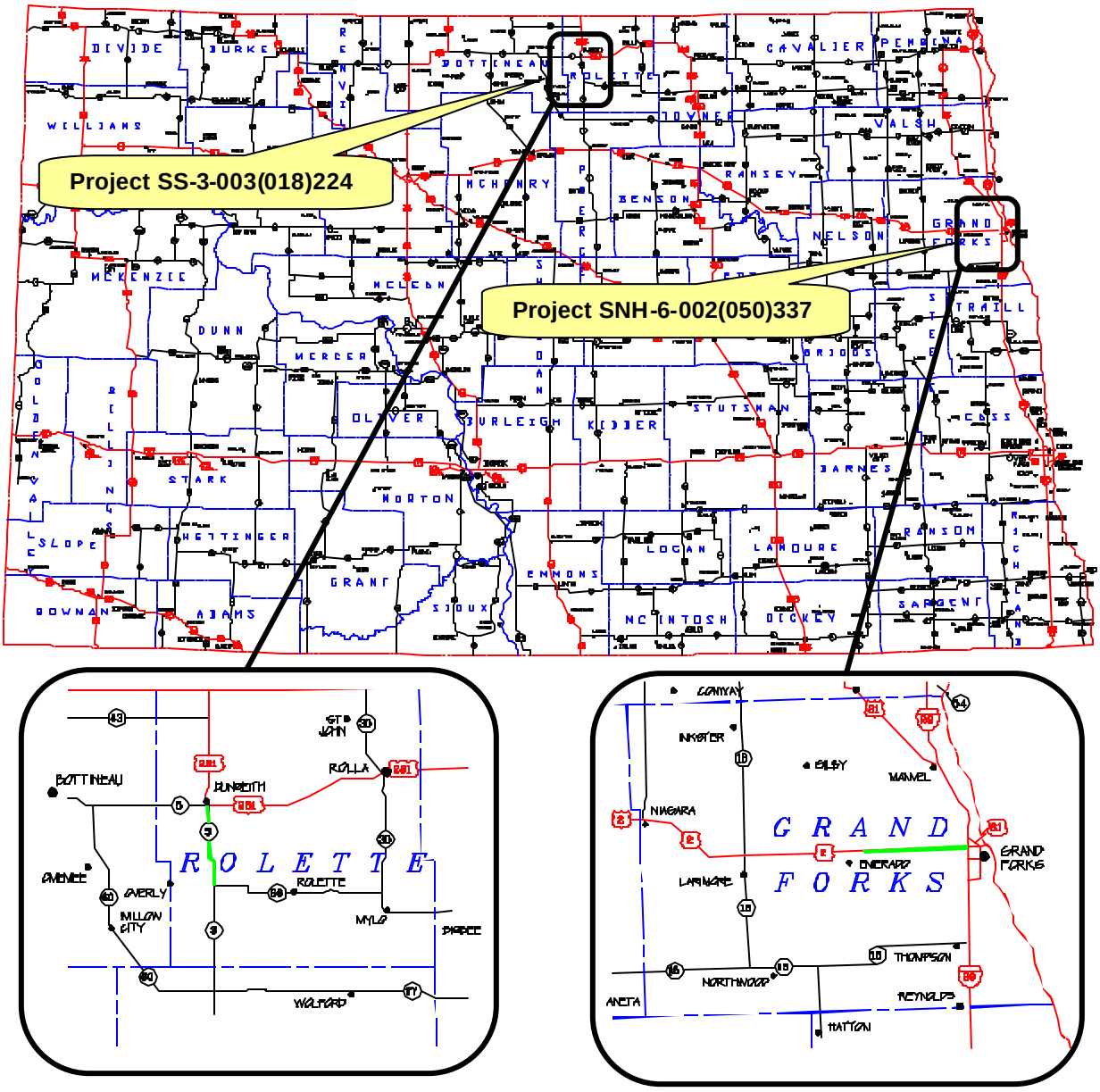
1. Evaluation of different methods of chip seal placement.
2. Loss of aggregate from the pavement surface.
3. Evaluate performance of different types of asphalt material.

Material and Research evaluated this experimental project for a period of five years.

Location

Experimental project 96-03 was incorporated into project SS-3-003(018)224 and was located on Highway 3, from Junction ND 66 north to Junction US 281 at Dunseith. The project length was approximately 9.2 miles. The entire seal coat project was considered an experimental project.

Also, an additional test section was added to experimental project 96-03. The additional chip seal section was located on Highway 2, from the city of Grand Forks west to the Turtle River State Park in the westbound lane. The experimental section was constructed under project number SNH-6-002(050)337.



Project History

Construction

Project SS-3-003(018)224

Table 1 shows the history of the pavement section between Junction 66 north to Junction 281 at Dunseith.

Year Constructed	Type of Construction	Depth (in.)	Roadway Width (ft.)
1992	Grade		52
1992	Aggregate Base	12.0	40
1993	Recycled Hot Bit. Pavement	4.0	36

Table 1

Project SNH-6-002(050)337

This project was comprised of several sections. Table 2 shows a generalized history of the pavement sections between the city of Grand Forks, ND and the Turtle River State Park (WB).

Year Constructed	Type of Construction	Depth (in.)	Roadway Width (ft.)
1948-60	Grade		40-50
1948-61	Aggregate Base	3.0	27-38
1948-61	Portland Cement Concrete Pavement	7-10	24
1984	PCC Joint Repair		
1989	Crack and Seat		
1989	Recycled Hot Bit. Pavement (120-150)	2.8	24
1996	Contract Chip Seal (HFRS-2)		24

Table 2

Traffic

Table 3 tabulates the two-way traffic for Highway 3 between ND 66 to US 281.

Year	Pass	Trucks	Total	30th Max Hour	Flex ESALs
1996	610	140	750	80	90
1998	810	190	1,000	100	165
2000	815	160	975	100	144

Table 3

Table 4 tabulates the one-way traffic for Highway 2 from the Turtle River State Park to the Grand Forks Airbase in the westbound lane.

Year	Pass	Trucks	Total	30th Max Hour	Flex ESALs
1997	2,890	360	3,250	440	280
1998	2,850	400	3,250	440	320
2000	2,550	400	2,950	295	332

Table 4

Table 5 tabulates the one-way traffic for Highway 2 from the Grand Forks Air Force Base to the Grand Forks City limits in the westbound lane.

Year	Pass	Trucks	Total	30th Max Hour	Flex ESALs
1997	5,550	400	5950	830	320
1998	6,600	450	5,950	595	355
2000	5,590	510	6,100	610	425

Table 5

Design

Project SS-3-003(018)224

This project was composed of ten sections, divided into two categories of five sections each. Each category used a different type of asphalt material. Each section has a different seal coat application method.

The initial five sections were designed with the following application methods and rates for the given asphalt material, chip seal aggregate, and sand. Actual rates applied during construction are included in this section and in appendix C. A brief discussion of each application method is included in the following paragraphs.

Type of asphalt material (sections 1-5): HFRS-2P (High Float Rapid Set Polymer Modified Emulsion).

Section 1

Type of application method

Modified single seal consisting of a layer of asphalt material, a layer of stone chips that have been through a crushing process, one pass with a steel wheel roller, another layer of asphalt material, and a final layer of sand. All followed by a pneumatic tired rolling according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications.

Application rates

The first application for the modified single seal method was to be 0.20 gal/yd^2 of asphalt material and 18 lbs/yd^2 of chip seal aggregate Class 43. The second application was to be 0.17 gal/yd^2 of asphalt material and 12 lbs/yd^2 of sand Class 45.

During construction of the test section the rates actually used were slightly different from what the plans called for. The first application for the modified single seal method was applied at an actual rate of 0.216 gal/yd^2 of asphalt material and 20.2 lbs/yd^2 of chip seal aggregate Class 43. The second application was applied at an actual rate of 0.216 gal/yd^2 of asphalt material and 11.5 lbs/yd^2 of sand Class 45.

Section 2

Type of application method

This section consisted of a thicker layer of asphalt material, a layer of stone chips that have been through a crushing process, one pass with a steel wheel roller, and a final layer of sand. All followed by a pneumatic tired rolling according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications.

Application rates

A rate of 0.31 gal/yd^2 of asphalt material was to be placed, followed by a layer of chip seal aggregate Class 43 at a rate of 25 lbs/yd^2. The final layer of sand Class 45 was to be placed at 8 lbs/yd^2.

During construction of the test section the rates actually used were slightly different from what the plans called for. An actual rate of 0.30 gal/yd^2 of asphalt material was placed, followed by a layer of chip seal aggregate Class 43 at an actual rate of 29 lbs/yd^2. The final layer of sand Class 45 was placed at an actual rate 10 lbs/yd^2.

Section 3

Type of application method

This section consisted of a layer of asphalt material, a layer of stone chips that have been through a crushing process, and one pass with a steel wheel roller. All followed by a pneumatic tired rolling according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications.

Application rates

A rate of 0.28 gal/yd^2 of asphalt material was to be placed, followed by a layer of chip seal aggregate Class 43 at a rate of 25 lbs/yd^2.

During construction of the test section the rates actually used were slightly different from what the plans called for. An actual rate of 0.28 gal/yd^2 of asphalt material was placed, followed by a layer of chip seal aggregate Class 43 at an actual rate of 30 lbs/yd^2.

Section 4

Type of application method

This section is a modified version of the conventional seal coat method. This application consists of a layer of asphalt material followed by a lighter application of stone chips that have been through a crushing process. This modified conventional method requires a pneumatic tire roller to be used for the rolling operation according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications.

Application rates

The application rate for the asphalt material was to be 0.28 gal/yd^2. The application of chip seal aggregate Class 43 was to be at a rate of 15 lbs/yd^2.

During construction of the test section the rates actually used were slightly different from what the plans called for. The actual application rate for the asphalt material was 0.30 gal/yd^2. The actual application of chip seal aggregate Class 43 was at a rate of 19 lbs/yd^2.

Section 5

Type of application method

This section consisted of a layer of asphalt material, a layer of stone chips, and a pass with a steel wheeled roller. All followed by a pneumatic tired roller according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications. The chips were to be a screened material that was not put through a crushing process.

Application rates

A rate of 0.28 gal/yd^2 of asphalt material was to be placed, followed by a layer of chip seal aggregate Class 43 at a rate of 25 lbs/yd^2.

During construction of the test section the rates actually used were slightly different from what the plans called for. The actual application rate for the asphalt material was 0.29 gal/yd^2. The actual application of chip seal aggregate Class 43 was

at a rate of 24.5 lbs/yd^2.

Type of asphalt material (sections 6-10): HFMS-2 (High Float Medium Set Emulsion).

The final five sections were designed with the following application method and rates for the given asphalt material, chip seal aggregate, and sand. A brief discussion of each application method is included in the following paragraphs. Actual rates used during construction are included in this section and in Appendix C.

Section 6

Type of application method

This section consisted of a layer of asphalt material, a layer of stone chips that have not been through a crushing process, and a pass with a steel wheeled roller. All followed by a pneumatic tired rolling according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications. The chips were to be a screened material that were not put through a crushing process.

Application rates

A rate of 0.38 gal/yd^2 of asphalt material was to be placed, followed by a layer of chip seal aggregate Class 43 at a rate of 25 lbs/yd^2.

During construction of the test section the rates actually used were slightly different from what the plans called for. The actual application rate for the asphalt material was 0.39 gal/yd^2. The actual application of chip seal aggregate Class 43 was at a rate of 28 lbs/yd^2.

Section 7

Type of application method

Modified single seal consisting of a layer of asphalt material, a layer of stone chips that have been through a crushing process, one pass with a steel wheel roller, another layer of asphalt material, and a final layer of sand. All followed by a pneumatic

tired rolling according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications.

Application rates

The first application for the modified single seal method was to be 0.23 gal/yd^2 of asphalt material and 18 lbs/yd^2 of chip seal aggregate Class 43. The second application was to be 0.20 gal/yd^2 of asphalt material and 12 lbs/yd^2 of sand Class 45.

During construction of the test section the rates actually used were slightly different from what the plans called for. The first application for the modified single seal method was applied at a rate of 0.24 gal/yd^2 of asphalt material and 18.3 lbs/yd^2 of chip seal aggregate Class 43. The second application was applied at an actual rate of 0.196 gal/yd^2 of asphalt material and 11.3 lbs/yd^2 of sand Class 45.

Section 8

Type of application method

This section consisted of a thicker layer of asphalt material, a layer of stone chips that have been through a crushing process, one pass with a steel wheel roller, and a final layer of sand. All followed by a pneumatic tired rolling according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications.

Application rates

A rate of 0.41 gal/yd^2 of asphalt material was to be placed, followed by a layer of chip seal aggregate Class 43 at a rate of 25 lbs/yd^2. The final layer of sand Class 45 was to be placed at 8 lbs/yd^2.

During construction of the test section the rates were slightly different from what the plans called for. A rate of 0.417 gal/yd^2 of asphalt material was placed, followed by a layer of chip seal aggregate Class 43 at a rate of 23.4 lbs/yd^2. The final layer of sand Class 45 was placed at an actual rate 8.3 lbs/yd^2.

Section 9

Type of application method

This section consisted of a layer of asphalt material, a layer of stone chips that have been through a crushing process, and a pass with a steel wheeled roller. All followed by a pneumatic tired rolling according to Section 420.04 C of the North Dakota Department of Transportation Standard specifications.

Application rates

A rate of 0.38 gal/yd^2 of asphalt material was to be placed, followed by a layer of chip seal aggregate Class 43 at a rate of 25 lbs/yd^2. During construction of the test section the rates used were slightly different from what the plans called for. An actual rate of 0.39 gal/yd^2 of asphalt material was placed, followed by a layer of chip seal aggregate Class 43 at a rate of 25.7 lbs/yd^2.

Section 10

Type of application method

This section was a modified version of the conventional seal coat method. This application consists of a layer of asphalt material followed by a lighter application of stone chips that have been through a crushing process. With this modified conventional method a pneumatic tire roller was used for the rolling operation according to Section 420.04 C of the North Dakota Department of Transportation Standard Specifications.

Application rates

The application rate for the asphalt material was to be 0.33 gal/yd^2. The application of chip seal aggregate Class 43 was to be at a rate of 15 lbs/yd^2.

During construction of the test section the rates used were slightly different from what the plans called for. The actual application rate for the asphalt material was 0.33 gal/yd^2. The application of chip seal aggregate Class 43 was at a rate of 15.3 lbs/yd^2.

Asphalt Emulsions

As noted in the previous paragraphs, asphalt emulsions were used exclusively in the design. More specifically high float emulsions. High float emulsions have a quality that permits a thicker film coating without danger of runoff on the roadway.

Based on past experience, emulsions have been used successfully on surface treatments. Several advantages include:

- They can be used with cold or hot aggregate.
- They can be used when the aggregate is damp.
- They need not be at highly elevated temperatures for proper application.
- They eliminate the fire hazard that is associated with the use of cutback asphalt.
- They set up more quickly than cutback asphalt.

Much of the design procedures for the modified surface treatments were based on the Asphalt Institute's MS-19, "*A Basic Asphalt Emulsion Manual*." The objective of a proper design is to produce a pavement surface one stone thick with just enough asphalt to hold the aggregate in place, but not so much that it will bleed.

The modified single seal surface treatment and the thick oil surface treatment were chosen to be experimental test sections because it is believed the application of blotter material develops a thicker surface, which has less chance of raveling and failure. This surface treatment may prove to be more cost-effective over its life cycle when compared to conventional surface treatments.

The Minnesota Department of Transportation (MnDOT) is currently experimenting with lighter stone chip applications of 12 to 15 lbs/yd^2 on their roadways. MnDOT makes certain that the stone chips, when placed, are only a single layer deep. The NDDOT decided to add a modified conventional surface treatment, containing a lighter application of stone chips to the test sections.

The Class 43 chips in all of the test sections except sections (5 & 6) were to have a minimum of 70% of the material retained on the No. 4 sieve with at least one fractured face and meet the following gradation requirements shown in Table 6.

Sieve Size	Total % Passing
3/8"	100
#4	0 - 40
#8	0 - 10
#200	0 - 2

Table 6

Two test sections were added containing conventional seal coat methods. However, the Class 43 chips placed in these have not been through a crushing process. The Class 43 chips to be used on sections 5 and 6 and the Class 45 sand seal shall meet the gradation requirements specified in the North Dakota Standard Specifications. The specifications for Class 43 and Class 45 material are shown in Table 7.

Sieve Size	Total % Passing	
	Class 43 (Chips)	Class 45 (Sand Seal)
3/8"	100	100
No. 4	20 - 70	85 - 100
No. 8	0 - 17	
No. 16		45 - 80
No. 50		10 - 30
No. 200	0 - 2	0 - 3
Shale (Maximum %)	8	3
L. A. Abrasion (Maximum %)	40	

Table 7

The plans also specified that prior to placing each section, the contractor shall demonstrate to the satisfaction of the engineer that the chip spreader has the proper calibration.

Project SNH-6-002(050)337

The original design called for the application of 0.38 gal/yd^2 of HFMS-2 emulsified asphalt and 25 lbs/yd^2 of Class 42 chips. The North Dakota standard specifications for Class 42 material are shown in Table 8.

Sieve Size	Total % Passing
	Class 42 (Chips)
3/8"	100
No. 4	20-70
No. 8	0-20
No. 200	0-5
Shale (Maximum %)	8
L. A. Abrasion (Maximum %)	40

Table 8

Since Highway 2 was a high traffic arterial, the Grand Forks District voiced concerns about loose chips. To alleviate this problem it was proposed to apply a light fog coat to the finished chip seal.

The purpose of the fog coat would be to try and hold the chips down on the roadway from the top and bottom. The fog coat would consist of a CSS-1H emulsion. This oil is recommended by the asphalt supplier for this type of application.

To aid in coating the chips, the supplier added 50% water by volume at his plant. It was then determined that the high float medium set emulsion (HFMS-2) be replaced with a high float rapid set emulsion (HFRS-2) to aid in the curing time. The application rate of the HFRS-2 will be reduced by .02 gal/yd^2 as recommended by the supplier. This yields a residual asphalt content nearly the same as with a conventional seal.

It was determined that the fog coat be applied after the roadway is swept, and prior to opening to traffic.

Construction

Project SS-3-003(018)224

The experimental project was constructed on August 21-22, 1996. Photos 1 & 2 depict the construction operation in general.

The contractor was Asphalt Surface Technologies Corporation (ASTECH) based in St. Cloud, Minnesota. The project engineer for NDDOT was John Holzer of the Bismarck District.

The project engineer ordered some sanding in section 10, after it was constructed, due to excess oil. Sections 1 through 4 and section 6 had more chips applied on the mainline than was called for in the plans, however, any approaches that were spread were included in the actual rate of application.

Project plans and specifications are located in Appendix A & Appendix B respectively. Aggregate test reports, asphalt reports, cost breakdowns, and actual plan rates for each section are located in Appendix C.

Photo 1 - Typical view of construction process.

Photo 2 - Typical view of construction operation.

Project SNH-6-002(050)337

The project was constructed between the dates of July 25,1996 and August 1, 1996. The contractor was Asphalt Surface Technologies Corporation (ASTECH) based in St. Cloud, Minnesota. The state project was under the supervision of Webster, Foster, & Weston (WFW) Consulting Engineers.

Construction went moderately well. The project was not considered an experimental project at the time of construction and was not evaluated for performance until the summer of 1997.

The weather conditions were favorable with temperatures ranging from 55 to 78 degrees each day. Other than one load, which was supplied by Koch Oil from the Pillsbury plant in North Dakota, Koch Oil from St. Paul supplied the oil. The oil was applied at a rate of approximately 0.38 gal/yd^2 and the chips were applied at a rate of 24 pounds/yd^2. The Class 42 chips were supplied by Bradshaw and were applied with a bearcat spreader. The Class 42 chips were a screened material that had not been through a crushing process.

There was some streaking of the seal. It was particularly noted on virtually all the oil from the St. Paul plant. Brooming of the loose chips occurred within 6 to 24 hours of application.

After the passing lane was completed, the fog coat was applied. The fog coat was applied at 0.1 gal/yd^2. The fog coat was left to cure on the first lane over a two-day weekend period. Traffic was then routed onto the completed sealed and fogged lane, and the driving lane was then sealed and fogged. The fog was applied one day after

the seal was finished in the driving lane.

While the driving lane was being sealed, the passing lane started to bleed in the shoulder near the pavement edge and a few areas had some chip loss. As a result blotter sand was applied. The consultant commented that the problem may have been alleviated if chip application could have been extended into the shoulder 1' or 2'. The rest of the project had minor bleeding during the construction period. After the construction period was over, several hot weather days caused an increase in the bleeding and maintenance crews had to apply blotter material to some areas.

During application of the passing lane seal, the chip spreader broke down for approximately 1.5 hours. As a result, the area located between station 718+50 and 753+25 was shot with oil but received no chips for approximately 1.5 hours. The area was eventually covered using dump trucks to dump directly on the oil. This condition was again experienced in the final two miles of the driving lane. The oil was shot but the chips were delayed approximately 1.5 hours due to the stockpile of chips becoming depleted. Project plans and specifications are located in appendix A and appendix B respectively. Aggregate test reports and asphalt reports are located in appendix C.

Evaluation

Project SS-3-003(018)224

On December 18, 2001, a research team representing North Dakota Department of Transportation (NDDOT) conducted the final evaluation of the segment of the experimental project located on Highway 3, north of Rugby, ND.

The team consisted of seven members. Those in attendance were: Jon Mill, Burleigh County Engineer; Glenn Salisbury, Devils Lake District; Mike Pike, Devils Lake District; Jerry Spaeth, Devils Lake District; Dan Schiele and Bryon Fuchs, Materials and Research Division; and Gary Goff, Federal Highway Administration.

The evaluation began with section 10 and proceeded through section 1. However, this report will begin at section 1 and proceed southward. Each section will be broken into two parts, previous evaluation and then the final evaluation so changes that may have occurred can be identified if there are any.

Section 1 (oil/chips/oil/sand)

Evaluation on August 8, 1998

Photo 3 shows an overview of section 1. One of the items that is very contrasting about Section 1 is the surface appearance as opposed to other test sections. The modified single seal coat method exhibits the darkest surface of all the methods in the experimental project.

Photo 3 - Overview of section 1.

There appears to be slight bleeding in this section as indicated by the darkening in the wheel tracks. The driving surface has a noticeably smoother texture as compared to

the other seal coat methods. The second coat of oil and application of blotter sand has filled in most of the voids between the chips.

One of the main concerns with section 1 was the distresses occurring in the roadway as shown in photos 3 & 4. These distresses are notably large spalls that may have been caused by snowplow blades. Most of the distresses present in section 1 are most always one-lane wide and approximately 3' to 6' long.

Notice in photo 4 that whatever caused the distress took the entire seal off the roadway. The distresses shown in photo 4 are isolated instances however. The majority of the distresses seen in this section appear to only affect the top layer leaving most of the first layer of oil and chips intact.

Photo 4 - View of distress located in the vicinity of approach.

There was much discussion as to what would cause distresses such as these. The general consensus of the research team is that the problems may be in the construction of the seal coat itself. The Devils Lake District believes the distresses happened immediately after the first major snowfall in late October of 1996. One possibility is that the contractor accidentally applied multiple layers of chips on the roadway. This may have easily happened when the contractor was switching dump trucks or beginning or finishing up a section.

One of the design criteria is that the chips are to be applied approximately one stone thick after the initial application of oil. This assures that the second coat of oil and

application of the blotter sand will encompass as many of the Class 43 chips as possible. If the Class 43 chips are applied too thick, causing multiple layers, there will be a shear plane between the loose chips on top and the chips adhered to the initial coat of oil. It is possible that traffic or snowplowing operations may remove the excess chips all at once because of the common adherence to the topcoat of oil and sand. Most of the research team agreed with this statement and that the distresses were not related to the oil itself. Another possibility discussed was the application of the sand. If the sand was applied too heavily in some areas, the excess sand may have absorbed too much of the second coat of oil before it was allowed to flow down around the chips. The chips would then have to rely on the initial application of oil, which alone is not sufficient to hold down the chips.

Also in nearly all of the distresses encountered in section 1, the wheel paths within these distresses were performing significantly better than the immediate area around them. This is probably due to the extra compaction they have received. At this point in the evaluation period, it does not appear that these distresses are worsening at any significant rate. There is approximately the same number of distresses detected during the first annual evaluation as were detected during the second annual evaluation.

Section 7 is constructed similar to section 1, however the asphalt material is different. The same kind of distresses as shown here in section 1 are present also in section 7.

During construction the plan rate for the Class 43 chips was 18 pounds per square yard and the actual rate applied was approximately 20 pounds.

The Devils Lake District believes that if construction errors could be minimized the modified single seal coat method may prove durable and give good performance for several years. There was some isolated chip loss present in the mainline and on the shoulders, but it was minimal.

The overall consensus is that, except for the isolated distresses mentioned above, the section is performing well.

Evaluation on December 18, 2001

Photo 5 shows a current overview of section 1. Note the darker appearance.

Photo 5 - Overview of section 1.

Some of the same distresses noted in the last evaluation appeared to have remained in the same condition and have not worsened. The general condition of this section is good. The surface looks uniform with minimal chip loss. The transverse tracks are less noticeable and appear to be tighter than the other cracks in sections 1 through 5.

Section 2 (Thick oil/chips/sand)

Evaluation on August 8, 1998

Section 2 has a similar texture to section 1, however, the surface color was lighter than section 1. The rate of oil shot down and the final layer of sand allowed the chips to become embedded deeper into the surface, giving the seal coat a smoother appearance. Photo 6 shows an overall view of section 2. Photo 6 also shows a hint of bleeding in the wheel paths.

In general the research team thought the seal coat was performing well.

Photo 6 - Overview of section 2.

Evaluation on December 18, 2001

Photo 7 shows a current view of section 2. As seen in photo 7, chip loss has occurred at centerline and in the wheel paths. Evaluating the surface close-up, it appears that the sand did not become embedded in the oil. This may be attributed to the light oil application. Had the sand become embedded in the oil, the chip loss may have been lessened. This chip seal is performing fair.

Photo 7 - Overview of section 2.

Section 3 (oil/chips)

Evaluation on August 8, 1998

Photo 8 depicts an overall view of section 3. This section was constructed using NDDOT's standard seal coat method. The surface was much rougher than the previous two sections. There was some isolated chip loss in the mainline. The surface was very light in color.

Photo 8 - Overview of section 3.

The general consensus of the team was that except for some chip loss, the section was performing well.

Evaluation on December 18, 2001

Photo 9 shows a current view of section 3. As can be seen in photo 9, there is chip loss at centerline, along the edge, between the wheel paths, and even along some of the transverse cracks. The chip loss is moderate throughout the section but between the wheel paths, chip loss is great. The chip density appears light due to the loss of chips. The chip loss may be attributed to the light oil application. This section is performing fair.

Photo 9 - Overview of section 3.

Section 4 (oil/ light application of chips)

Evaluation on August 8, 1998

Photo 10 depicts an overall view of section 4. This section called for only 15 pounds of chips, however, 19 pounds were actually applied. Photo 10 depicts a track that proceeded for nearly the entire length of the section.

Photo 10 - Overview of section 4.

During construction the contractor had problems with his machinery rolling up with oil and chips. The general consensus was the track shown in photo 10 was construction related and not the result of traffic or snowplow damage. The section was gray in color.

There was some isolated chip loss in the mainline, perhaps more so than in the previous sections. There was also evidence of some loose chips lying off the shoulders. The overall consensus is that except for some chip loss the section was performing moderately well.

Evaluation on December 18, 2001

Photo 11 shows a current view of section 4. As seen in photo 11, there is chip loss in the wheel paths, centerline, and along the edges. There is also moderate chip loss throughout the entire section. The chip loss is mostly thought to be the result of light oil application. The coverage of the chips appears to be thin as well. This section is performing fair.

Photo 11 - Overview of section 4.

Section 5 (oil/non-crushed chips)

Evaluation on August 8, 1998

Photo 12 depicts an overall view of section 5. Like the previous four sections, section 5 was constructed with a high float rapid set polymer modified asphalt emulsion. There was some concern that the non-crushed chips used in this section were not holding as well as the crushed chips used in the earlier sections. Some members believed that the surface appeared slightly rougher in texture. They believed that the rougher texture may have been caused by the non-crushed chips tending to shift due to the roundness of some of the chips.

Photo 12 - Overview of section 5.

The general consensus is that the section was not performing quite as well as similar sections containing chips that have been through a crushing process.

Evaluation on December 18, 2001

Photo 13 shows a current view of section 5. Notice in photo 13 the chip loss throughout the entire section. Chip loss is estimated at 40% to 50%. The chip loss is attributed to the light oil application and the non-crushed (screened) chips. This section's performance is poor.

Photo 13 - Overview of Section 5.

Section 6 (oil/non-crushed chips)

Evaluation on August 8, 1998

Photos 14 and 15 depict an overall view of section 6. Section 6 is constructed with a high float medium set asphalt emulsion (HFMS-2). There was some concern in this section, as in section 5, that the non-crushed chips were not holding as well as crushed chips.

Photo 14 - Overview of section 6.

Photo 15 - Close up view of section 6.

Some members believed that the surface appeared slightly rougher in texture. They believed that the rougher texture may have been caused by the non-crushed chips tending to shift due to the roundness of some of the chips. Photo 15 depicts a close-up view of section 6. Notice the chips appear to be bunched together in several places. Section 6 appeared slightly darker in color than some of the other sections except sections 1 and 7. The general consensus is that the section was not performing quite as well as similar sections containing chips that have been through a crushing process.

Evaluation on December 18, 2001

Photo 16 shows a current view of section 6. Section 6 has experienced moderate chip loss throughout the section. There was also chip loss at centerline that is not evident in photo 16. The research team felt that construction related problems were the likely cause of chip loss at centerline. Some of the same distresses noted in the last evaluation were noted in this evaluation but does not appear to have worsened. The overall performance of this section is fair.

Photo 16 - Overview of section 6.

Section 7 (oil/chips/oil/sand)

Evaluation on August 8, 1998

Photo 17 depicts an overall view of section 7. Notice in photo 17 that the surface appears dark in color as seen in section 1.

Photo 17 - Overview of section 7.

As previously mentioned section 7 and section 1 are constructed using the same

method. The only difference between the two sections is that section 7 is constructed using a HFMS-2 emulsion as opposed to the HFRS-2P emulsion used in section 1. The application rate is slightly higher using the HFMS-2 emulsion, however, there appears to be less bleeding in the wheel paths than in section 1.

The driving surface, in section 7, has a noticeably smoother texture compared to the other seal coat methods. The second coat of oil and application of blotter sand has filled in most of the voids between the chips.

One of the main concerns with section 7 was the distresses occurring in the sealcoat. As in section 1 the sealcoat is suffering from large spalls that have occurred possibly from snow plow blades. In most cases the distresses encompass the entire width of the lane as shown in photo 18. The length of the distresses are approximately 3' to 6'. In the previous photos it is important to note that the lighter colored areas show the distress. It is within these lighter colored areas that part of the seal coat is missing.

Photo 18 - Typical distress associated with section 7.

The Devils Lake District believes these distresses, as in section 1, happened immediately after the first major snowfall in late October of 1996.

There was much discussion as to what would cause distresses such as these. The general consensus of the research team is that the problems may be in the construction of the seal coat itself. One possibility is that the contractor accidentally applied multiple layers of chips on the roadway. This may have easily happened when

the contractor was switching dump trucks when beginning or finishing up a section. One of the design criteria is, after the initial application of oil, the chips are to be applied approximately one stone thick. This assures that the second coat of oil and application of the sand will encompass as many of the Class 43 chips as possible. If the Class 43 chips are applied too thick, having multiple layers, there will be a shear plane between the loose chips on top and the chips adhered to the initial coat of oil. It is possible that traffic or snowplowing operations may remove the plane of excess chips all at once because of the common adherence to the top coat of oil and sand. Most of the research team agreed with this statement and that the distresses were not related to the oil itself.

Another possibility discussed was the application of the sand. If the sand was applied too heavily in some areas, the excess sand may have absorbed too much of the second coat of oil before it was allowed to flow down around the chips. The chips would then have to rely on the initial application of oil, which is not sufficient to hold down the chips.

Photos 19 and 20 depict an abnormally large spalled area in section 7 taken during the 1997 and the 1998 evaluation respectively. These photos, however, were taken at opposite ends of the distress.

Photo 19 - Large spalled area near the end of section 7 taken during the summer of 1997.

Photo 20 - View of spalled area shown in photo 19 during the summer of 1998.

It appears from photos 19 and 20 that the contractor may have had problems regulating the application of either the Class 43 chips or the sand. It is also possible that the contractor may be having problems with his distributor as shown by the bleeding in photo 19. Photo 21 depicts a close-up view of a pencil bridged across a distressed area (lighter color). Notice also in the background of photo 20 that the seal coat has been completely removed from the surface leaving just the initial coat of oil. The distress shown in photos 19 and 20 are approximately 70' long.

Photo 21 - Distress area shown in the two previous photos.

It is apparent after closely examining these two photos that no significant amount of deterioration has taken place within the distress over the past year.

Also, in nearly all of the distresses encountered in section 7, the wheel paths within these distresses were performing significantly better than the immediate area around them. This is probably due to the extra compaction they have received.

At this point in the evaluation period it does not appear that the number of distresses are increasing.

The Devils Lake District believes that if construction errors could be minimized the modified single seal coat method may prove durable and give good performance for several years. The overall consensus is that, except for the isolated distresses mentioned above, the section is performing well.

Evaluation on December 18, 2001

Photo 22 shows a current view of section 7. Some of the distresses noted in the previous evaluation were not as noticeable this evaluation. Traffic and weather has probably had an effect on these areas to make them less noticeable over time.

Photo 22 - Overview of section 7.

As can be seen in photo 22, chip loss is prevalent at centerline however this may be a construction related problem. Overall, this section is performing good.

Section 8 (thick oil, chips, sand)

Evaluation on August 8, 1998

Section 8 was constructed by the same method as section 2 except that the asphalt material used was HFMS-2. Photo 23 depicts an overview of section 8. Once again the texture of the roadway is smoother when compared to a conventional seal coat. The heavier rate of oil used allowed the chips to become embedded deeper into the surface; thereby giving the seal coat a smoother appearance. The surface was very light in color.

In general the research team thought the seal coat was performing well.

Photo 23 - Overview of section 8.

Evaluation on December 18, 2001

Photo 24 shows a current view of section 8. Section 8 had a very tight, uniformed appearance to the surface. Chip loss was minimal in this section.

Photo 24 - Overview of section 8. The bleeding in section 8 is the result of a scotch patch, not the original chip seal.

Photo 24 also indicates that chip loss at centerline is not seen in this section. The transverse cracks appear tighter and not depressed as seen in other sections. One item that is not evident in photo 24 is the light color of the surface. This section had the lightest color of all sections. The light color of this surface is able to reflect more light for nighttime driving increasing the drivers ability to see better for safer night driving.

Section 8 is performing the best out of all sections and the performance is excellent.

Section 9 (oil/chips)

Evaluation on August 8, 1998

Photo 25 depicts an overall view of section 9. This section was constructed very close to the NDDOT's standard seal coat method, as was used in section 3, but with a High Float Medium Set asphalt (HFMS-2). There was some isolated chip loss in the mainline. The general consensus of the team was that except for some chip loss the section was performing well.

Photo 25 - Overview of section 9.

Evaluation on December 18, 2001

Photo 26 shows a current view of section 9. Section 9 has minor chip loss throughout the section. Chip loss at centerline is the major distress noted in this section. Overall, chip density is good and this section is performing well.

Photo 26 - Overview of section 9.

Section 10 (oil/ light application of chips)

Evaluation on August 8, 1998

Photo 27 depicts an overall view of section 10. This section called for only 15 pounds of chips and slightly less oil as compared to a conventional seal. In a significant portion of section 10 the southbound lane is slightly darker than the northbound lane. After examination the research team concluded that many more chips were missing in this lane. Just after construction of this section the traffic was allowed to travel over the southbound lane causing the chips to pick-up on the tires. The project engineer made a decision to sand the southbound lane in an effort to resolve the problem.

Photo 27 - Overview of section 10.

Section 10 is much darker in color than section 9. Although there was a good covering of chips, it appeared there was still room for additional chips.

There were several areas along the centerline in section 10 where the chips had been removed either by snowplows or lack of oil.

The general consensus of the research team was that considering only 15 pounds of chips were applied, the seal coat was holding up well.

Evaluation on December 18, 2001

Photo 28 shows a current view of section 10. The transverse cracks appear to

be more depressed in this section. The appearance in this section is uniform however the amount of chips appears to be thin. Chip loss is minor with the majority of chip loss

Photo 28 - Overview of section 10.

occurring at centerline. The overall performance of this section is good.

Team Performance Ratings

During the final evaluation period, most of the research team rated sections 1 (oil/chips/oil/sand) and 8 (thick rate oil/chips/sand) as the best performing seal coats. The conventional seals containing non-crushed chips were rated the lowest in general performance.

The general consensus of the research team is that the sections containing HFMS-2 oil are performing better than the sections containing HFRS-2P oil. However, it is unclear whether the performance difference is related to the oil or the different application rates. The HFRS-2P sections had lighter oil application rates.

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Evaluation on August 14, 1998

An additional test section was added to experimental project 96-03 titled "Modified Chip Seal Surface Treatments vs. Conventional Chip Seal Surface Treatments." On August 14, 1998, a research team representing North Dakota Department of Transportation (NDDOT) conducted a second annual evaluation of this additional test section.

The evaluation began on the east end of the test section and proceeded westward. Highway 2 is a high traffic area. It serves as a main arterial for the city of Grand Forks and the Grand Forks Air Force Base. The Grand Forks International Airport is also located along Highway 2.

Photo 29 shows an overview of the test section. Notice in photo 29 the surface of the test section, barring the wheel tracks, appears moderately light in color. The application of the fog coat did not appear to significantly change the surface color of a conventional chip seal. After construction of this project, neither Webster, Foster, & Weston nor the Grand Forks district received any complaints about flying chips from the driving public. Up to this point in the evaluation there still has been no complaints about

Photo 29 - Overview of Highway 2 test section.

flying chips. Photo 30 depicts a view of another overall view of the test section. Notice

in photo 30 the patching that has occurred in the driving lane. A significant portion of the driving lane in the test section has been patched by maintenance forces due to rutting.

The general consensus of the research team is that the seal coat appears to be

Photo 30 - Overview of Highway 2 where patching has been done.

performing well, however, it remains undetermined whether the fog coat played a decisive role in holding the chips on the roadway.

Evaluation on December 18, 2001

Photos 31 and 32 show an overview of the Highway 2 segment in this research project. Photo 31 is taken in the segment from the city of Grand Forks to the Grand Forks Air Force Base. Photo 32 is taken from the Grand Forks Air Force Base to Turtle River State Park.

Photo 31 - Bleeding on Highway 2. City of Grand Forks to the Grand Forks Air Force Base.

The photos indicate bleeding in one segment that is not present in the other segment. The segment in photo 31 has a traffic flow of 3,000 more vehicles on a daily basis. However, the bleeding may be a result of the asphalt surface below (as noted above, rutting is occurring in this segment and has had maintenance done to correct this problem).

Photo 32 - Highway 2, Grand Forks Air Force Base to Turtle River State Park.

The appearance is darker than any other segment we have evaluated. Chip loss is minimal throughout this project. The lack of chip loss is thought to be the result of the fog coat or the heavier oil application or perhaps both. The oil was used on Highway 2 was a HFRS-2 with an application rate of 0.38 gal/yd^2.

Overall, this segment is performing well with the exception of the bleeding.

Summary

Project SS-3-003(018)224

Several distresses were common in each section at different severity levels. The common distresses were as follows; chiploss, centerline stripping, and stripping at the shoulders. However, section 8 is the only section where stripping was not observed at centerline or the shoulders and had only minimal chiploss.

Sections 1 through 5 appear to have more distresses than sections 6 through 10. The conclusion of the research team was the difference in the oil application rate is the likely cause of the increased distresses.

Refer to Table 9 for the application rates, materials used, cost and the ranking of each project. Section 6 shows typical application rates (aggregate is approximately 3 lb/yd^2 heavier than normal) and used are current specification for aggregates). Note there is approximately a $0.13 difference between what is currently used (section 6 - ranked last using HFMS-2 oil) versus the best performing section (8).

Section	*Aggregate	HFRS-2P (gal/yd^2)	1st Agg App. (lb/yd^2)	HFRS-2P (gal/yd^2)	Cl. 45 Sand (lb/yd^2)	Rank in Section	1996 Cost per yd^2	**2000 Cost per yd^2
1	Cl. 43-Cr	0.216	20.2	0.216	11.5	1	$0.76	$0.77
2	Cl. 43-Cr	0.30	29.0	N/A	10.0	2	$0.62	$0.69
3	Cl. 43-Cr	0.28	30.0	N/A	N/A	4	$0.55	$0.51
4	Cl. 43-Cr	0.30	19.0	N/A	N/A	3	$0.51	$0.44
5	Cl. 43-Sc	0.29	24.5	N/A	N/A	5	$0.53	$0.47
Section	*Aggregate	HFMS-2 (gal/yd^2)	1st Agg App (lb/yd^2)	HFMS-2 (gal/yd^2)	Cl. 45 Sand (lb/yd^2)	Rank in Section	1996 Cost per yd^2	**2000 Cost per yd^2
6	Cl. 43-Sc	0.39	28.0	N/A	N/A	5	$0.48	$0.54
7	Cl. 43-Cr	0.24	18.3	0.196	11.3	4	$0.51	$0.69
8	Cl. 43-Cr	0.417	23.4	N/A	8.3	1	$0.51	$0.67
9	Cl. 43-Cr	0.39	25.7	N/A	N/A	2	$0.46	$0.52
10	Cl. 43-Cr	0.33	15.3	N/A	N/A	3	$0.35	$0.39
Section	*Aggregate	HFRS-2 (gal/yd^2)	1st Agg App (lb/yd^2)	CSS-1h (gal/yd^2)	Cl. 45 Sand (lb/yd^2)	Rank in Section	1996 Cost per yd^2	**2000 Cost per yd^2
HWY 2	Cl. 42-Sc	0.38	24.0	0.1	N/A	N/A	$0.53	$0.76

*Cr=Crushed, Sc=Screened
**Prices based on 2000 average annual bid prices.

Table 9

Referring to Table 9, you will notice that each section that utilized screened chips instead of crushed chips were rank lasted, regardless of the oil type used.

The basic theory in designing surface treatments is that the aggregate used should be primarily one size. When the aggregate is placed on top of the asphalt film, the particles are un-arranged. Rolling arranges the aggregate to a dense pattern and traffic helps orientate the aggregate to their densest positions, lying on their flattest or largest side. If the aggregate does not have a flat (fractured) or a wider side, the aggregate will have a tendency to roll out of the asphalt film.

Table 10 contains the sample results of the Class 42 and Class 43 material used on this project.

Sieve Size	Cl. 43 - Modified (Crushed)	Cl. 43 - Screened (Standard Specification)	Cl. 42 - Standard Specification
	% Passing	% Passing	% Passing
3/8"	100	100	100
No. 4	28	42	45
No. 8	1.0	5.0	7.0
No. 200	0.1	0.5	0.6
Fractured Faces (one side)	76.4	N/A	N/A

Table 10

The Class 43 - modified had 72% of the material retained on the No. 4 sieve while the other aggregates retained only 55% to 58%. Approximately 55% of the Class 43 - modified material had at least one fractured surface, which helps keep the aggregate from popping out under the traffic conditions.

Two different oil types were used in this research project at different application rates. It is difficult to determine the performance of these oils based on the varying application rates. However, oils used on this project have performed satisfactory on other projects.

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The chip loss on this project is minimal. The heavier application rate of oil followed by the fog coat may have minimized the chip loss. The fog coat may have given the seal coat a darker appearance.

Bleeding was a problem on this project for the first seven to eight miles.

Bleeding is thought to be the result of the poor condition of the existing asphalt mat. Within two years of the seal coat application, maintenance was done to correct rutting and shoving in the existing mat.

Recommendation

Based on the information contained in this report, it is recommended that an oil application rate of 0.40-0.42 gal/yd^2, followed by an application of chips (crushed - 20% to 40% passing the No. 4 sieve) at 22-25 lbs/yd^2, followed by an application of Class 45 sand at a rate of 7-10 lbs/yd^2 be used for future surface treatments. The material retained on the No. 40 sieve and above should a minimum of 50% fractured faces on one side. The recommended percent passing on the No. 40 sieve allows more of the larger aggregate to be used.

The recommended oil application rate is approximately 0.02-0.04 gal/yd^2 heavier than currently being used. The heavier rate of oil is to allow the Class 45 sand to become embedded in the oil and help cement the chips in place. The addition of the sand will also lighten up the appearance of the surface thus reflecting more light at night for safer driving.

The oil type used should be selected by the engineer based on location, the amount of traffic, and existing mat conditions.

Appendix A

TRAFFIC – 600 ADT

JOB# 18

FEDERAL REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	SS-3-003(018)224	1

NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

IN ROLETTE COUNTY

FEDERAL AID PROJECT NO. SS-3-003(018)224

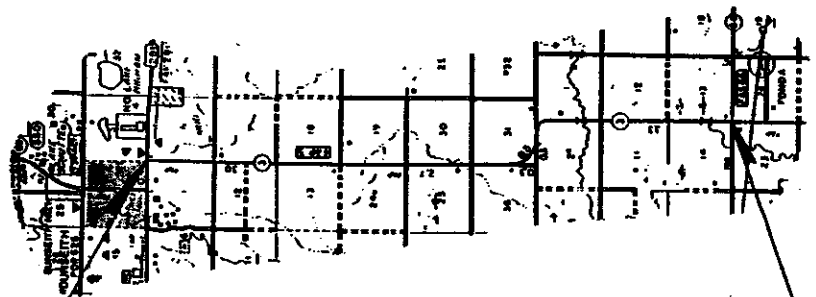
SEAL COAT

GOVERNING SPECIFICATIONS:

Standard Specifications adopted by the North Dakota Department of Transportation September 1992; Standard Drawings currently in effect; and other Contract Provisions submitted herein.

LENGTH OF PROJECT

9.213 Miles



BEGIN STA 0+00 NE Cor of SEC 1, TWP 161N, RGE 73W

END STA 486+44.9 SE Cor of Sec 14, TWP 160N, RGE 73W

PAVING SECTION Brian Kroeni

URBAN SECTION

TRAFFIC SECTION Clifford A. Schmaltz

RURAL SECTION

RECOMMEND APPROVAL 12-22, 1995

DESIGN ENGINEER Vern Otto

APPROVED DATE 12-22-95

Ray Zink

DIRECTOR OF HIGHWAYS AND ENGINEERING

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

RAY ZINK REGISTERED

A-1

FHWA REGION	STATE	FED. AID PROJ. NO.	SHEET NO.
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D-704-8	Breakaway Systems for Construction Zone Signs
D-704-9,10,11,12,13,14,15,20,22, & 26	Construction Sign Details
D-754-21	Reflectorized Delineators
D-762-1	Pavement Marking Message Details
D-762-3	Striping for Flared Intersections
D-762-4	Pavement Marking

NOTE: Standard drawings are included in the back of the plans

FHWA REGION	STATE	FED. AID PROJ. NO.	SHEET NO.
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ESTIMATED QUANTITIES

SPEC	CODE	ITEM DESCRIPTION	UNIT	SECTIONS 1, 2, 3, 4, & 5	SECTIONS 6, 7, 8, 9, & 10	(34)PD, (18)SL & (2) FLARED INTERS	TOTAL
103	0100	CONTRACT BOND	L SUM		1		1
420	0025	HFRS2P	GAL	14,834		1,214	16,048
420	0112	HFMS-2 EMULSIFIED ASPHALT	GAL		49,179	3,221	52,400
420	0145	COVER COAT MATERIAL - CL 43	TON	378	989	109	1,476
420	0146	COVER COAT MATERIAL - CL 45	TON	71	221	30	322
702	0100	MOBILIZATION	L SUM		1		1
704	0100	FLAGGING	M HR	50	150		200
704	1100	TRAFFIC CONTROL	L SUM		1		1
704	1185	PILOT CAR	HRS	25	75		100
754	0650	18IN X 18IN SIGNS	EA	5	5		10
762	0128	PLASTIC PVMT MARKING - FILM MESSAGE	SF			74	74
762	1104	PVMT MKG PAINTED 4IN LINE	LF	25,740	92,831	2,800	121,371
762	1108	PVMT MKG PAINTED 8IN LINE	LF			552	552
762	1124	PVMT MKG PAINTED 24IN LINE	LF			24	24

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BASIS OF ESTIMATE AND NOTES

420 P01 CLASS 43 COVER COAT MATERIAL (CHIPS):
All Class 43 chips shall be washed.
Class 43 chips used for Sections 5 and 6 shall meet the gradation requirements specified in the Supplemental Specs. The chips shall be a screened material that have not been through a crushing process. Class 43 chips for Sections 1, 2, 3, 4, 7, 8, 9, & 10 shall have a minimum of 70% of the material retained on the No 4 sieve with at least one fractured face and shall meet the following gradation requirements:

SIEVE SIZE	TOTAL % PASSING
3/8"	100
#4	0-40
#8	0-10
#200	0-2

420 P02 CONSTRUCTION DETAILS: All test sections shall use the application specified in the basis of estimate and shall be placed according to Section 420, unless otherwise specified below.
SECTION 1-Spray an application of HFRS2P and immediately place a layer of chips. Make one pass with a steel wheel roller. After the initial application of HFRS2P has cured, spray a lighter application of HFRS2P and immediately place a layer of Cl 45 (sand). Roll with a pneumatic tired roller according to Section 420.
SECTION 2-Spray an application of HFRS2P and immediately place a layer of chips. Make one pass with a steel wheel roller and immediately place a layer of Cl 45 (sand). Roll with a pneumatic tired roller according to Section 420.
SECTION 3-Spray an application of HFRS2P and immediately place a layer of chips. Make one pass with a steel wheel roller and roll with a pneumatic tired roller according to Section 420.
SECTION 4-Spray an application of HFRS2P and immediately place a layer of chips. Roll with a pneumatic tired roller according to Section 420.
SECTION 5-Spray an application of HFRS2P and immediately place a layer of chips. Roll with a pneumatic tired roller according to Section 420.
SECTION 6-Spray an application of HFMS-2 and place a layer of chips. Make one pass with a steel wheel roller and roll with a pneumatic tired roller according to Section 420.
SECTION 7-Spray an application of HFMS-2 and place a layer of chips. Make one pass with a steel wheel roller. After the initial application of HFMS-2 has cured, spray a lighter application of HFMS-2 and place a layer of sand. Roll with a pneumatic tired roller according to Section 420.
SECTION 8-Spray an application of HFMS-2 and place a layer of chips. Make one pass with a steel wheel roller and place a layer of sand. Roll with a pneumatic tired roller according to Section 420.
SECTION 9-Spray an application of HFMS-2 and place a layer of chips. Make one pass with a steel wheel roller and roll with a pneumatic tired roller according to Section 420.
SECTION 10-Spray an application of HFMS-2 and place a layer of chips. Roll with a pneumatic tired roller according to Section 420.

420 P03 At the end of a distributor shot, the contractor shall remove all equipment from the sealed portion of the roadway. The rollers shall roll through the end of the shot. The HFRS2P shall be applied at the temperature recommended by the manufacurer.

420 P04 CHIP SPREADER CALIBRATION: Prior to placing each Section, the contractor shall demonstrate to the satisfaction of the engineer that the chip spreader has the proper calibration.

704 310 CONSTRUCTION SIGNING (SEAL COATS): The contractor shall furnish the necessary signing as shown on the std drawings, 'Construction Sign and Barricade Details', under Type A, H, K, L and C-C as required by the contractor's operation.

762 P01 PLASTIC PAVEMENT MARKING FILM MESSAGE: Plastic pavement marking film shall be installed a minimum of two weeks and a maximum of three weeks prior to the seal coat installation. Areas to receive pavement marking film shall have all the in-place pavement markings removed as specified by the manufacturer of the plastic pavement marking film. Just prior to beginning the seal coat installation, adhesive-coated paper liner shall be placed to protect the plastic markings from seal oil and chips. The paper liner shall be as recommended by the plastic markings manufacturer. Spotting tabs shall be placed at the beginning of each paper liner to provide for location of the paper liner. The paper liner shall be placed to the length of that day's seal run. Upon completion of that day's seal run, all paper liners shall be removed. The paper liner and the seal coat removed shall be loaded and disposed of outside the highway right of way. The cost of placing tabs, paper liners, removal, and disposal shall be included in the price bid for 'Plastic Pavement Marking Film Message.'

TWO LANE ROADWAY - BASIS OF ESTIMATE
PAVEMENT MARKING PAINTED LINE

Edge Lines - 4" White, 10,560 LF/Mi	97,289 LF
Centerlines - 4" Yellow, 10' Lines, 30' Skip - 1,320 LF/Mi	12,161 LF
Barrier Lines - 4" Dbl Yellow Line, 3" Between - 990 LF/Mi	9,121 LF

ADDITIONAL BARRIER QUANTITY FOR:

(2)TYPE III FLARED INTERSECTIONS(0+00 & 486+44.9)	
4" Line - 1,400 LF/EA	2,800 LF
8" Line - 276 LF/EA	552 LF
24" Line - 12 LF/EA	24 LF

PLASTIC PAVEMENT MARKING FILM MESSAGES

(2)Only @ 22 SF/EA(0+00 & 486+44.9)	44 SF
(2)Right Arrows @ 15 SF/EA(0+00 & 468+44.9)	30 SF

NOTE: Edge lines shall be continued through private drives and broken for intersections.

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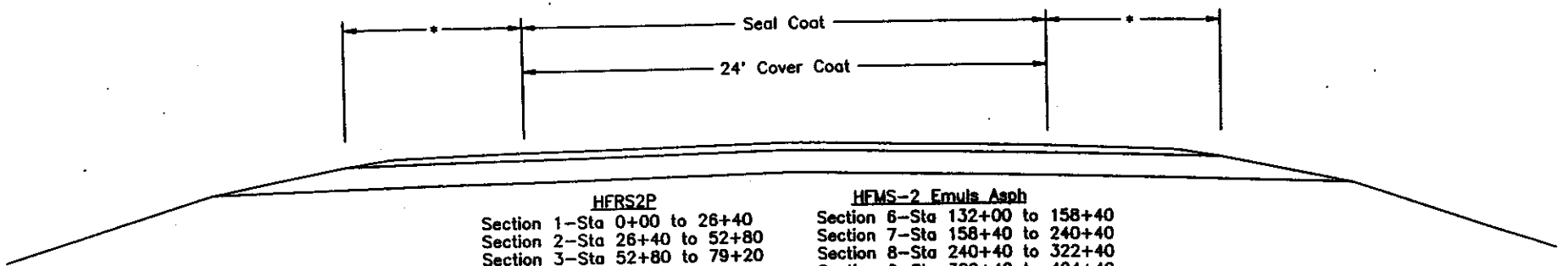
TYPICAL SURFACING SECTIONS



HFRS2P
Section 1–Sta 0+00 to 26+40
Section 2–Sta 26+40 to 52+80
Section 3–Sta 52+80 to 79+20
Section 4–Sta 79+20 to 105+60
Section 5–Sta 105+60 to 132+00

HFMS-2 Emuls Asph
Section 6–Sta 132+00 to 158+40
Section 7–Sta 158+40 to 240+40
Section 8–Sta 240+40 to 322+40
Section 9–Sta 322+40 to 404+40
Section 10–Sta 404+40 to 486+44.9

BASIS OF ESTIMATE

DESCRIPTION	UNIT	SECTION 1 APPL RATE/SY	SECTION 1 QUANT /STA	SECTION 1 WIDTH	SECTION 2 APPL RATE/SY	SECTION 2 QUANT /STA	SECTION 2 WIDTH	SECTION 3 APPL RATE/SY	SECTION 3 QUANT /STA	SECTION 3 WIDTH	SECTION 4 APPL RATE/SY	SECTION 4 QUANT /STA	SECTION 4 WIDTH	SECTION 5 APPL RATE/SY	SECTION 5 QUANT /STA	SECTION 5 WIDTH
HFRS2P for Seal Coat	GAL	0.20 gal	53.3	24'	0.31 gal	82.7	24'	0.28 gal	74.7	24'	0.28 gal	74.7	24'	0.28 gal	74.7	24'
Cover Coat Mtrl, Class 43	TON	18 lbs	2.4	24'	25 lbs	3.3	24'	25 lbs	3.3	24'	15 lbs	2.0	24'	25 lbs	3.3	24'
HFRS2P for Seal Coat	GAL	0.17 gal	75.6	40'	0.17 gal	30.2	*28'	0.17 gal	30.2	*28'	0.17 gal	30.2	*28'	0.20 gal	35.6	*28'
Cover Coat Mtrl, Class 45	TON	12 lbs	1.6	24'	8 lbs	1.1	24'									

*Shoulder Seal

DESCRIPTION	UNIT	SECTION 6 APPL RATE/SY	SECTION 6 QUANT /STA	SECTION 6 WIDTH	SECTION 7 APPL RATE/SY	SECTION 7 QUANT /STA	SECTION 7 WIDTH	SECTION 8 APPL RATE/SY	SECTION 8 QUANT /STA	SECTION 8 WIDTH	SECTION 9 APPL RATE/SY	SECTION 9 QUANT /STA	SECTION 9 WIDTH	SECTION 10 APPL RATE/SY	SECTION 10 QUANT /STA	SECTION 10 WIDTH
HFMS-2 Emuls Asph for Seal Coat	GAL	0.38 gal	101.3	24'	0.23 gal	61.3	24'	0.41 gal	109.3	24'	0.38 gal	101.3	24'	0.33 gal	88.0	24'
Cover Coat Mtrl, Class 43	TON	25 lbs	3.3	24'	18 lbs	2.4	24'	25 lbs	3.3	24'	25 lbs	3.3	24'	15 lbs	2.0	24'
HFMS-2 Emuls Asph for Seal Coat	GAL	0.20 gal	35.6	*28'	0.20 gal	88.9	40'	0.20 gal	35.6	*28'	0.20 gal	35.6	*28'	0.20 gal	35.6	*28'
Cover Coat Mtrl, Class 45	TON				12 lbs	1.6	24'	8 lbs	1.1	24'						

SMH32243 PS

TRAFFIC VOLUME

ADT: 1995 (North Rdwy) 6600

JOB# 6

FHWA REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	SNH-6-002(050)337	1

NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

IN GRAND FORKS COUNTY

PROJECT SNH-6-002(050)337

SEAL COAT

NORTH ROADWAY

GOVERNING SPECIFICATIONS:

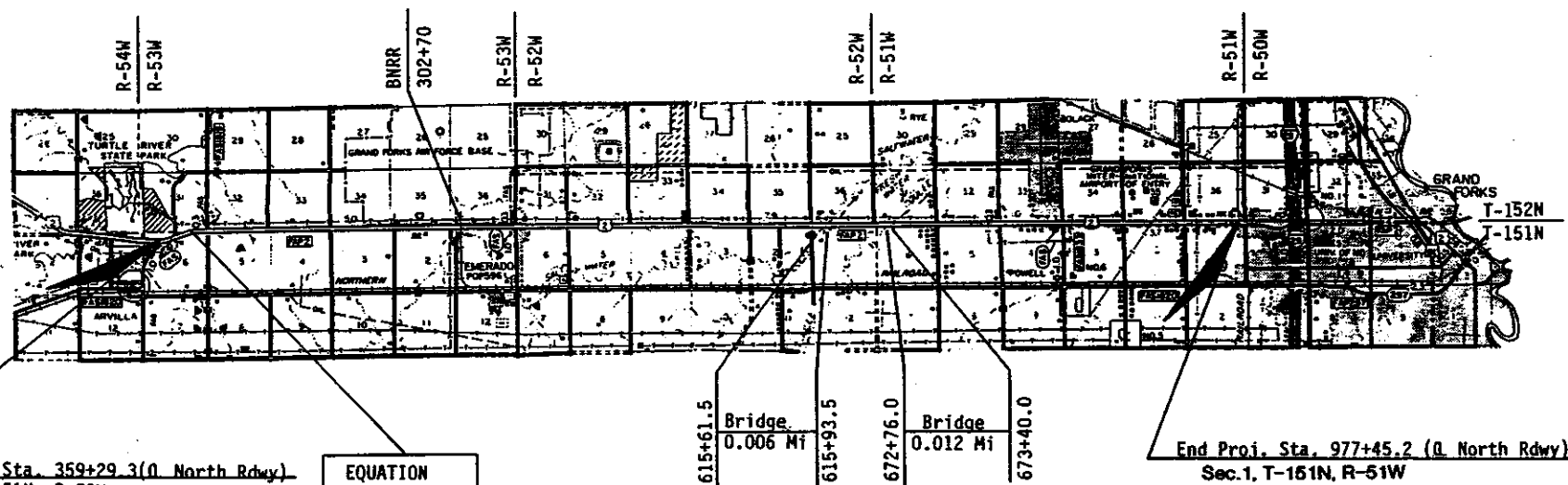
Standard Specifications adopted by the North Dakota Department of Transportation September 1992 Standard Drawings currently in effect; and other Contract Provisions submitted herein.

LENGTH OF PROJECT

Miles Gross	Miles Net
17.384	17.366

0.018 Miles Deducted for Bridges

N



A-6

Beg. Proj. Sta. 359+29.3 (Q North Rdwy)
Sec. 6, T-151N, R-53W

EQUATION
378+96.7 Bk=
79+26.1 Ahd

End Proj. Sta. 977+45.2 (Q North Rdwy)
Sec.1, T-151N, R-51W

PAVING SECTION Brian Rosin

URBAN SECTION

TRAFFIC SECTION

RURAL SECTION

RECOMMEND APPROVAL 7-28, 1995

DESIGN ENGINEER David K. Olson

APPROVED DATE

Ray Zink

DIRECTOR OF HIGHWAYS AND ENGINEERING

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

RAY ZINK REGISTERED PROFESSIONAL P.E. 972 ENGINEER NORTH DAKOTA

FHWA REGION	STATE	FED. AID PROJ. NO.
8	ND	SNH-6-002(050)337

BASIS OF ESTIMATE

DESCRIPTION	UNIT	① QUANTITY PER MILE	① WIDTH	② QUANTITY PER MILE	② WIDTH	③ QUANTITY PER MILE	③ WIDTH	APPROACHES (8)SL	APPROACHES (38)PD	APPROACHES (5)FD
MFMS-2 Emuls Asph for Seal Coat @ 0.38 Gal/SY	Gal	5,350	24'	5,350	24'	5,350	24'	198	9	5
Cover Coat, Class 42 @ 25#/SY	Ton	176	24'	176	24'	176	24'	6.5	0.3	0.2
MFMS-2 Emuls Asph for Seal Coat @ 0.20 Gal/SY (Shldr)	Gal	1,877	11.5'-4.5'	2,053	11.5'-6'	1,643	11'-3'			

A-7

Appendix B

North Dakota Department of Transportation

608 East Boulevard Avenue • Bismarck, ND 58505-0700

Edward T. Schafer, Governor
Marshall W. Moore, Director

Information: (701) 328-2500
FAX Mail: (701) 328-4545
TTY: (701) 328-4156

March 20, 1996

ADDENDUM 1 JOB 18

TO: All prospective bidders on Project SS-3-003(018)224, Job No. 18, scheduled for the March 29, 1996 bid opening.

The following Plan and Proposal revisions shall be made:

Plan Revision:

SHEET 4, NOTE 420/P02, SECTION 5, delete second sentence and replace with "Make one pass with a steel wheel roller and roll with a pneumatic tired roller according to Section 420."

Proposal Revision:

Remove pages 1 of 2 and 2 of 2 of the NORTH DAKOTA DEPARTMENT OF TRANSPORTATION REVISION TO SUPPLEMENTAL SPECIFICATIONS and replace with the enclosed pages revised 3-13-96.

Page 2 of 2: Penetration specifications were changed.

This addendum is to be incorporated into the bidder's proposal for this project.

Cal J Gendreau

CAL J. GENDREAU - CONSTRUCTION ENGINEER

JM
enclosure

ADDENDUM

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
REVISION TO SUPPLEMENTAL SPECIFICATIONS

The following Specification is a revision to the Supplemental Specifications for 03-29-96:

818.02 SPECIFIC REQUIREMENTS **Page 421** **03-29-96**

Delete Section 818.02 E in its entirety and insert the following:

E. **Anionic Emulsified Asphalt**.....ASTM D977

The following requirement for HFMS asphalts shall also apply when a high float medium set emulsion is specified:

Characteristics	**Test**	**HFMS-2**
Demulsibility, 0.02N $CaCl_2$, % min.	AASHTO T-59	30

HFRS 2P emulsified asphalts shall meet the following:

HFRS 2P (High Float Rapid Set Polymer Modified Asphalt) emulsified asphalt shall be an emulsified blend of polymerized asphalt, water, and emulsifiers. The asphalt cement shall be polymerized prior to emulsification and shall contain a minimum of three percent polymer by weight of asphalt cement. The emulsion, standing undisturbed for a minimum of 24 hours shall show no white, milky separation, but shall be smooth and homogeneous throughout. The emulsion shall be pumpable and suitable for application through a distributor. The emulsified blend shall conform to the following requirements:

PROPERTY	AASHTO TEST NO.	SPECIFICATION	
		Min.	Max.
Viscosity, Sabolt-Furol at 122°F sec.	T-59	50	450
Storage Stability Test, 24 hrs., percent	T-59		1.0
Sieve Test, percent	T-59		0.1
Demulsibility, 0.02 N $CaCl_2$, percent	T-59	30	
Oil Distillate by volume, percent	T-59		3.0
Residue by distillation, percent	T-59[1]	65	
Tests on Residue:			
Penetration 77°F, 100 gr., 5 sec.	T-49	100	200
Float Test, 140°F, sec.	T-50	1200	
Ductility, 77°F, cm.	T-51	75	
Solubility in Trichloroethylene, percent	T-44	97.5	
Elastic Recovery, 77°F, percent	T-51[2]	58	

1 AASHTO T-59 modify to include a 400 + 10°F maximum temperature to be held for 15 minutes.

2 AASHTO T-51 with the following modifications:

- Prepare and test one specimen.
- After filling the mold with the hot sample, cool to room temperature for a period of 30-40 minutes, then place the base plate and filled mold in the water bath maintained at 50°F for 85-95 minutes before trimming.
- Remove the specimen from the bath and immediately position it in the ductilometer, which has a bath temperature maintained at 50°F. Proceed to elongate the specimen at the rate of 5 cm/min.
- Elongate the specimen to 20 cm, then stop the ductilometer. Immediately cut the elongated specimen approximately in half with a scissors.
- Allow the specimen to remain in the ductilometer undisturbed for 1 hour.
- Retract the movable half of the specimen until the two broken ends touch, then observe the elongated measurements.
- Calculate: $\%\ \text{Elastic Recovery} = \frac{20 - X}{20} \times 100$

X = Elongated measurement after rejoining the ends of the specimen.

day's run in advance of the adjacent lane. The Contractor may be required to alter the milling operation to best suit construction conditions. When the milling is stopped, the milled depth shall be gradually tapered to the original pavement surface.

The completed milled surface shall be free from transverse and longitudinal irregularities exceeding 1/4 inch when measured with a 10-foot straightedge.

The Contractor shall dispose of the milled material as indicated in the Contract.

When the material is stockpiled, the stockpile site shall be shown on the Plans or if not shown, the Contractor shall select the site. The stockpile site shall be prepared according to Section 405.02 A.

The Contractor shall clean the milled surface by brooming before opening to traffic.

The Contractor shall remove equipment, materials, and residue from the roadway according to Section 107.05.

410.04 METHOD OF MEASUREMENT.

A. **Milling Pavement Surface.** Milling Pavement Surface shall be measured by the Ton or by the Square Yard. The labor, equipment, brooming, cleaning before and after milling, water used in milling, and depositing of the milled material on the roadbed or in a hauling unit, will not be measured for payment but will be considered incidental to the milling.

B. **Prepare and Restore Stockpile Site.** Prepare and Restore Stockpile Site will be measured and paid for as one Lump Sum regardless of the number of sites used. The Lump Sum bid shall include payment for removal, stockpiling, and replacement of topsoil; shaping the site subgrade; furnishing, placing, shaping, removal, and disposal of six inches of aggregate bedding and all incidental items.

C. **Stockpiled Surfacing.** Stockpiled Surfacing will be measured to the nearest 0.1 Ton of material weighed and placed in the stockpile. Loading, hauling, and stockpiling will not be measured but will be considered incidental to the pay item Stockpiled Surfacing.

   When Stockpiled Surfacing is not a Bid Item, all loading, hauling, and stockpiling will be incidental to Milling Pavement Surfacing.

410.05 BASIS OF PAYMENT.

Payment will be made at the Contract Unit Price for the following:

Pay Item	Pay Unit
Milling Pavement Surface	Ton, Square Yard
Prepare and Restore Stockpile Site	Lump Sum
Stockpiled Surfacing	Ton

This payment will be full compensation for all labor, equipment, and materials necessary to complete the work.

SECTION 420
BITUMINOUS SEAL COAT

420.01 DESCRIPTION.

This work consists of an application of bitumen followed by an application of cover coat material on a prepared surface.

420.02 MATERIALS.

A. **Bitumen.** The type and grade of bitumen will be specified in the Contract.

   The bitumen shall meet and will be accepted according to Section 818. The bitumen will be conditionally accepted at the Project and sampled according to Department procedures.

B. **Cover Coat Material.** Cover coat material shall meet Section 816 for the class specified. The material will be sampled and tested according to Department procedures. The Department will determine the point of acceptance for the cover coat material.

C. **Blotter Material.** Blotter material shall meet Section 816. The material will be sampled and tested according to Department procedures. The Department will determine the point of acceptance for the blotter material.

420.03 EQUIPMENT.

Equipment shall meet the following:

Item	Section
General	151.01
Material-Hauling Equipment	151.03 B
Self-Propelled Pneumatic-Tired Rollers	151.02 B
Liquid Bitumen Distributors	151.05
Heating Equipment for Bitumen	152.01 B
Aggregate Spreader	151.06

420.04 CONSTRUCTION REQUIREMENTS.

A. **Preparation of Surface.** Bitumen shall not be spread until the surface has been cleaned and the section has been approved.

   Where the surface is broken or shows instability, the Contractor shall make the necessary repairs before placing the bitumen.

B. When the average of the test results specified in Section 408.05 A.3 shows a larger shale content than the maximum allowable specified, the following deduction from the Bid Price for the bituminous mixture item will be made:

One percent reduction in unit price for each 0.2% above the maximum allowable percentage. If the percentage of shale exceeds the allowable limits by 2% or more, the material will be rejected unless the Construction Engineer elects to accept it under Section 105.07.

This reduction will apply to lots of 10,000 tons, and will be applied independently of Section 408.05 A.2.

C. Material for patching or leveling of an existing bituminous surface constructed under a previous Contract shall be obtained from the tonnage provided in the basis of estimate and will be paid according to the following provisions:

1. If no excavation is required, payment will be made at the Contract Unit Prices for the materials used in the repair.
2. When the patching requires excavation, the method and site of disposal of the waste materials shall be subject to the approval of the Engineer, and:
   a. If the excavated material is disposed of within the Right of Way adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-I."
   b. If the excavated material is loaded and hauled to a disposal area not adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-I."
   c. If aggregate is required to replace excavated material in the existing base or subgrade, payment for the class of aggregate used will be made under Section 104.03 D. Payment will include disposal of excavated material, and the furnishing, placing, and compacting of the aggregate.
   d. Payment for prime, tack, and the bitumen in the mix used in the repair will be made at the Contract Unit Prices for those items.

420.02 MATERIALS. **Page 185** **02-17-95 09-22-95 02-16-96**

Delete Section 420.02 in its entirety and insert the following:

A. **Bitumen.** The type and grade of bitumen will be specified in the Contract.

The bitumen shall meet and will be accepted according to Section 818. The bitumen will be conditionally accepted at the Project and sampled by the Contractor according to the Department's procedures. The Department will test the bitumen according to the Department's procedures.

B. **Cover Coat Material.** Cover Coat Material shall meet Section 816 for the class specified. The material will be sampled by the Contractor at random locations determined by the Engineer. The Department will determine the point of acceptance for the cover coat material and test it according to the Department's procedures. The Field Engineer will determine the actual amount of bitumen to be used based on a computer analysis of the chip size.

C. **Blotter Material.** Blotter material shall meet Section 816. The material will be sampled by the Contractor according to the Department's procedures. The Department will determine the point of acceptance for the blotter material and test it according to the Department's procedures.

420.03 EQUIPMENT. **Page 185** **09-22-95**

Add the following to the equipment list in Section 420.03:

Item	Section
Asphalt Transporter	152.06

420.04 CONSTRUCTION REQUIREMENTS. **Page 186** **02-16-96**

Insert the following as paragraph two in Section 420.04 B, Application of Bitumen.:

Streaking of the bitumen on the road surface will not be allowed. Streaking is the non-uniform application of bitumen leaving alternating lean and heavy narrow bands of bitumen. If the Engineer determines that streaking is occurring, the Contractor shall cease operations until the Engineer is satisfied that streaking has been eliminated.

420.04 CONSTRUCTION REQUIREMENTS. **Page 186** **02-16-96**

Delete the first sentence in the last paragraph of Section 420.04 B.

420.04 CONSTRUCTION REQUIREMENTS. **Page 186** **02-17-95**
04-21-95
02-16-96

Delete Section 420.04 C. in its entirety and insert the following:

C. **Cover Coat Material Application.** The cover coat material shall be spread uniformly over the bituminous material with an aggregate spreader. The angle of the scalper screen, the size of the openings in the screen, and the rate of application shall be coordinated so the coarse fraction of the aggregate is placed on the bitumen first and the fine fraction is dropped on top of the larger particles. Small areas inaccessible to the aggregate spreader may be covered by hand or other approved methods.

The quantities of cover coat material shown are based on estimated rates. The actual coverage rates will be determined by the Engineer.

Immediately after the cover coat material is spread, any deficient areas shall be covered by additional cover coat material or blotter material as directed by the Engineer.

Rolling shall begin immediately behind the spreader and shall continue until a minimum of four complete coverages are obtained. The speed of the roller shall not exceed 7 MPH on the initial coverage. A self-propelled pneumatic-tired roller shall be used to complete the rolling.

The loose cover coat material shall be lightly broomed off during the cool period of early morning within 36 to 48 hours from the time of application. The broom shall have a positive means of controlling the vertical pressure on the broomhead. Care shall be taken to avoid dislodging embedded aggregate. A final brooming shall be accomplished at the end of the maintenance period.

Excess material in curb and gutter sections shall be broomed toward the gutter and shall be picked up and disposed of by the Contractor.

1. **Requirements for Cutback Asphalts.** When using a cutback asphalt, the cover coat material shall be flushed with clear water and be well drained before it is applied to the roadway.

   The cover coat aggregate shall be applied immediately following application of the bitumen.

2. **Requirements for High Float Emulsified Asphalts.** When using a high float emulsified asphalt, the cover coat material shall not be flushed with water unless the Engineer determines that wetting of the aggregate is necessary.

   The cover coat material shall be applied when a surface skin develops on the emulsion. The surface skin is developed when the surface of the high-float emulsion is black while a brown color remains beneath the surface. Dependent upon weather conditions, the surface skin should form in 5 to 15 minutes after application of the emulsion to the roadway.

3. **Requirements for Cationic Emulsions.** When using a cationic emulsion, the cover coat material shall be flushed with clear water and be well drained before it is applied to the roadway.

   The cover coat aggregate shall be applied within 1 minute following application of the bitumen. If an application of emulsified asphalt is not covered before it begins to break, corrective action will be required by the Contractor at no cost to the Department.

Where seal work is the only Contract item, repairs shall be done according to Section 104.03 D.

Where the surfacing and seal coat are included in the same Contract, surface repair work will not be paid for unless the Engineer determines the damage was through no fault of the Contractor, in which case repairs shall be done according to Section 104.03 D.

B. **Application of Bitumen.** Bitumen shall be applied with a pressure distributor in a uniform, continuous spread. The quantity of bitumen to be used per square yard shall be as directed by the Engineer. Any skipped areas or deficiencies shall be corrected. Junctions of spreads shall be carefully made to assure a smooth riding surface and complete cover.

The surfaces of all structures and other appurtenances shall be protected against splattering. If splattering occurs, it shall be removed to the satisfaction of the Engineer at the Contractor's expense.

When traffic is maintained, the bitumen shall be applied in passes of approximately 1/2 the width of the completed surface. If the width of the surface makes such application impracticable, the bitumen may be applied in more than 2 passes.

The bitumen shall be applied so that when covered the overlaps caused by successive applications will not result in ridges or depressions at the transverse or longitudinal joints. The joints shall be smooth and consistent with the adjacent completed surface treatment.

Longitudinal laps may vary from 6 to 10 inches in width and shall not overlap at the end junctions. To prevent lapping at transverse junctions, the bitumen spray shall be promptly shut off at the end of the application. Before continuing the application, building paper or metal sheets shall be spread a sufficient distance back from the joint on the cover aggregate so the sprayers are operating at full force when the distributor has attained the predetermined speed upon reaching the uncovered surface. All paper or metal sheets used shall be removed.

C. **Cover Coat Material Application.** Cover coat material shall be applied immediately following application of bitumen at the rate designated or as directed by the Engineer. Cover aggregate shall be applied with an aggregate spreader and shall be rolled within 15 minutes. The application of bitumen, aggregate, and the rolling shall be a synchronized operation.

Small areas inaccessible to the aggregate spreader may be covered by hand or other methods as approved by the Engineer.

Immediately after the cover coat material is spread, any deficient areas shall be covered by additional material. Rolling shall consist of 4 complete coverages with self-propelled pneumatic-tired rollers. Fat spots shall be removed and replaced as directed by the Engineer.

D. **Blotter Material Application.** The application of blotter material may be necessary to correct "bleeding." Blotter material shall be applied in the quantity and manner approved by the Engineer.

E. **Protection of Traffic and Preservation of the Seal Coat.** The Contractor shall furnish flagpersons, pilot cars, signs, and lights according to Section 704.

The seal coat shall be maintained by the Contractor during the seal coat operation and maintenance shall continue for an additional 5 calendar days after completion of the seal coat work. The Contractor shall repair the seal coat within 2 hours of the time the need for such repairs are noted.

Maintenance of the seal coat may require application of blotter sand to prevent bleeding, application of more bitumen, application of more seal aggregate, and additional rolling. The blotter sand shall be applied with a mechanical spreader such as a tailgate sander or other approved device. The sweeping of loose cover coat material from the shoulder onto the new sealed surface will not be permitted.

As soon as practicable after sealing and no later than 5 days after the seal has been applied, all excess cover coat material shall be swept and removed from the entire surface as directed by the Engineer.

F. **Limitations.**

1. **Weather.** Bitumen shall not be applied on a wet surface or when weather conditions would prevent the proper construction of the seal coat. Seal work will not be permitted when the pavement temperature is below 70°F.

   Seal work shall not be started after September 1.

2. **Operational.** Each type of surface listed below shall be allowed a curing period after laydown and compaction has been completed as follows:

   a. Prime coat -- 4 days.

   b. SC, MC or RC Pavements -- 15 days.

   c. Asphalt Cement Pavements -- 7 days.

   d. Emulsion Pavements -- 15 days.

   These curing periods may be increased or decreased by written permission of the Engineer.

   Sealing work shall not be permitted at night. Unless otherwise authorized by the Engineer, the work shall be scheduled so that the last application of the day shall be placed in time for the bitumen to cure sufficiently to allow installation of the temporary striping before sunset, as specified in Section 762.04 D.1.

420.05 METHOD OF MEASUREMENT.

A. **Bitumen.** Bitumen will be measured by the Ton or Gallon.

B. **Cover Coat Material and Blotter Material.** Cover Coat Material and Blotter Material will be measured by the Ton or Cubic Yard or for urban projects, Square Yard, according to Section 109.

420.04 CONSTRUCTION REQUIREMENTS. Page 187 02-17-95 04-21-95 03-29-96

Insert the following after the first paragraph in Section 420.04 E.:

On two-lane, two-way traffic highways, the Contractor shall provide additional flaggers and signs at each end of the seal operation and at major intersections within the seal operation area, to alert the traveling public to the hazards of flying chips. These flaggers and signs will be in addition to the flaggers used with the pilot car at the seal operation. The additional flaggers shall be placed immediately beyond the daily seal operation area or outside the sealed area that presents a hazard with flying chips. The flaggers will be on the project during the seal coat application operation when a pilot car is being used. The flaggers shall provide each motorist with a notice printed on a sheet of paper a minimum of 3" x 5" in size similar to the following:

THIS HIGHWAY IS BEING RESURFACED WITH A CHIP SEAL COAT.

EXCESSIVE SPEED WILL CAUSE FLYING CHIPS WHICH COULD RESULT IN CHIPPED PAINT OR GLASS ON YOUR VEHICLE OR TO OTHER VEHICLES. ASPHALT MAY ALSO BE SPLATTERED ON YOUR VEHICLE.

REDUCE YOUR SPEED TO 40 MPH OR LESS. ANOTHER FLAGGER AND A PILOT CAR WILL ESCORT YOU AROUND THE SEAL COAT APPLICATION AREA.

The DO NOT PASS, NO CENTERLINE STRIPE, FRESH OIL LOOSE ROCK, and SPEED LIMIT signs shall remain covered until the chip seal operation is within 3 miles of that portion of the project.

On four-lane highways the additional flaggers and printed notices will not be required.

420.06 BASIS OF PAYMENT. Page 188 04-21-95

Add the following sentence to the second paragraph in Section 420.06:

The cost of flushing the cover coat material with water shall be incidental to the cost of the Contract Unit Price Bid for cover coat material.

550.02 MATERIALS. Page 193 07-29-94

Delete Section 550.02 B. in its entirety and insert the following:

B. **Portland Cement Concrete.** Pavement concrete shall be a Class AE-3 concrete meeting the requirements of Section 802.

550.04 CONSTRUCTION REQUIREMENTS. Page 198 05-28-93 02-16-96

Delete the sixth paragraph of Section 550.04 I.2. in its entirety and replace with the following:

A thin uniform coat of multipurpose lithium grease, NLGI Grade #2, shall be used as the release agent. The release agent shall be applied to the dowel bars within two hours of being covered with concrete.

Delete the second paragraph of Section 550.04 I.3. in its entirety and replace with the following:

Dowel bars shall be installed in the expansion joint to act as a load transfer device. The dowels shall be held in the specified position parallel to the slab surface and centerline by a metal supporting device securely staked to the roadbed and shall hold the dowel bars at the correct spacing, alignment, and elevation. The dowel bars shall be placed within a tolerance of 1/8 inch per foot vertically and horizontally. The "free" half of each dowel shall be coated with a thin uniform coat of multipurpose lithium grease, NLGI Grade #2, as the release agent, and covered with a metal or plastic dowel cap or sleeve. The caps or sleeves shall fit the dowel bars tightly and the closed end shall be watertight. After the dowel bar assembly is staked to the roadbed and the dowel bars are held firmly in place, the assembly ties running parallel to the dowel bars shall be removed to allow for free movement of the dowel bars.

420.06 BASIS OF PAYMENT.

Payment will be made at the Contract Unit Price for the following:

Pay Item	Pay Unit
---Liquid Asphalt	Ton or Gallon
---Emulsified Asphalt	Ton or Gallon
Cover Coat Material Class----	Ton or Cubic Yard or Square Yard
Blotter Material	Ton or Cubic Yard

This payment will be full compensation for all labor, equipment, and materials necessary to complete the work.

If the bid item "Blotter Material" is not included as a pay item in the Contract, payment will be made at the rate specified in the Price Schedule (PS-1) in the Proposal.

SECTION 500
RIGID PAVEMENT

Appendix C

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504
TEST, TANK CAR AND TRUCK REPORT

PROJECT: SS-3-003(018)224 DATE RECEIVED:

SUBMITTED BY: John Holzer COUNTY: Rolette

MANUFACTURER: Koch REPORT NO. 213

LAB. NO.	FIELD NO.	MANIFEST NO.	MATERIAL TYPE	KIN VIS @ 140 F (cSt)	DATE SAMPLED
EM-87	6	8470	HFMS-2		8-23-96
EM-88	7	8471	HFMS-2		8-23-96
EM-89	8	8472	HFMS-2		8-23-96

	EM-87	EM-88	EM-89
Viscosity SFS @ 50°C	59 sfs		62 sfs
Sieve Test - Retained on No. 20	0.01%	0.02%	0.10%
Oil Distillate (% by Volume)			0.5%
Distillation Residue			66.60%
Ending Demulsibility			26.14% *Fail

Distribution:
Dist: Devils Lake
Proj Engr: Spaeth
Contractor: ASTECH
Manufacturer: Koch
Construction Records:

SFN10084

Conformity to Specifications:
* Failing sample
Joe Davis, Bituminous Engineer
September 5, 1996

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504
TEST, TANK CAR AND TRUCK REPORT

PROJECT: SS-3-003(018)224 DATE RECEIVED:

SUBMITTED BY: John Holzer COUNTY: Rolette

MANUFACTURER: Koch REPORT NO. 212

LAB. NO.	FIELD NO.	MANIFEST NO.	MATERIAL TYPE	KIN VIS @ 140 F (cSt)	DATE SAMPLED
EM-82	1	8451	HFMS-2		8-21-96
EM-92	1	8451 ck	HFMS-2		
EM-83	2	8452	HFMS-2		
EM-93	2	8452 ck	HFMS-2		
EM-84	3	8455	HFMS-2		
EM-85	4	8456	HFMS-2		
EM-86	5	8458	HFMS-2		

	EM-82	EM-92	EM-83	EM-93	EM-84	EM-85	EM-86
Viscosity SFS @ 60°C Koppler	2150						
Viscosity SPF @ 50°C sfs	30 *	26*	30*	28*	44	85	70
Sieve Test - Retained on No. 20	0.06%		0.08%		0.21%*	0.08%	0.04%
Oil Distillate (% by Volume)	0.5%						
Distillation Residue	66.45%						
Tests on Distillation Residue:							
Penetration @ 25°C	186						
Ductility @ 25° C	45+%						
Float test @ 60°C	1300+						
Demulsibility	43.08%						

Distribution:

Dist:Devils Lake

Proj Engr: Spaeth

Contractor: ASTECH

Manufacturer: Koch

Construction Records:

SFN10084

Conformity to Specifications:

* - Failing samples

Joe Davis, Bituminous Engineer

September 5, 1996

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504
TEST, TANK CAR AND TRUCK REPORT

PROJECT: SS-3-003(018)224 DATE RECEIVED:

SUBMITTED BY: John Holzer COUNTY: Rolette

MANUFACTURER: Koch REPORT NO. 214

LAB. NO.	FIELD NO.	MANIFEST NO.	MATERIAL TYPE	KIN VIS @ 140 F (cSt)	DATE SAMPLED
EM-80	1	7723	HFRS-2P		8-22-96
EM-90	1	7723 ck	HFRS-2P		
EM-81	2	7730	HFRS-2P		8-22-96
EM-91	2	7730 ck	HFRS-2P		

	EM-80	EM-90	EM-81	EM-91
Viscosity SFS @ 50°C	30 sfs * Fails	28 sfs*	31 sfs*	32 sfs*
Sieve Test - Retained on No. 20	0.08%		0.13% * Fails	
Oil Distillate (% by Volume)	0.5%		0.5%	
Distillation Residue	68.25%		68.25%	
Tests on Distillation Residue:				
Penetration @ 25°C	160			
Solubility in Trichlor	99.81%			
Ductility @ 25° C	100+ cm			
Float test @ 60°C	192 sec* Fails			
Elastic Recovery	65%			
Demulsibility	34.99%			
Ending Demulsibility			36.28%	

Distribution:

Dist: Devils Lake

Proj Engr: Spaeth

Contractor: ASTECH

Manufacturer: Koch

Construction Records:

Conformity to Specifications:

Sample Fails

Joe Davis, Bituminous Engineer

September 3, 1996

SFN10084

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504

AGGREGATE TEST REPORT

MATERIAL: COVER COAT

SPECIFICATION: 420 CL 43

PIT LOCATION: W1/2 35-162-73

OWNER: BRADSHAW

PROJECT: SS-3-003(018)224

COUNTY: ROLETTE

LABORATORY NO: CA-134-96

FIELD SAMPLE NO: PROGRESS 2

DATE RECEIVED: 08/23/96

DATE SAMPLED: 08/14/96

SAMPLE FROM: STOCKPILE

SUBMITTED BY: SALISBURY

SIEVE	%PASSING
4"	
3 1/2"	
3"	
2 1/2"	
2"	
1 1/2"	
1"	
3/4"	
5/8"	
1/2"	
3/8"	100
NO.4	42
NO.8	5
NO.10	
NO.16	
NO.30	
NO.40	
NO.50	
NO.100	
NO.200	0.5

%LT. WT. PARTICLES(LESS THAN 1.95 SPG) +NO.4:
%LT. WT. PARTICLES(LESS THAN 1.95 SPG) -NO.4:
%LT. WEIGHT PARTICLES IN TOTAL SAMPLE: 3.5
L.A. ABRASION %LOSS:
CLAY(% OF TOTAL SAMPLE):
WT. LBS/C.F. LOOSE:
WT. LBS/C.F. RODDED:
LIQUID LIMIT (-200): (-40):
PLASTICITY INDEX (-200): (-40):
%FRACTURED FACES +NO.4:
%FRACTURED FACES +NO.8:
%MOISTURE:
%ASPHALT:
%SOUNDNESS CRSE:
%SOUNDNESS FINE:

( ) TEST RESULTS AFTER EXTRACTION OF ASPHALT

N.T. NOT TESTED
** PREVIOUS TEST SATISFACTORY

(X) MEETS SPECIFICATIONS
( ) DOES NOT MEET SPECIFICATIONS

REMARKS:

DISTRIBUTION

DISTRICT: DEVILS LAKE
PROJECT ENGR: HOLZER
CENTRAL LABORATORY
CONTRACTOR: ASTECH

DENNIS J. BLASL
TESTING LAB. SUPERVISOR
09/18/96

FORM SFN-9993

AGGREGATE SAMPLE INFORMATION

State Highway Department, Materials Lab.
SFN 16258 (1-89)

MATERIAL: Cover Coat Material	CONTRACTOR: Asphalt Surface Tech
SPECIFICATION SIZE OR CLASS: 420 C1 43	FIELD SAMPLE NO.: Progress 2

Pit Location

SAND	GRAVEL	AGGREGATE: W½ 35-162-73
PIT OWNER: Bradshaw		DATE SAMPLED: 8-14-96
PROJECT: SS-3-003(018)224		SAMPLE FROM: Stockpile
COUNTY: Rolette		SUBMITTED BY: R Glenn Salisbury
DISTRICT: Devils Lake		PROJECT ENGINEER: John Holzer

Indicate tests to be performed by check mark and give specification requirements on these tests.

Check Item	Class of Aggregate Specification	Specification Requirements
( )	pH Test	
(X)	Lightweight Pieces	max 8%
( )	Particle Size Analysis	
( )	Unit Weight	
( )	Fractured Faces	
( )	Plasticity Index	
( )	Specific Gravity	
( )	Moisture-Density Relations of Soils	
	Concrete Aggregate Specification	
( )	Shale	
( )	Hard Iron Oxide Particles	
( )	Lignite and Other Coal	
( )	Soft Particles	
( )	Thin or Elongated Pieces	
( )	Material Passing No. 200	
( )	LA Abrasion	
( )	Soundness	
( )		
( )		

Check Items	Sieve Analysis Sieve Size	Specification Requirements
( )	1 1/2"	
( )	1"	
( )	3/4"	
( )	5/8"	
( )	1/2"	
(X)	3/8"	100
(X)	No. 4	20-70
(X)	No. 8	0-17
( )	No. 10	
( )	No. 16	
( )	No. 30	
( )	No. 30	
( )	No. 50	
( )	No. 100	
(X)	No. 200	0-2
( )		
( )		

Central Lab Use Only
Lab No. CF-134-96
Date Received 8-23-96
Approved
Not Approved

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504

AGGREGATE TEST REPORT

MATERIAL: COVER COAT
LABORATORY NO: CA-133-96

SPECIFICATION: 420 CL 43 MODIFIED
FIELD SAMPLE NO: PROGRESS 1

PIT LOCATION: W1/2 35-162-73
DATE RECEIVED: 08/23/96

OWNER: BRADSHAW
DATE SAMPLED: 08/14/96

PROJECT: SS-3-003(018)224
SAMPLE FROM: STOCKPILE

SUBMITTED BY: SALISBURY

COUNTY: ROLETTE

SIEVE	%PASSING
4"	
3 1/2"	
3"	
2 1/2"	
2"	
1 1/2"	
1"	
3/4"	
5/8"	
1/2"	
3/8"	100
NO.4	28.
NO.8	1
NO.10	
NO.16	
NO.30	
NO.40	
NO.50	
NO.100	
NO.200	0.1

%LT. WT. PARTICLES(LESS THAN 1.95 SPG) +NO.4:
%LT. WT. PARTICLES(LESS THAN 1.95 SPG) -NO.4:
%LT. WEIGHT PARTICLES IN TOTAL SAMPLE: 1.6
L.A. ABRASION %LOSS:
CLAY(% OF TOTAL SAMPLE):
WT. LBS/C.F. LOOSE:
WT. LBS/C.F. RODDED:
LIQUID LIMIT (-200): (-40):
PLASTICITY INDEX (-200): (-40):
%FRACTURED FACES +NO.4: 76.4
%FRACTURED FACES +NO.8:
%MOISTURE:
%ASPHALT:
%SOUNDNESS CRSE:
%SOUNDNESS FINE:

( ) TEST RESULTS AFTER EXTRACTION OF ASPHALT

N.T. NOT TESTED
** PREVIOUS TEST SATISFACTORY

(X) MEETS SPECIFICATIONS
( ) DOES NOT MEET SPECIFICATIONS

REMARKS:

DISTRIBUTION

DISTRICT: DEVILS LAKE
PROJECT ENGR: JOHN HOLZER
CENTRAL LABORATORY
CONTRACTOR: ASTECH

DENNIS J. BLASL
TESTING LAB. SUPERVISOR
09/16/96

FORM SFN-9993

AGGREGATE SAMPLE INFORMATION

State Highway Department, Materials Lab.
SFN 16258 (1-89)

MATERIAL: Cover Coat Material	CONTRACTOR: Asphalt Surface Tech
SPECIFICATION SIZE OR CLASS: 420 - C1 43 modified	FIELD SAMPLE NO.: Progress 1

Pit Location

SAND	GRAVEL	AGGREGATE: W½ 35-162-73
PIT OWNER: Bradshaw		DATE SAMPLED: 8-14-96
PROJECT: SS-3-003(018)224		SAMPLE FROM: Stockpile
COUNTY: Rolette		SUBMITTED BY: R Glenn Sabakuny
DISTRICT: Devils Lake		PROJECT ENGINEER: John Holzer

Indicate tests to be performed by check mark and give specification requirements on these tests.

Check Item	Class of Aggregate Specification	Specification Requirements
( )	pH Test	
(X)	Lightweight Pieces	max 8% (2.00)
( )	Particle Size Analysis	
( )	Unit Weight	
(X)	Fractured Faces	min 70%
( )	Plasticity Index	
( )	Specific Gravity	
( )	Moisture-Density Relations of Soils	
	Concrete Aggregate Specification	
( )	Shale	
( )	Hard Iron Oxide Particles	
( )	Lignite and Other Coal	
( )	Soft Particles	
( )	Thin or Elongated Pieces	
( )	Material Passing No. 200	
( )	LA Abrasion	
( )	Soundness	
( )		
( )		

Check Items	Sieve Analysis Sieve Size	Specification Requirements
( )	1 1/2"	
( )	1"	
( )	3/4"	
( )	5/8"	
( )	1/2"	
(X)	3/8"	100
(X)	No. 4	0-40
(X)	No. 8	0-10
( )	No. 10	
( )	No. 16	
( )	No. 30	
( )	No. 30	
( )	No. 50	
( )	No. 100	
(X)	No. 200	0-2
( )		
( )		

Central Lab Use Only
Lab No. LP-133-96
Date Received 8-22-96
Approved
Not Approved

SS-3-003(018)224
Application Rates

Material	Average Rate Per S.Y.	Plan Rate Per S.Y.	Material	Average Rate Per S.Y.	Plan Rate Per S.Y.
Section #1			**Section #7**		
HFRS-2P (1st shot)	0.216 gals.	0.20 gals.	HFMS-2	0.24 gals.	0.23 gals.
HFRS-2P (2nd shot)	0.216 gals.	0.17 gals.	Cl. 43 Mod.	18.3 lbs.	18 lbs.
Cl. 43	20.2 lbs.	18 lbs.	HFMS-2	0.196 gals.	0.20 gals.
Cl. 45	11.5 lbs.	12 lbs.	Cl. 45	11.3 lbs.	12 lbs.
Section #2			**Section #8**		
HFRS-2P	0.30 gals.	0.31 gals.	HFMS-2	0.417 gals.	0.41 gals.
Cl. 43	29 lbs.	25 lbs.	Cl. 43 Mod.	23.4 lbs.	25 lbs.
Cl. 45	10 lbs.	8 lbs.	Cl. 45	8.3 lbs.	8 lbs.
Section #3			**Section #9**		
HFRS-2P	0.28 gals.	0.28 gals.	HFMS-2	0.39 gals.	0.38 gals.
Cl. 43	30 lbs.	25 lbs.	Cl. 43	25.7 lbs.	25 lbs.
Section #4			**Section #10**		
HFRS-2P	0.30 gals.	0.28 gals.	HFMS-2	0.33 gals.	0.33 gals..
Cl. 43	19 lbs.	15 lbs.	Cl. 43	15.3 lbs.	15 lbs.
Section #5					
HFRS-2P	0.29 gals.	0.28 gals.			
Cl. 43	24.5 lbs.	25 lbs.			
Section #6					
HFMS-2	0.39 gals.	0.38 gals.			
Cl. 43	28 lbs.	25 lbs.			

SS-3-003(018)224
COST/SECTION
Prorated Page1

SECTION #1

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	71.2	12.20	868.64
Cl. 45	29.0	9.90	287.10
HFRS-2P	2,744.0	1.30	3,567.20
Shoulders			1,220.26
All other items (prorated)			1,408.62
TOTAL			7,351.82

SECTION #2

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	109.2	12.20	1,332.24
Cl. 45	44.7	9.90	442.53
HFRS-2P	2,352.0	1.30	3,057.60
Shoulders			1,220.26
All other items (prorated)			1,408.62
TOTAL			7,461.25

SECTION #3

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	109.0	12.20	1,329.80
HFRS-2P	1,983.0	1.30	2,577.90
Shoulders			1,220.26
All other items (prorated)			1,408.62
TOTAL			6,536.58

SECTION #4

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	67.5	12.20	823.50
HFRS-2P	2,107.0	1.30	2,739.10
Shoulders			1,220.26
All other items (prorated)			1,408.62
TOTAL			6,191.48

SECTION #5

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	87.7	12.20	1,069.94
HFRS-2P	2,009.0	1.30	2,611.70
Shoulders			1,220.26
All other items (prorated)			1,408.62
TOTAL			6,310.52

SECTION #6

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	101.4	12.20	1,237.08
HFMS-2	2,831.0	0.78	2,208.18
Shoulders			732.15
All other items (prorated)			1,408.62
TOTAL			5,586.03

SECTION #7

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	200.0	12.20	2,440.00
Cl. 45	123.3	9.90	1,220.67
HFMS-2	10,548.0	0.78	8,227.44
Shoulders			2,273.70
All other items (prorated)			4,059.72
TOTAL			18,221.53

SECTION #8

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	249.4	12.20	3,042.68
Cl. 45	90.4	9.90	894.96
HFMS-2	9,360.0	0.78	7,300.80
Shoulders			2,273.70
All other items (prorated)			4,059.72
TOTAL			17,571.86

SS-3-003(018)224
COST/SECTION
Prorated Page 3

SECTION #9

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	286.5	12.20	3,495.30
HFMS-2	9,493.0	0.78	7,404.54
Shoulders			2,273.70
All other items (prorated)			4,059.72
TOTAL			17,233.26

SECTION #10

MATERIAL	QUANTITY	UNIT PRICE	TOTAL
Cl. 43	166.5	12.20	2,031.30
HFMS-2	7,116.0	0.78	5,550.48
Shoulders			2,273.70
All other items (prorated)			4,059.72
TOTAL			13,915.72

SUMMARY OF AGGREGATE QUALITY TESTS

State Highway Department, Materials Lab.
SFN 10072 (Rev. 4-89)

Specification Section No. and Title: Sect. 420 Cover Coat Cl. 42

Project No. SNH-6-002(050)337 — Aggregate Class 12 - Cover Coat Material

County Grand Forks — Los Angeles Wear N/T

Location Hwy 42, W.B. Lane Arvilla to G.F. — Lab. Test No.

Source of Aggregates Bradshaw gravel - Border Pit SW¼-29-150N-52W

SPECIFICATIONS	SIEVE SIZES AND PERCENTS PASSING												
	3/8"	#4	#8	#16	#30	#50	#200		Shale				
	100	20-70	2-20	-	-	-	0-5		Max 8%				

TEST DATA

Date/Time Sampled	Location Sampled	Test No.	PERCENTS PASSING													REMARKS
7/15/96	Stockpile	1	100	43	11	2.2	1.2	0.8	0.3		0.3					
		2	100	50	7.9	2.5	1.7	1.4	1.0		N/T					
		3	100	54	10	2.2	1.4	1.1	0.7		N/T					
		4	100	43	7	1.6	1.0	0.8	0.6		N/T					
7/25/96	Stockpile	5	100	40	2.9	0.6	0.6	0.5	0.4		0.2					
		6	100	46	8.4	1.9	1.2	0.9	0.5		NT					
		7	100	43	2.8	0.7	0.5	0.4	0.3		NT					
		8	100	44	7.4	1.7	1.0	0.8	0.5		NT					
7/29/96	Stockpile	9	100	45	8.5	2.4	1.8	1.5	1.2		NT					
		10	100	46	11	2.7	1.6	1.2	0.7		NT					
7/30/96	Stockpile	5-1	100	43	2.9	NT	0.9	NT	0.59		0.14					State tested split sample from test #5
7/30/96	Stockpile	9-2	100	51	8.8	NT	2.0	NT	1.21		NT					State tested split sample from test #9
7/4/96	Stockpile	CL.1	100	42	6	NT	NT	NT	0.5							Control lab sample #1

C-12

If the PI and LL are required, these should also be shown. Percentages shall be reported to the nearest whole percent, except for the No. 200 sieve which shall be reported to the nearest 0.1 percent. Include all tests conducted, both passing and failing, and circle all failing percentages. Indicate under "Remarks" the action taken to correct the situation causing failing tests. As each item of the project is completed, submit the original copies of these reports to the district materials coordinator for correction and review. When he is satisfied that all tests are tabulated, he will sign and forward a copy to FHWA.

Submitted by

Signature of Project Engineer

Reviewed by

Signature of District Materials Coordinator

Date

Legend - Test Type
J - Job Control
P - Progress Record
F - Final Record
B - Witnessed by FHWA

AGGREGATE GRADATION REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
DISTRICT TESTING LABORATORY

MATERIAL: COVER COAT MATERIAL

SPECIFICATION: SEC. 420 CLASS-42

PIT LOCATION: SW ¼ 29-150-52

OWNER: BRADSHAW - ROEDER

PROJECT: SNH-6-002- (050)337

COUNTY: GRAND FORKS

LABORATORY NO.: GMG-96-43

FIELD SAMPLE NO.: 9-2

DATE RECEIVED: 08/12/96

DATE SAMPLED: 07/30/96

SAMPLE FROM: STOCKPILE

SUBMITTED BY: HALL-WEB,FOS,WESTON

SIEVE		DISTRICT % PASSING	CL-42 SPEC.
1/2"	(12.5)	100	100
3/8"	(9.5)	100	100
NO.4	(4.75)	51	20 - 70
NO.8	(2.36)	8.8	2 - 20
NO.30	(600um)	2.0	
NO.200	(75um)	1.21	0 - 5
SHALE		N.T.	8 % MAX.
L.A. ABRASION		N.T.	40 % MAX.
WT. LBS./C.F. LOOSE		N.T.	
WT. LBS./C.F. RODDED		N.T.	

CONFORMITY TO SPECIFICATIONS ***** APPROVED *****
X SUFFICIENT FOR REJECTION
N.T. NOT TESTED

REMARKS:

DISTRIBUTION

DISTRICT: GRAND FORKS
PROJECT ENGR: HALL-WEB,FOS,WESTON
CONTRACTOR: ASTECH
DIST LAB
CONSTRUCTION
FORM SFN-9993

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 08/20/96

AGGREGATE GRADATION REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
DISTRICT TESTING LABORATORY

MATERIAL: COVER COAT MATERIAL

SPECIFICATION: SEC. 420 CLASS-42

PIT LOCATION: SW ¼ 29-150-52

OWNER: BRADSHAW - ROEDER

PROJECT: SNH-6-002- (050)337

COUNTY: GRAND FORKS

LABORATORY NO.: OMG-96-42

FIELD SAMPLE NO.: 5-1

DATE RECEIVED: 08/12/96

DATE SAMPLED: 07/30/96

SAMPLE FROM: STOCKPILE

SUBMITTED BY: ROB HALL-WEB,FOS,WS

SIEVE		DISTRICT % PASSING	CL-42 SPEC.
1/2"	(12.5)	100	100
3/8"	(9.5)	100	100
NO.4	(4.75)	43	20 - 70
NO.8	(2.36)	2.9	2 - 20
NO.30	(600um)	0.9	
NO.200	(75um)	0.59	0 - 5
SEALE		0.140	8 % MAX.
L.A. ABRASION		N.T.	40 % MAX.
WT. LBS./C.F. LOOSE		N.T.	
WT. LBS./C.F. RODDED		N.T.	

CONFORMITY TO SPECIFICATIONS ***** APPROVED *****
X SUFFICIENT FOR REJECTION
N.T. NOT TESTED

REMARKS:

DISTRIBUTION

DISTRICT: GRAND FORKS
PROJECT ENGR: HALL-WEB,FOS,WESTON
CONTRACTOR: ASTECH
DIST LAB
CONSTRUCTION
FORM SFN-9993

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 08/20/96

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504

AGGREGATE TEST REPORT

MATERIAL: COVER COAT

SPECIFICATION: 420 CL 42

PIT LOCATION: SW1/4 29-150-52

OWNER: BRADSHAW/ROEDER

PROJECT: SNH-6-002(050)337
- - ( )

LABORATORY NO: CA-65-96

FIELD SAMPLE NO: CEN LAB 1

DATE RECEIVED: 07/17/96

DATE SAMPLED: 07/11/96

SAMPLE FROM: STOCKPL NEAR ARVILLA

SUBMITTED BY: DVORAK

COUNTY: GRAND FORKS

SIEVE	%PASSING
4"	
3 1/2"	
3"	
2 1/2"	
2"	
1 1/2"	
1	
3/4"	
5/8"	
1/2"	
3/8"	100
NO.4	42
NO.8	6
NO.10	
NO.16	
NO.30	
NO.40	
NO.50	
NO.100	
NO.200	0.5

%LT. WT. PARTICLES(LESS THAN 1.95 SPG) +NO.4:
%LT. WT. PARTICLES(LESS THAN 1.95 SPG) -NO.4:
%LT. WEIGHT PARTICLES IN TOTAL SAMPLE: 0.2
L.A. ABRASION %LOSS:
CLAY(% OF TOTAL SAMPLE):
WT. LBS/C.F. LOOSE:
WT. LBS/C.F. RODDED:
LIQUID LIMIT (-200): (-40):
PLASTICITY INDEX (-200): (-40):
%FRACTURED FACES +NO.4:
%FRACTURED FACES +NO.8:
%MOISTURE:
%ASPHALT:
%SOUNDNESS CRSE:
%SOUNDNESS FINE:

( ) TEST RESULTS AFTER EXTRACTION OF ASPHALT

N.T. NOT TESTED
** PREVIOUS TEST SATISFACTORY

(X) MEETS SPECIFICATIONS
( ) DOES NOT MEET SPECIFICATIONS

REMARKS:

DISTRIBUTION

DISTRICT: GRAND FORKS
PROJECT ENGR: WEBSTER,FOSTER,WESTON
CENTRAL LABORATORY
CONTRACTOR: ASTECH

DENNIS J. BLASL
TESTING LAB. SUPERVISOR
08/06/96

FORM SFN-9993

TEST, TANK CAR AND TRUCK REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS TESTING LABORATORY

DATE RECEIVED: 07/25/96 PROJECT: SNH-6-002(050)337

SUBMITTED BY: DALE BERGUM,WEB,FOS,WESTN COUNTY: GRAND FORKS

MANUFACTURER: KOCH TYPE: HFRS-2 REPORT NO: 37-96

LAB. NO.	FIELD NO.	MANIFEST NO.	VIS @ 122	WT/GAL 60 F	NET WT.	NET GALS.	DATE SAMPLED
216	1	608318	80	8.400	66180	7879	07/24/96
217	2	608316	84	0.000	69960	8329	07/24/96

CONFORMITY TO SPECIFICATIONS: SAMPLES WERE VERY HOMOGENEOUS WITH ONLY A VERY MINUTE AMOUNT OF RESIDUE RETAINED ON THE #20 SIEVE. TESTED WITH A #3 ZAHN CUP. SAMPLES WERE LESS THAN 24HRS OLD.

(Y) APPROVED
( ) NOT APPROVED

X SUFFICIENT FOR REJECTION

DISTRIBUTION

DIST: GRAND FORKS
PROJECT ENGR: BERGUM, WFW
CONTRACTOR: ASTECH
MANUFACTURER KOCH
DIST LAB
CONSTRUCTION

FORM SFN-10064

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 07/26/96

RECEIVED

JUL 30 1996

WEBSTER, FOSTER P...
GRAND FORKS, ND...

TEST, TANK CAR AND TRUCK REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS TESTING LABORATORY

DATE RECEIVED: 07/26/96 PROJECT: SNH-6-002(050)337

SUBMITTED BY: DALE BERGUM,WEB-FOS-WESTN COUNTY: GRAND FORKS

MANUFACTURER: KOCH TYPE: HFRS-2 REPORT NO: 38-96

LAB. NO.	FIELD NO.	MANIFEST NO.	VIS @ 122	WT/GAL 60 F	NET WT.	NET GALS.	DATE SAMPLED
218	3A	606328	70 X	8.400	66940	7969	07/25/96
219	4A	606333	72 X	0.000	53300	6345	/ /
220	5A	608330	92	0.000	71380	8498	/ /
221	6A	606335	60 X	0.000	64360	7662	/ /
222	7A	606336	58 X	0.000	50120	5967	/ /
223	8A	606339	60 X	0.000	69000	8214	/ /
	3B		74 X	0.000	0	0	/ /
	4B		76	0.000	0	0	/ /
	6B		58 X	0.000	0	0	/ /
	7B		56 X	0.000	0	0	/ /
	8B		60 X	0.000	0	0	/ /

CONFORMITY TO SPECIFICATIONS: SAMPLES 5A & 4B(CK) MEET THE MIN VIS OF 75 SEC @ 122° F. THE OTHER 4 DO NOT MEET ALL TESTS WITH A #3 ZAHN CUP @ 122° F. ALL SAMPLES VISIBLY DIFFERENT FROM YSTDYS

(Y) APPROVED
(X) NOT APPROVED

X SUFFICIENT FOR REJECTION

DISTRIBUTION

DIST: GRAND FORKS
PROJECT ENGR: BERGUM - WFW
CONTRACTOR: ASTECH
MANUFACTURER KOCH
DIST LAB
CONSTR & CENT LAB

FORM SFN-10084

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 07/26/96

TEST, TANK CAR AND TRUCK REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS TESTING LABORATORY

DATE RECEIVED: 07/30/96 PROJECT: SNH-6-002(050)337

SUBMITTED BY: DALE BERGUM-WEB,FOS,WESTN COUNTY: GRAND FORKS

MANUFACTURER: KOCH TYPE: HFRS-2 REPORT NO: 39-96

LAB. NO.	FIELD NO.	MANIFEST NO.	VIS @ 122	WT/GAL 60 F	NET WT.	NET GALS.	DATE SAMPLED
224	9A	606345	120	8.400	67420	8026	07/26/96
225	10A	606357	100	8.400	70340	8374	07/29/96
226	11A	606359	100	8.400	50060	5960	07/29/96
227	12A	606363	100	8.400	67160	7995	07/29/96
228	13A	606366	100	8.400	69640	8290	07/29/96

CONFORMITY TO SPECIFICATIONS: THESE SAMPLES VERY MUCH LIKE #'S 1 & 2 FROM 07-24-96. VERY HOMOGENEOUS. VERY CONSISTENT & ALMOST NO RETAINAGE ON THE #20 SIEVE. #3 ZAHN CUP USED.

(Y) APPROVED
( ) NOT APPROVED

X SUFFICIENT FOR REJECTION

DISTRIBUTION

DIST: GRAND FORKS
PROJECT ENGR: BERGUM - WFW
CONTRACTOR: ASTECH
MANUFACTURER KOCH
DIST LAB
CONSTRUCTION

FORM SFN-10064

JACOB B. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 07/30/96

TEST, TANK CAR AND TRUCK REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS TESTING LABORATORY

DATE RECEIVED: 07/31/96 PROJECT: SNH-6-002(050)337

SUBMITTED BY: DALE BERGUN-WEB,FOS,WESTN COUNTY: GRAND FORKS

MANUFACTURER: KOCH TYPE: HFRS-2 REPORT NO: 41-96

LAB. NO.	FIELD NO.	MANIFEST NO.	VIS @ 122	WT/GAL 60 F	NET WT.	NET GALS.	DATE SAMPLED
232	14	606367	116	8.400	65480	7795	07/30/96
233	15	616674	400 *	8.434	51440	6099	07/30/96
234	16	606369	140	8.400	69700	8298	07/30/96
235	17	606375	142	8.400	66620	7931	07/30/96
236	18	606381	152	8.400	52740	6279	07/30/96
237	19	606363	160	8.400	67000	7976	07/30/96

CONFORMITY TO SPECIFICATIONS: SAMPLE 15 FROM ST PAUL. LIKE FLOOR TILE ADHESIVE @ ROOM TEMP. BARELY PASSES SIEVE. REMAINING SAMPLES VERY CLEAN & CONSISTENT.

(Y) APPROVED
( ) NOT APPROVED

X SUFFICIENT FOR REJECTION

DISTRIBUTION

DIST: GRAND FORKS
PROJECT ENGR: BERGUN-WFW
CONTRACTOR: ASTECH
MANUFACTURER KOCH
DIST LAB
CONSTRUCTION.

FORM SFN-10084

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 07/31/96

TEST, TANK CAR AND TRUCK REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS TESTING LABORATORY

RECEIVED
AUG 1 1996
WEBSTER, FOSTER & WESTON
GRAND FORKS, NORTH DAKOTA

DATE RECEIVED: 07/30/96 PROJECT: SNH-6-002(050)337

SUBMITTED BY: DALE GERGUM -WEB,FOS,WSTN COUNTY: GRAND FORKS

MANUFACTURER: KOCH TYPE: CSS-1H REPORT NO: 40-96

LAB. NO.	FIELD NO.	MANIFEST NO.	VIS @ 77	WT/GAL 60 F	NET WT.	NET GALS.	DATE SAMPLED
229	1A	608344	14 X	8.520	48480	5690	07/26/96
	1B		14 X	0.000	0	0	/ /
230	2A	608351	14 X	8.520	49100	5763	07/26/96
	2B		14 X	0.000	0	0	/ /
231	3A	608353	14 X	8.520	8460	993	07/26/96
	3B		14 X	0.000	0	0	/ /

CONFORMITY TO SPECIFICATIONS: NONE MEET MINIMUM OF 20 SECS @ 77°F. TESTS WITH A #2 ZAHN CUP. MATERIAL SO "WATERY" IT WAS SURPRISING TO DMC THAT VIS WAS NOT LOWER. SAMPLES WERE "CLEAN".

( ) APPROVED
(X) NOT APPROVED

X SUFFICIENT FOR REJECTION

DISTRIBUTION

DIST: GRAND FORKS
PROJECT ENGR: BERGUM WFW
CONTRACTOR: ASTECH
MANUFACTURER KOCH
DIST LAB
CONSTRUCTION

FORM SFN-10064

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 07/30/96

TEST, TANK CAR AND TRUCK REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS TESTING LABORATORY

DATE RECEIVED: 07/30/96 PROJECT: SNH-6-002(050)337

SUBMITTED BY: DALE GERGUM -WEB,FOS,WSTN COUNTY: GRAND FORKS

MANUFACTURER: KOCH TYPE: CSS-1H REPORT NO: 40-96REVSD

LAB. NO.	FIELD NO.	MANIFEST NO.	VIS @ 77	WT/GAL 60 F	NET WT.	NET GALS.	DATE SAMPLED
229	1A	606344	14	8.520	48480	5690	07/26/96
	1B		14	0.000	0	0	/ /
230	2A	606351	14	8.520	49100	5763	07/26/96
	2B		14	0.000	0	0	/ /
231	3A	606353	14	8.520	8460	993	07/26/96
	3B		14	0.000	0	0	/ /

CONFORMITY TO SPECIFICATIONS: THIS MATERIAL WAS ORDERED WITH ADDITIONAL WATER ADDED TO AID FOG COAT APPLICATION. THE MATERIAL IS NOT CONVENTIONAL AND THE SPEC OF 20-100 VIS CANNOT APPLY.

(Y) APPROVED
( ) NOT APPROVED

X SUFFICIENT FOR REJECTION

DISTRIBUTION

DIST: GRAND FORKS
PROJECT ENGR: BERGUM WFW
CONTRACTOR: ASTECH
MANUFACTURER KOCH
DIST LAB
CONSTRUCTION

FORM SFN-10064

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 08/01/96

TEST, TANK CAR AND TRUCK REPORT
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS TESTING LABORATORY

RECEIVED
AUG 2 1996
WEBSTER, FOSTER & WESTON
GRAND FORKS, NORTH DAKOTA

DATE RECEIVED: 07/31/96 PROJECT: SNH-6-002(050)337

SUBMITTED BY: ROB HALL-WEB,FOS,WESTN COUNTY: GRAND FORKS

MANUFACTURER: KOCH TYPE: CSS-1H REPORT NO: 42-96

LAB. NO.	FIELD NO.	MANIFEST NO.	VIS @ 77	WT/GAL 60 F	NET WT.	NET GALS.	DATE SAMPLED
238	4A	606386	0 *	8.520	51980	6101	07/31/96
239	5A	606391	0 *	8.520	50280	5901	07/31/96

CONFORMITY TO SPECIFICATIONS: THIS MATERIAL ORDERED WITH ADDITIONAL WATER ADDED TO AID FOG COAT APPLICATION. DID NOT TEST. DID VISUAL OBSERVATION. THE MATERIAL CANNOT MEET STD SPEC.

(Y) APPROVED
( ) NOT APPROVED

X SUFFICIENT FOR REJECTION

DISTRIBUTION

DIST: GRAND FORKS
PROJECT ENGR: HALL - WFW
CONTRACTOR: ASTECH
MANUFACTURER KOCH
DIST LAB
CONSTRUCTION

FORM SFN-10084

JACOB J. DVORAK
DISTRICT MATERIALS COORDINATOR
DATE: 08/01/96

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504
TEST, TANK CAR AND TRUCK REPORT

PROJECT: SNH-4-002(050)337 6

DATE RECEIVED: 7/24/96

SUBMITTED BY: Dvorak

COUNTY: Grand Forks

MANUFACTURER: Koch

REPORT NO. 196

LAB. NO.	FIELD NO.	MANIFEST NO.	MATERIAL TYPE	KIN VIS @ 140 F (cSt)	DATE SAMPLED
EM-70	2B	608316	HFRS-2		7-24-96

Viscosity SFS @ 50°C	42 sec Fails
Sieve Test - Retained on No. 20	0.14% Fails
Oil Distillate (% by Volume)	0.5%
Distillation Residue	67.8
Tests on Distillation Residue:	
Penetration @ 25°C	193
Solubility in Trichlor	99.98
Ductility @ 25° C	40+
Float test @ 60°C	1200+
Demulsibility	68.29%

Dist: Grand Forks
~~Proj Engr: Dvorak~~ WFW
Contractor: ASTECH
Manufacturer: Koch
Bituminous Lab
Construction Records

SFN10084

Conformity to Specifications:
Does Not Meet Specifications
Joe Davis, Bituminous Engineer
August 16, 1996

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504
TEST, TANK CAR AND TRUCK REPORT

PROJECT: SNH-6-002(050)337 DATE RECEIVED: 7-30-96

SUBMITTED BY: Dvorak COUNTY: Grand Forks

MANUFACTURER: Koch REPORT NO. 197

LAB. NO.	FIELD NO.	MANIFEST NO.	MATERIAL TYPE	KIN VIS @ 140 F (cSt)	DATE SAMPLED
EM-71	18B	608381	HFRS-2		7-30-96

Oil Distillate (% by Volume)	.5 %
Distillation Residue	66.8%
Demulsibility	66.87 %

Dist: Grand Forks
Proj-Engr: WFW - GF
Contractor: ASTECH
Manufacturer: Koch
Bituminous Lab
Construction Records

SFN10084

Conformity to Specifications:

Joe Davis, Bituminous Engineer
August 16, 1996

NDDOT MATERIALS & RESEARCH DIVISION
300 AIRPORT ROAD, BISMARCK ND 58504
TEST, TANK CAR AND TRUCK REPORT

PROJECT: SNH-6-002(050)337 DATE RECEIVED: 8-2-96

SUBMITTED BY: Dvorak COUNTY: Grand Forks

MANUFACTURER: Koch REPORT NO. 198

LAB. NO.	FIELD NO.	MANIFEST NO.	MATERIAL TYPE	KIN VIS @ 140 F (cSt)	DATE SAMPLED
EM-69	15B	616874	HFRS-2		7-30-96

Viscosity SFS @ 50°C	902 sec Fails
Sieve Test - Retained on No. 20	0.02 %
Oil Distillate (% by Volume)	1.0 %
Distillation Residue	66.1 %
Tests on Distillation Residue:	
Penetration @ 25°C	120
Solubility in Trichlor	99.92 %
Ductility @ 25° C	75+
Float test @ 60°C	1200+
Demulsibility	64.44 %

Dist: Grand Forks
Proj Engr: WFW - GF
Contractor: ASTECH
Manufacturer: Koch
Bituminous Lab

Conformity to Specifications:
Does Not Meet Specifications
Joe Davis, Bituminous Engineer
August 16, 1996