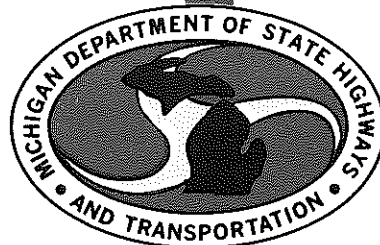


EVALUATION OF SPRINKLE TREATMENT
FOR IMPROVING SKID RESISTANCE
OF ASPHALT SURFACES

A Progress Report



**TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION**

EVALUATION OF SPRINKLE TREATMENT
FOR IMPROVING SKID RESISTANCE
OF ASPHALT SURFACES

A Progress Report

J. H. DeFoe

Research Laboratory Section
Testing and Research Division
Research Project 78 C-19
Research Report No. R-1134

Michigan Transportation Commission
Hannes Meyers, Jr., Chairman; Carl V. Pellonpaa,
Vice-Chairman; Weston E. Vivian, Rodger D. Young,
Lawrence C. Patrick, Jr., William C. Marshall
John P. Woodford, Director
Lansing, January 1980

The information contained in this report was compiled exclusively for the use of the Michigan Department of Transportation. Recommendations contained herein are based upon the research data obtained and the expertise of the researchers, and are not necessarily to be construed as Department policy. No material contained herein is to be reproduced—wholly or in part—without the expressed permission of the Engineer of Testing and Research.

INTRODUCTION

Limestone is the predominant source of aggregate in several areas of Michigan. Bituminous paving mixtures containing limestone aggregates are susceptible to polishing by traffic which may result in lower friction values. Aggregate which is more durable and polish resistant must be transported into these limestone areas if bituminous surfaces with adequate friction levels are to be achieved.

A potential method for reducing the cost of transporting high quality aggregate into these areas is to apply the more durable aggregate to only the surface of a pavement rather than to use it throughout the wearing course mixture. 'Sprinkle treatment,' a method of applying such high quality aggregate, has been developed by several state transportation agencies, supported by the Federal Highway Administration.

Sprinkle treatment consists of the application of 5 to 10 lb/sq yd of precoated, high quality aggregate particles, 1/2-in. nominal size, onto the surface of a wearing course with embedment achieved by the rolling operation. Application of sprinkle aggregate is made immediately behind the paver, and prior to compaction, by a specially designed chip spreader which is commercially produced and was made available for this project by FHWA.

This report describes Michigan's experience in the construction of an experimental overlay to evaluate the sprinkle treatment method of achieving adequate friction values on wearing surface in accordance with FHWA Demonstration Project No. 50.

THE PROJECT

A four-mile portion of a bituminous resurfacing project on US 23 in Presque Isle County was selected for application and evaluation of the sprinkle treatment method (Fig. 1). In addition to the four-mile experimental section, two adjacent sections resurfaced with conventional bituminous aggregate (MDOT Specification 4.11) and bituminous concrete (MDOT Specification mixtures 4.12) were selected to provide a basis for comparison with the sprinkle treatment. Paving of the experimental section was completed in July 1979.

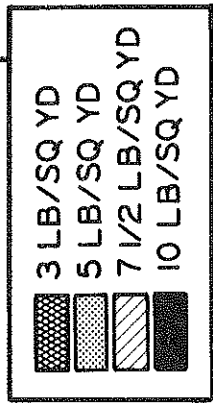
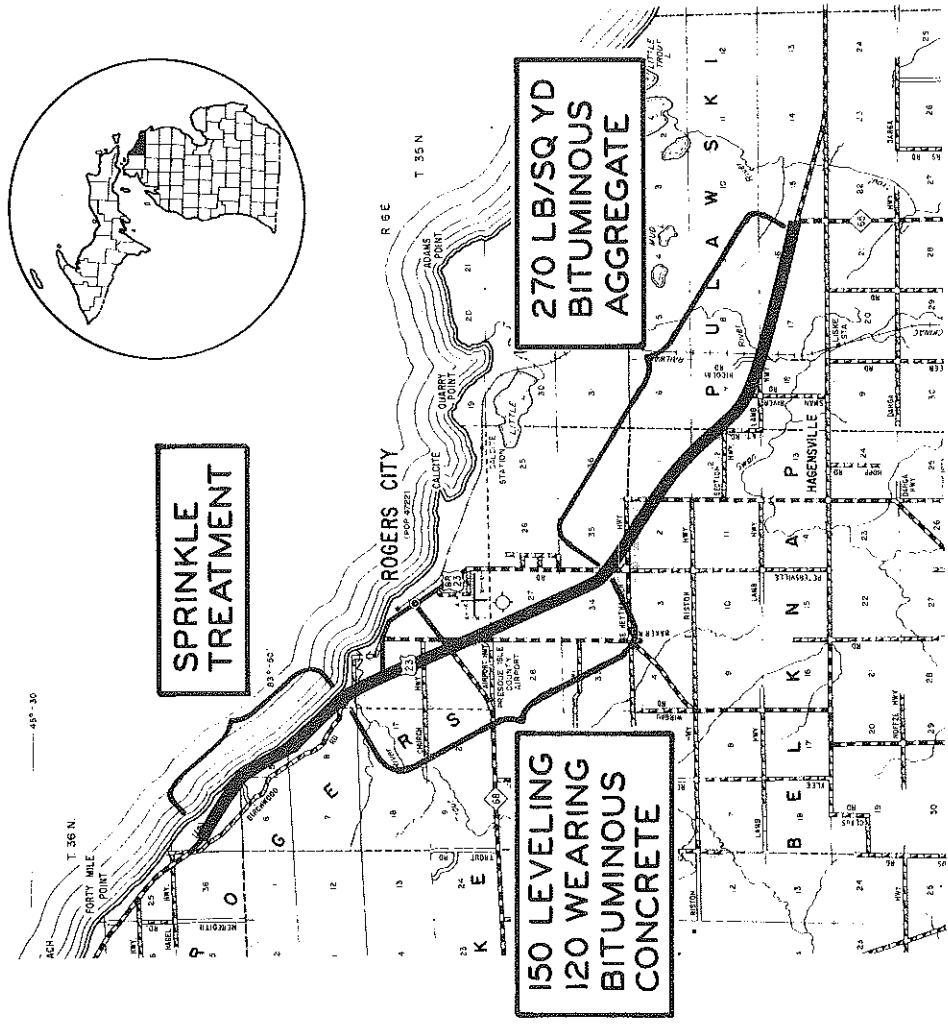
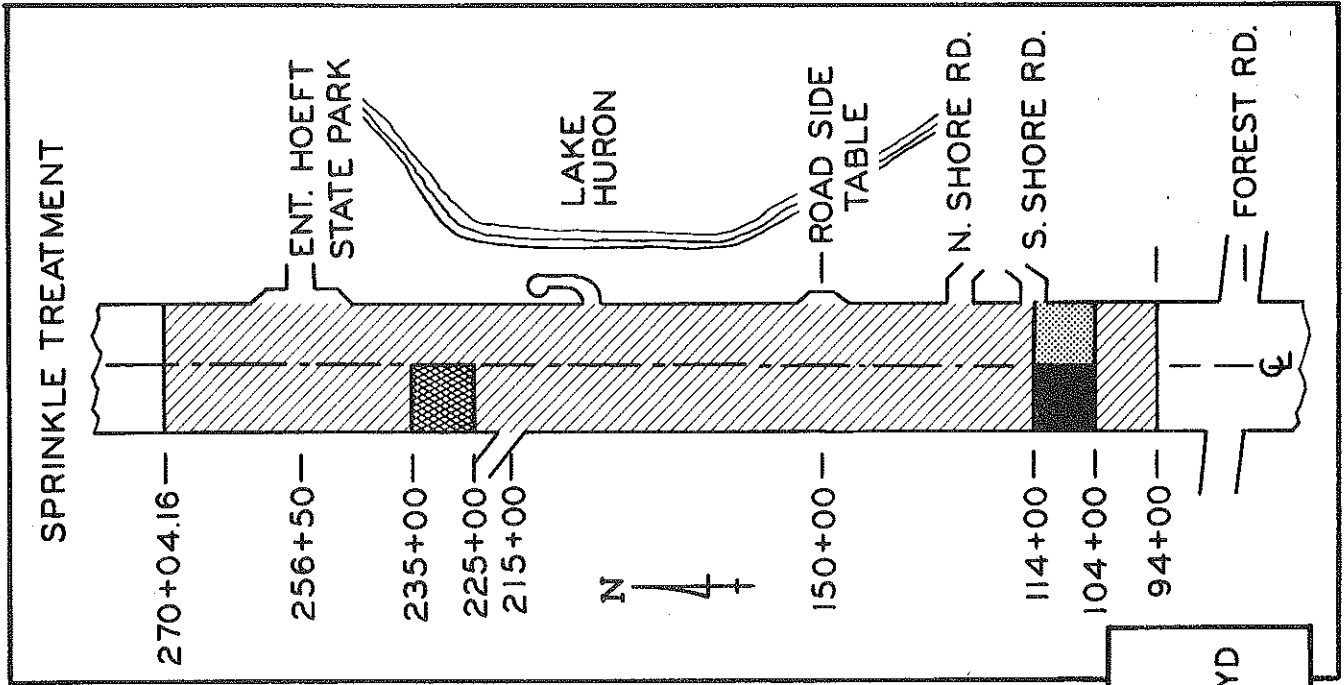


Figure 1. Experimental sprinkle treatment sections on US 23 in Presque Isle County.

MATERIALS

Wearing Course Mixtures

Resurfacing for the sprinkle treatment section consisted of a 4.12 bituminous concrete mixture composed of a local limestone aggregate and an 85-100 penetration asphalt cement meeting Department requirements for a wearing course, Type CM paving mixture. A comparative section of road, approximately four miles long, was also surfaced with this same 4.12 mixture in the usual manner.

The remaining comparative section (Fig. 1) was surfaced with a mixture using another local limestone aggregate which met Department specifications for a 4.11 bituminous aggregate mixture.

Sprinkle Aggregate

Aggregate for the sprinkle treatment was obtained from an upper peninsula pit and was a crushed natural gravel low in carbonate particles and having a significant amount of sandstone particles. Specifications for the sprinkle aggregate, as well as precoating and application requirements, are described in the "Special Provision for Sprinkling Bituminous Wearing Course Mixture with Precoated Aggregate," appended to this report.

The sprinkle aggregate was precoated and stockpiled one day prior to being applied to the road. Precoating was accomplished by heating and mixing the aggregate with the coating asphalt in a conventional batch plant at a temperature of 250 F. A one-minute wet mix cycle was used. Trial batches were prepared in this manner using various quantities of an 85-100 penetration grade asphalt. A 1.25 percent asphalt treatment was selected which resulted in complete coating of nearly all stone particles. Higher coating rates which were tried, 1.66 percent and 1.5 percent, produced rich appearing mixtures and resulted in the material sticking together. Excess asphalt flowed through the material and pooled on the surface of the storage area when these higher percentages were used.

The precoated sprinkle aggregate was stockpiled on a paved surface at the plant site. The stockpile, 240 tons, was 3 to 4 ft high and was watered the evening it was produced, again the next morning, and during loading for transport to the spreader. The temperature inside the stockpile was 140 F at 7:30 a. m. the day of mixing. Despite additional cooling with water during loading, the temperature of the sprinkle material averaged 80 F as delivered to the spreader.



Figure 2. Application of sprinkle aggregate with the Bristowes MkV spreader.



Sprinkle-treated surface compared with a 25-cent coin.



Surface texture of sprinkle treatment compared with that of a square yard of conventional surface which remained untreated after checking the application tests.

Figure 3. Surface texture of sprinkle-treated bituminous pavement.

Application of Sprinkle Aggregate

The sprinkle aggregate was applied to the road the day following pre-coating. The procedure consisted of placing the conventional hot mix bituminous surfacing with a paver in the usual manner, and applying the sprinkle aggregate with a special self-propelled spreader, followed by compacting with the usual sequence of rollers. The spreader, a Bristowes MkV, was kept as close as possible to the paver at all times, usually within 10 ft, as shown in Figure 2.

Because of the wide shoulders and relatively flat terrain on this job, the truck hauling the sprinkle aggregate could be driven on the shoulder. A conveyor was used to transfer the sprinkle aggregate from the truck to the hopper of the spreader.

Specifications required the shoulder and driving lane to be paved at the same time. The wheels of the sprinkle aggregate spreader spanned 15 ft, a 12-ft lane plus a 3-ft shoulder. The end of the spreader was blocked so that only the 12-ft lane was sprinkle-treated leaving the shoulders to be of conventional construction.

A 10-ton steel breakdown roller was used to make a single pass, forward and back, followed by a 5-ton steel finish roller working until all roller marks were eliminated.

Throughout the paving operation, temperatures of the surfacing materials were measured. The mixture was approximately 280 F immediately behind the paver and about 220 F when the sprinkle aggregate was applied.

The experimental work plan called for a sprinkle aggregate application rate of as much as 10 to 15 lb/sq yd. FHWA technicians assisting with the project, however, suggested a 3 to 5 lb/sq yd application, based on experience gained from several other projects. Application rates, therefore, were varied on this project to include 3, 5, 7-1/2, and 10 lb/sq yd application, all of which seemed to provide a relatively uniform exposure of the sprinkle aggregate (Fig. 3).

FRICITION VALUES

Wet sliding friction values were measured one month after paving and again after three months of service. The Department's Pavement Friction Tester, which complies with ASTM Specification E-17, was used to measure friction values at 30, 40, and 55 mph. These values are shown in Figure 4. The results show the sprinkle-treated surface to have somewhat higher

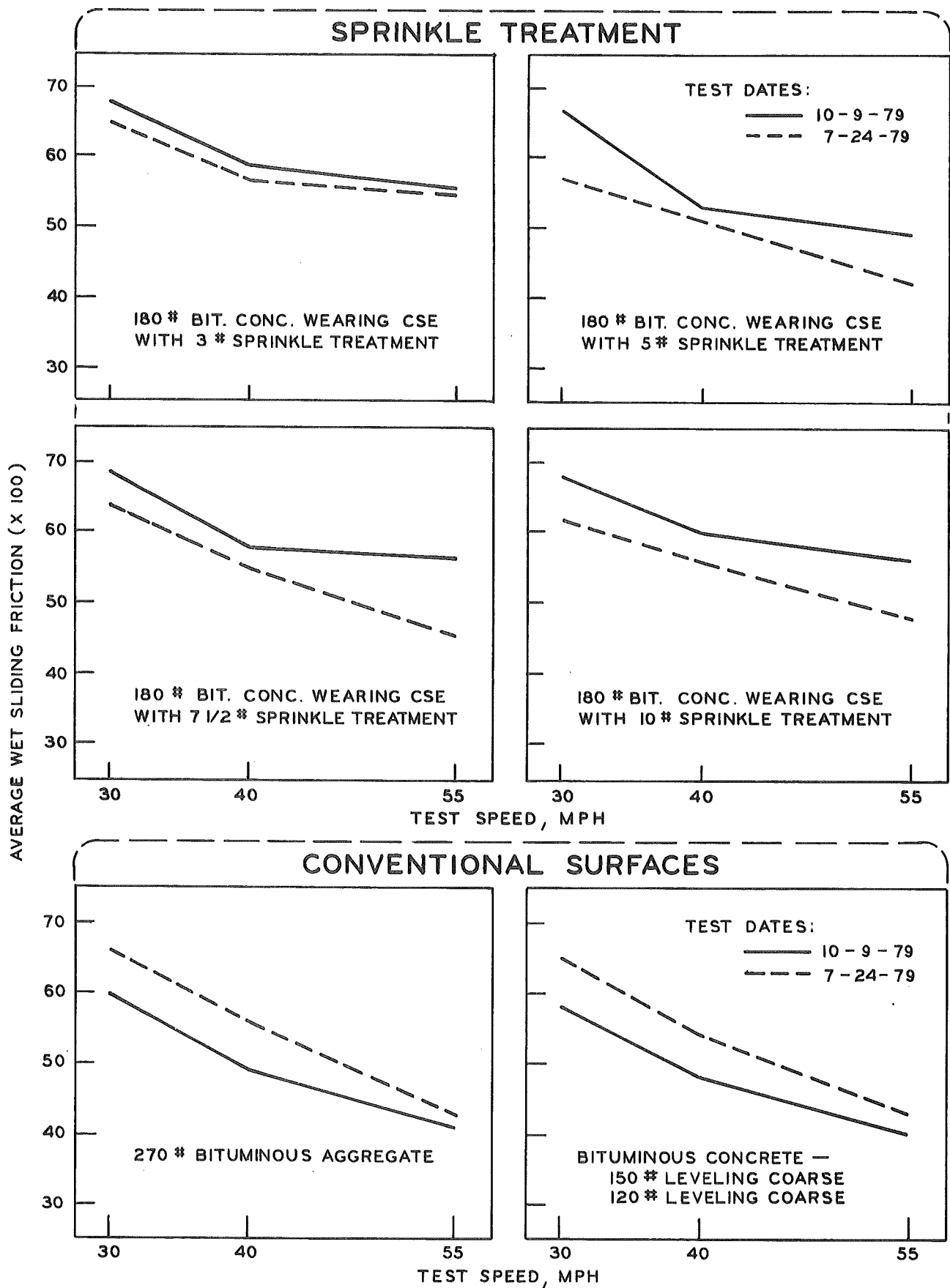


Figure 4. Comparison of wet sliding friction (Wsf) values for sprinkle-treated and conventional roadway surfaces—test speeds of 30, 40, and 55 mph.

friction values at the three speeds than the conventional surface materials. It can be seen from Figure 4 that three-month friction values measured on the sprinkle-treated surfaces are higher than those obtained initially; whereas, for the conventional surfaces the friction values seem to be decreasing with time. Similar measurements are to be made annually on this road for several years so that more significant, long-term trends can be determined.

CONCLUSIONS

No major problems were encountered during the construction of this test section. Loading of the spreader hopper could be a problem on two-lane roads where shoulders are narrow or where there are side restrictions such as guardrails, retaining walls, or where steep slopes are close to the pavement.

Friction values measured to date indicate the sprinkle treatment to be superior to the comparative conventional surfaces. Friction values for the conventional surfaces were lower after three months service; whereas, sprinkle-treated surfaces increased in friction levels. Additional friction measurements, to be made during the next several years, are necessary to determine the significance of this trend.

APPENDIX

SPECIAL PROVISION
FOR
SPRINKLING BITUMINOUS WEARING COURSE
MIXTURE WITH PRECOATED AGGREGATE

US 23, FR 71072-15287A, Presque Isle County

a. Description. -The sprinkle treatment shall consist of properly graded, precoated aggregate applied to the surface of plant mixed bituminous concrete pavement immediately after laydown, for the purpose of providing a skid-resistant wearing surface. Sprinkle treatment will be applied to both traffic lanes, 22 feet in width, between Station 7337+50 and Station 7498+00.

b. Materials:

1. Asphalt. -The asphalt cement used to coat the sprinkle aggregate shall be the same as used in the bituminous concrete pavement. An approved anti-stripping agent may be required in the asphalt used to coat the sprinkle aggregate.

2. Sprinkle Aggregate. -Samples of the sprinkle aggregate shall be submitted to the Testing Laboratory at least three weeks prior to the start of coating operations.

Aggregate for the sprinkle treatment shall be a crushed natural gravel obtained from an upper peninsula source producing material containing less than 10 percent carbonate particles and more than 25 percent sandstone particles. Additionally, the aggregate shall meet the requirements for 25A coarse aggregate in Section 8.02 of the 1976 Standard Specifications except that the aggregate shall have the following gradation:

Sieve Size	3/4-inch	3/8-inch	No. 4	No. 200
Percent Passing	100	20-55	0-5	1.5 max.

c. Preparing and Stockpiling Sprinkle Aggregate. -Precoating of the aggregate shall consist of drying the aggregate and mixing at a temperature between 240 F and 300 F. The range of asphalt content shall be between

8-15-78
8-31-78
11-21-78
1-5-79

0.5 and 2.0 percent by weight, as determined by the Engineer. The intent is to produce a uniformly coated aggregate with approximately the maximum amount of asphalt that will allow the aggregate to be spread uniformly when cold.

The coated aggregate shall be stockpiled at the plant on an approved surface to prevent contamination of the coated aggregate. The coated aggregate shall not be stockpiled over 3 feet high while hot and shall be wetted with water after 15 minutes if its temperature is above 320 F. Manipulation in the stockpile may be required if crusting or unusual adherence of aggregate particles occurs. The Engineer may require the stockpile to be covered.

d. Equipment:

1. Rollers. -Pneumatic-tired rollers will not be permitted on any phase of the sprinkle treatment construction.
2. Spreader. -The spreader for applying the sprinkle aggregate has a 12-foot spreading width and will be provided by FHWA at no cost to the Contractor. FHWA will deliver the spreader to the job site, provide a man for training the Contractor's spreader operator for a period of time not to exceed one week, and will remove the spreader from the job site.

The Contractor is responsible for providing an operator and fuel for the spreader; and performing normal routine maintenance and minor repairs for the spreader.

The Contractor is responsible for notifying FHWA of his need for the spreader. The Contractor is advised that FHWA needs approximately 2 weeks notice to assure timely delivery of the spreader. The address for notifying FHWA of the need for the spreader is:

Federal Highway Administration
Region 15
1000 North Glebe Road
Arlington, Virginia 22201
Attn: Douglas Bernard
(703) 557-0522

8-15-78
8-31-78
11-21-78
1-5-79

- e. **Temperature Limitations.** -Wearing course and sprinkle treatment shall not be placed when the air temperature is below 50 F.
- f. **Paving Limitations.** -Construction of shoulder base and paving of shoulder surface shall not be started in the sprinkle treatment section until the section has been completed in both lanes.

A berm of aggregate shoulder material at least 6 inches wide shall be banked against the outside edge of the bituminous wearing course after each day's operation before the lane is open to traffic.

- g. **Delivery of Precoated Sprinkle Aggregate.** -The precoated aggregate shall be delivered to the spreader in a "Flo-Boy" type hauling unit operating beside the spreader on the shoulder. A front end loader, or other approved conveyance, shall be used to transfer the sprinkle aggregate from the "Flo-Boy" to the hopper of the spreader. The bucket on the loader shall be of a size to prevent spillage of the aggregate.
- h. **Applying Precoated Sprinkle Aggregate.** -Immediately after the passage of the paver and prior to any rolling, the precoated aggregate shall be applied uniformly to the surface of the wearing course with the mechanical spreader. The sprinkle aggregate shall be placed cold.

The aggregate shall be applied at the rate of 10 to 15 pounds per square yard, as directed by the Engineer.

- i. **Rolling.** -Rolling shall commence immediately after the coated aggregate is applied unless otherwise directed by the Engineer. Compaction of the sprinkle-treated surface course shall be as specified under Rolling, 4.12.08, of the 1976 Standard Specifications except that pneumatic rollers will not be permitted.
- j. **Opening to Traffic.** -Traffic will not be permitted on the surface until the pavement has cooled to such a temperature that the sprinkle aggregate will not pick up under the tires. Watering may be required by the Engineer to promote cooling of the pavement prior to opening to traffic.
- k. **Measurement and Payment.** -The completed work as measured for SPRINKLE TREATMENT will be paid for at the contract unit price for the following contract item (pay item).

<u>Pay Item</u>	<u>Pay Unit</u>
Sprinkle Treatment	sq yd

8-15-78
 8-31-78
 11-21-78
 1-5-79

Sprinkle treatment will be paid for by the square yard of surface treated and will include the asphalt and the aggregate, coating the aggregate, and applying to the wearing course surface; providing an operator and fuel for the spreader; and performing normal routine maintenance and minor repairs for the spreader. Water as required shall be incidental to the sprinkle treatment and will not be paid for separately.

8-15-78
8-31-78
11-21-78
1-5-79