



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

DEC 19 2003

FROM: HQ AFCESA/CESC
139 Barnes Drive
Tyndall AFB FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 03-8, Rejuvenation of Hot-Mix Asphalt (HMA) Pavements**

1. Purpose. This ETL provides a guide specification for the application of a rejuvenator or rejuvenator/sealer to existing HMA pavements.

2. Application. This ETL is applicable to all Air Force organizations with pavement maintenance and repair responsibility.

2.1. Authority: Air Force Policy Directive (AFPD) 32-10, *Installations and Facilities*.

2.2. Effective Date: Immediately.

2.3. Intended Users: Base civil engineers (BCE) responsible for maintenance and repair of pavements.

2.4. Coordination: Major command (MAJCOM) pavement engineers.

3. Acronyms and Terms:

AASHTO	– American Association of State Highway and Transportation Officials
AFPD	– Air Force Policy Directive
ASTM	– American Society for Testing and Materials
BCE	– base civil engineer
C	– Celsius
DSR	– Dynamic Shear Rheometer
ETL	– Engineering Technical Letter
F	– Fahrenheit
FOD	– foreign object damage
HMA	– hot-mix asphalt
HQ AFCESA	– Headquarters, Air Force Civil Engineer Support Agency
kg/m ²	– kilograms per square meter
lb/yd ²	– pounds per square yard
MAJCOM	– major command
mm	– millimeters
UFC	– Unified Facilities Criteria

4. Referenced Publications:

4.1. Department of the Air Force:

- AFPD 32-10, *Installations and Facilities*, available at <http://www.e-publishing.af.mil/>

4.2. Joint-Service Publications:

- Unified Facilities Criteria (UFC) 3-270-01, *Asphalt Maintenance and Repair*, available at http://65.204.17.188/report/doc_ufc.html

5. Explanation.

5.1. General. For structurally sound HMA airfield pavements, the majority of distresses are related to environmental effects. The environmental distresses that occur include: raveling, weathering, block cracking, longitudinal cracking, and transverse cracking. These distresses occur because the asphalt cement that binds the pavement together ages (hardens) with time due to the oxidation process. Over time, this process causes a decrease in the binder's ability to hold aggregate particles together (raveling) and the HMA becomes unable to withstand the effects of thermal or moisture stresses (cracking). When these distresses become severe enough, they can create the potential for foreign object damage (FOD) and cause a decrease in pavement serviceability, which will reduce the life of the pavement. The pavement's life will be extended if the asphalt binder can be softened or "rejuvenated" to obtain material properties similar to those when the HMA was originally placed.

5.2. Products. A number of proprietary products are currently produced for HMA pavements. These materials can be categorized into three general groups: rejuvenators, rejuvenators/sealers, and seal coats. This ETL addresses the first two categories of materials because these are materials that have the potential to rejuvenate the HMA. The use of seal coat materials is addressed in UFC 3-270-01, *Asphalt Maintenance and Repair*.

5.2.1. Rejuvenators. This first group contains products that leave no or relatively little residual material on the surface of the pavement. Rejuvenators will only rejuvenate the asphalt binder in the top surface of the pavement, usually to a depth of 3 to 6 millimeters (0.125 to 0.25 inches). Because these products leave almost no residual material, they can be reapplied as necessary.

5.2.2. Rejuvenator/Sealer Materials. This second group of products can perform a dual function. These are often (but not exclusively) coal tar-based materials that leave a substantial amount of residual material on the surface. These materials not only rejuvenate the pavement, but the residual material acts to seal the surface. If the rejuvenator/sealer is a coal tar-based material, it will also provide some fuel resistance

to the surface. The durability of this fuel resistance is largely dependent upon the level of traffic; when the seal begins to wear off, it will no longer be fuel resistant.

5.3. Performance. Recent research with a number of rejuvenator and rejuvenator/sealers has shown that they all provide some rejuvenation to the asphalt binder in the pavements surface; however, the long-term performance of these materials has not been completely determined. One major concern is the long-term effect of the residual material deposited on the surface by the rejuvenator/sealer materials. The experience of one state department of transportation was that a coal tar-based rejuvenator/sealer initially rejuvenated the pavement, but after repeated applications, the treated section showed higher viscosity results (harder asphalt) than that of the untreated sections of the pavement. It was surmised that the residual material from the initial application had hardened to a degree that affected the test results on the binder extracted after the second application. Additionally, rejuvenators will, at least somewhat, reduce the skid resistance of a pavement surface, as would the application of any material without the use of additional aggregate. This reduction does not have to be significant or long lasting, depending on factors such as the condition of the pavement, the properties of the rejuvenator, and the amount of rejuvenator applied. Skid testing of rejuvenated pavements with the Air Force GripTester has shown a minimal reduction in the short term following application. Rejuvenator/sealers leave enough residual material on the pavement surface to allow the application of aggregate (medium to fine sand [<1.18 mm], in limited quantity [<0.54 kg/m² (1.0 lb/yd²)], to prevent the potential for FOD) immediately after application of the material. With this light coating of aggregate, the skid numbers can remain satisfactory, exceeding minimum requirements for airfield pavements. **Because of the concerns with skid resistance effects, particularly in areas of high traffic speeds such as runways and high-speed taxiways, the responsible Air Force MAJCOM pavement engineer must approve the use of rejuvenators or rejuvenator/sealers on these airfield pavement features.**

5.4. Requirements. Due to the proprietary nature of the rejuvenator and rejuvenator/sealer materials, United States Air Force Guide Specification, *Bituminous Rejuvenation*, does not include material ingredient requirements. This guide specification requires a percentage reduction in the viscosity or phase angle of the surface asphalt binder and evidence of long-term performance in similar applications, supplied by the manufacturer.

5.5. Applications. A rejuvenator should be applied to pavements after a few years of service. The pavement surface can have some small hairline cracks, often the beginning of block cracking, but should not show evidence of medium or high severity raveling. Pavement surfaces that are experiencing low severity raveling and low severity cracking can benefit from a rejuvenator/sealer application. This would help to seal loose surface aggregate, rejuvenate the surface binder, and protect the pavement from future damage from environmental factors.

5.6. Guide Specification. A copy of United States Air Force Guide Specification, *Bituminous Rejuvenation*, is provided as Attachment 1.

6. Point of Contact: Recommendations for improvements to this ETL are encouraged and should be furnished to Mr. Jim Greene, HQ AFCESA/CESC, 139 Barnes Drive, Suite 1, Tyndall AFB, FL 32408-5319, DSN 523-6334, commercial (850) 283-6334, FAX DSN 523-6219, Internet james.greene@tyndall.af.mil.

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Director of Technical Support

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1. United States Air Force Guide
Specification, *Bituminous Rejuvenation*
2. Distribution List

USAF (August 2003)

UNITED STATES AIR FORCE GUIDE SPECIFICATION

SECTION TABLE OF CONTENTS

BITUMINOUS REJUVENATION

08/03

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 UNIT PRICES
 - 1.2.1 Measurement
 - 1.2.1.1 Quantity of [Rejuvenator] [Rejuvenator/Sealer]
 - 1.2.1.2 Quantity of Aggregate
 - 1.2.1.3 Treated Pavement
 - 1.2.2 Payment
- 1.3 PERFORMANCE
- 1.4 SUBMITTALS
- 1.5 MATERIAL STORAGE AND HANDLING
- 1.6 WEATHER LIMITATION
- 1.7 EQUIPMENT, TOOLS, AND MACHINES
 - 1.7.1 [Rejuvenator] [Rejuvenator/Sealer] Storage Tanks
 - 1.7.2 Bituminous Distributor
 - 1.7.3 Specialized Bituminous Spray Applicator
 - 1.7.4 Brooms and Blowers

PART 2 PRODUCTS

- 2.1 REJUVENATOR
- 2.2 REJUVENATOR/SEALER
- 2.3 AGGREGATE

PART 3 EXECUTION

- 3.1 PREPARATION OF SURFACE
- 3.2 APPLICATION OF [REJUVENATOR] [REJUVENATOR/SEALER] MATERIAL
 - 3.2.1 Calibration Test
 - 3.2.2 Excess [Rejuvenator] [Rejuvenator/Sealer] Material
 - 3.2.3 Ponding and Puddling of [Rejuvenator] [Rejuvenator/Sealer] Material
 - 3.2.4 Excess Runoff of [Rejuvenator] [Rejuvenator/Sealer] Material
 - 3.2.5 Insufficient [Rejuvenator] [Rejuvenator/Sealer] Material
- 3.3 APPLICATION OF AGGREGATE
- 3.4 SAMPLING AND TESTING
 - 3.4.1 Test Section
 - 3.4.2 Sampling
 - 3.4.3 Testing

-- End of Section Table of Contents --

USAF (August 2003)

UNITED STATES AIR FORCE GUIDE SPECIFICATION

BITUMINOUS REJUVENATION
08/03

NOTE: This guide specification covers the requirements for rejuvenation of bituminous pavements using a rejuvenator or rejuvenator/sealer material. A rejuvenator or rejuvenator/sealer material should only be used when rejuvenation of the pavement is the main priority of the application.

The rejuvenator/sealer material will leave some material on the surface that can be used to tie together loose surface aggregate.

A delineation within the guide specification between rejuvenator and rejuvenator/sealer will only be made within a paragraph when the specific requirements are different.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of this specification at the Air Force Civil Engineer Support Agency (AFCESA), Tyndall AFB, FL.

Use of electronic communication is encouraged.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest change (Notice) to this guide specification.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO T 202 (2002) Viscosity of Asphalts by Vacuum
Capillary Viscometer
- AASHTO T 315 (2002) Determining the Rheological Properties
of Asphalt Binder Using a Dynamic Shear
Rheometer (DSR)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D 140 (2001) Sampling Bituminous Materials
- ASTM D 1250 (2002) Standard Guide for Petroleum Measurement
Tables
- ASTM D 1856 (1995a) Recovery of Asphalt from Solution by
Abson Method
- ASTM D 2170 (2001a) Kinematic Viscosity of Asphalts
(Bitumens)
- ASTM D 2171 (2001) Viscosity of Asphalts by Vacuum
Capillary Viscometer
- ASTM D 2172 (2001e1) Quantitative Extraction of Bitumen
from Bituminous Paving Mixtures
- ASTM D 2995 (1999) Determining Application Rate of
Bituminous Distributors
- ASTM D 5404 (2003) Recovery of Asphalt from Solution Using
the Rotary Evaporator

Unified Facilities Guide Specifications (UFGS)

- UFGS 01330 (2002) SUBMITTAL PROCEDURES

1.2 UNIT PRICES

**NOTE: Delete these paragraphs when lump-sum
bidding is used. Delete reference to aggregate,
when the product manufacturer does not require it.
Rejuvenator materials do not require aggregate.
Rejuvenator/Sealers leave a portion of their
material on the surface of the pavement and may be
able to hold aggregate to provide satisfactory
skid resistance until worn off.**

1.2.1 Measurement

1.2.1.1 Quantity of [Rejuvenator] [Rejuvenator/Sealer]

The quantity of [rejuvenator] [rejuvenator/sealer] to be paid for will be the number of [liters] [gallons] used in the accepted work as determined by the Contracting Officer, corrected to [liters at 15 degrees C] [gallons at 60 degrees F] in accordance with ASTM D 1250, and provided that the measured quantities are not 5 percent over the approved application rate. Any amount of [rejuvenator] [rejuvenator/sealer] exceeding the approved application rate by more than 5 percent will be deducted from the measured quantities except for irregular areas where hand spraying of the material is necessary. The Contracting Officer will determine the actual application rate by dividing the number of [liters] [gallons] of [rejuvenator] [rejuvenator/sealer] actually applied by the number of [square meters] [square yards] of pavement treated.

1.2.1.2 Quantity of Aggregate

The quantity of aggregate paid for will be the number of [metric tons (tons)] [cubic meters (cubic yards)] of aggregate placed and accepted in the completed work or placed in authorized stockpiles.

1.2.1.3 Treated Pavement

The quantity of pavement treated with [rejuvenator] [rejuvenator/sealer] will be paid according to the number of [square meters] [square yards] completed and accepted as determined by the Contracting Officer. The number of [square meters] [square yards] of treated pavement will be determined by measuring the length and width of the specified work area. Measurements to determine the number of [square meters] [square yards] will be along the surface of the pavement and will be to the closest [25 millimeters] [inch] for width and the closest [meter] [foot] for length.

1.2.2 Payment

Quantities of [rejuvenator] [rejuvenator/sealer] [, aggregate,] and treated pavement will be paid for at respective unit prices. Payment will not be made for quantities of [rejuvenator] [rejuvenator/sealer] and treated pavement when actual application rate of material is more than 5 percent below the approved application rate until deficiency is corrected in accordance with paragraph: *Insufficient [Rejuvenator] [Rejuvenator/Sealer] Material.*

NOTE: The reduction in viscosity or phase angle achieved will be dependent upon several factors, especially the amount of rejuvenator applied to the surface. Reductions of 40 percent can be specified; however, in areas where skid resistance is critical (high-speed locations), lower than normal application rates may need to be applied, with resulting lowering of rejuvenation of the pavement. The reduction in viscosity or phase angle will be lower with newer (recently placed) asphalt pavements. In the situation of higher-

speed locations and newer pavements, the requirement for reduction should be 20 percent. Rejuvenator/Sealers that use a sand application during placement do not normally require a reduction in application rate, provided the aggregate produces satisfactory skid resistance.

1.3 PERFORMANCE

The [rejuvenator] [rejuvenator/sealer] shall be applied so that the test properties of binder extracted from samples of the upper [9 millimeters] [3/8 inch] of the surface of the test section show that viscosities or phase angle of the asphalt binder have decreased by at least { } percent. Either test property (viscosity or phase angle) can be used to evaluate performance. The percent decrease in viscosity or phase angle shall be computed as follows:

$$100 \frac{((\text{Viscosity of untreated sample}) - (\text{Viscosity of treated sample}))}{(\text{Viscosity of untreated samples})}$$

$$100 \frac{((\text{Phase angle of untreated sample}) - (\text{Phase angle of treated sample}))}{(\text{Phase angle of untreated samples})}$$

1.4 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

Indicate submittal classification in the blank space following the name of the item requiring the submittal by using "G" when the submittal requires Government approval. Submittals not classified as "G" will show on the submittal register as "Information Only." For submittals requiring Government approval, a code of up to three characters should be used following the "G" designation to indicate the approving authority; codes of "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval are recommended.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with UFGS 01330:

SD-03 Product Data

[Rejuvenator] [Rejuvenator/Sealer]; G, [_____]

Past performance information, manufacturers handling and construction procedures and specific material requirements, including referenced ASTM standards.

SD-04 Samples

[Rejuvenator] [Rejuvenator/Sealer]; [_____]

Two-liter (1/2 gallon) sample.

1.5 MATERIAL STORAGE AND HANDLING

[Rejuvenator] [Rejuvenator/Sealer] shall be stored within temperature ranges recommended by the manufacturer. Due to concerns with flammability, smoking, fire, or flames other than heaters that are part of the equipment will not be permitted in the vicinity of heating, distributing, or material transferring operations.

1.6 WEATHER LIMITATION

The [rejuvenator] [rejuvenator/sealer] shall be applied to a dry surface when the atmospheric temperature in the shade is [10 degrees C] [50 degrees F] or above. Application shall be delayed if rain appears imminent within 8 hours following planned time of application.

1.7 EQUIPMENT, TOOLS, AND MACHINES

Equipment, tools, and machines shall be subject to approval and shall be maintained in satisfactory working condition at all times.

1.7.1 [Rejuvenator] [Rejuvenator/Sealer] Storage Tanks

[Rejuvenator] [Rejuvenator/Sealer] storage tanks shall be capable of heating the rejuvenating material under effective and positive control at all times to the required temperature. Heating shall be accomplished by steam coils, hot oil, electricity, or another suitable method. An armored thermometer shall be affixed to the tank so that the temperature of the material may be read at all times.

NOTE: The application equipment used should meet the requirements as given by the product manufacturer. Some materials can be applied with a bituminous distributor; however, others may require more specialized application equipment, often with an enclosed spray bar or with brush attachments to equalize the spray distribution. These application machines will be called 'specialized bituminous spray applicators.'

1.7.2 Bituminous Distributor

The bituminous distributor shall be designed and equipped to spray the bituminous material in a uniform double or triple lap at the temperature recommended by the manufacturer, at variable widths, and at readily

determined and controlled rates from [0.10 to 1.0 liter per square meter] [0.04 to 0.2 gallon per square yard] with an allowable variation from the specified rate of not more than plus or minus 5 percent. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.7.3 Specialized Bituminous Spray Applicator

The specialized bituminous spray applicator shall be designed and equipped to apply [rejuvenator] [rejuvenator/sealer] as recommended by the manufacturer. The application rate shall be readily determined and controlled from [0.10 to 0.5 liter per square meter] [0.04 to 0.1 gallon per square yard] with an allowable variation from the specified rate of not more than plus or minus 5 percent. These machines shall meet all other equipment requirements given in paragraph: *Bituminous Distributor*.

1.7.4 Brooms and Blowers

Brooms and blowers shall be of the power type and shall be suitable for cleaning the surfaces of bituminous pavements.

PART 2 PRODUCTS

NOTE: Delete the following paragraphs depending upon whether a rejuvenator or a rejuvenator/sealer is selected for use. If a rejuvenator/sealer is used, then include the paragraph for aggregate. No aggregate is required for the rejuvenator material; however, the contractor should keep some available as a blotting sand in case excess rejuvenator is inadvertently applied. The blotting sand may be any type of sand, including unwashed sand with relatively high amounts of fines.

The use of a rejuvenator/sealer may sufficiently obscure pavement markings, thereby requiring reapplication of the markings. Therefore, unless remarking is already part of the current project or the material supplier specifies that use of their product will not require remarking, a section on marking should become part of the project.

2.1 REJUVENATOR

The rejuvenator material manufacturer shall provide data, for a minimum period of 3 years, showing rejuvenation of and asphalt pavement binder meeting the requirements as given in this specification. The

rejuvenated pavement shall be of similar type and age of the pavement to be treated. The material selected shall neither permanently damage nor obscure pavement markings. Specific application rates shall be as recommended by the contractor and approved by the Contracting Officer. The rejuvenating material shall be sampled according to ASTM D 140 and the test results shall conform to the material requirements as given by the material manufacturer.

2.2 REJUVENATOR/SEALER

The rejuvenator/sealer material manufacturer shall provide data, for a minimum period of 3 years, showing rejuvenation of and asphalt pavement binder meeting the requirements as given in this specification. The rejuvenated pavement shall be of similar type and age of the pavement to be treated. The material shall also have a proven record of leaving enough residual material on the pavement surface to prevent the loss of surface aggregate and to hold the application of aggregate for increased skid resistance. Specific application rates shall be as recommended by the contractor and approved by the Contracting Officer. The rejuvenating material shall be sampled according to ASTM D 140 and the test results shall conform to the material requirements as given by the material manufacturer.

2.3 AGGREGATE

NOTE: The following aggregate is intended to provide skid resistance for rejuvenator/sealer materials. The intent is to provide a fine, clean, angular aggregate. The gradation may be adjusted if the following gradation is difficult to obtain in the project area. Aggregates that have 100 percent by weight passing the 1.18 millimeters (No. 16) sieve and have no more than 5 percent passing the 0.075-millimeter (No. 200) sieve should perform in a satisfactory manner. For example, a 40-100 aggregate, with 95 percent passing the 0.425-millimeter (No. 40) sieve and no more than 5 percent retained on the 0.15-millimeter (No. 100) sieve would be acceptable.

The aggregate shall consist of clean, sound, durable particles of crushed stone, slag, or gravel. The aggregate shall meet the gradation requirements as given below:

<u>Sieve Designation</u>	<u>Percent by Weight Passing</u>
1.18 mm	100
0.60 mm	25-100
0.30 mm	2-25
0.15 mm	0-5

<u>Sieve Designation</u>	<u>Percent by Weight Passing</u>
No. 16	100
No. 30	25-100
No. 50	2-25
No. 100	0-5

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the [rejuvenator] [rejuvenator/sealer], loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. After the cleaning operation and prior to application of the material, the Contracting Officer will inspect the area to be treated to determine fitness of the area to receive the [rejuvenator] [rejuvenator/sealer].

3.2 APPLICATION OF [REJUVENATOR] [REJUVENATOR/SEALER] MATERIAL

Following preparation and subsequent inspection of the surface, the [rejuvenator] [rejuvenator/sealer] shall be uniformly applied over the surface to be treated at the approved rate with an allowable variation from the approved rate of application of plus or minus 5 percent, in accordance with ASTM D 2995. Materials shall be applied at the temperature recommended by the supplier. To obtain uniform application of the material on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface at a sufficient distance back from the ends of each application so that the material may be started and stopped on the paper. Immediately after application, the building paper shall be removed and properly disposed. Areas missed by the distributor shall be properly treated with the hand spray. Following application of the [rejuvenator] [rejuvenator/sealer], the surface shall not be disturbed for a period of at least 24 hours.

3.2.1 Calibration Test

Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor or other application equipment. Calibration shall be made with approved job material and prior to applying the [rejuvenator] [rejuvenator/sealer] to the prepared surface. Calibration of the bituminous distributor and the specialized bituminous spray applicator shall be in accordance with ASTM D 2995.

3.2.2 Excess [Rejuvenator] [Rejuvenator/Sealer] Material

Approved mineral aggregate shall be provided by the Contractor and shall be spread in sufficient quantity to effectively blot up any excess [rejuvenator] [rejuvenator/sealer] material remaining on the treated pavement surface after 24 hours.

3.2.3 Ponding and Puddling of [Rejuvenator] [Rejuvenator/Sealer] Material

If low spots and depressions in the pavement surface cause ponding or puddling of the [rejuvenator][rejuvenator/sealer], the pavement surface

shall be broomed with a broom drag. Brooming shall continue until the pavement surface is free of any pools of excess material.

3.2.4 Excess Runoff of [Rejuvenator] [Rejuvenator/Sealer] Material

The application rate shall be reduced if the surface grade of the pavement surface causes excessive runoff of the [rejuvenator] [rejuvenator/sealer]. Additional [rejuvenator][rejuvenator/sealer] may be applied after the first application of material has penetrated into the pavement.

3.2.5 Insufficient [Rejuvenator] [Rejuvenator/Sealer] Material

When it is determined by the Contracting Officer that the actual application rate of the [rejuvenator][rejuvenator/sealer] is more than 5 percent below the approved application rate, subsequent applications of material shall be made to bring the actual application rate up to the approved rate; additional [rejuvenator] [rejuvenator/sealer] material shall penetrate into the pavement surface within 24 hours after application.

3.3 APPLICATION OF AGGREGATE

NOTE: This section relates only to rejuvenator/sealer materials and should be deleted when a rejuvenator is applied. The application of aggregate should be kept to the minimum required for satisfactory skid resistance.

The aggregate shall be applied to the surface of the treated pavement immediately following application of the rejuvenator/sealer material. The rate of application shall be determined by the contractor and approved by the Contracting Officer. The rate will not exceed 0.54 kg/m² (1.0 lb/yd²), unless approved by the Contracting Officer.

3.4 SAMPLING AND TESTING

3.4.1 Test Section

Prior to application of the [rejuvenator] [rejuvenator/sealer] material, a representative test section shall be prepared on the pavement to be treated. If it is anticipated that the amount of material applied will have to be varied to meet existing different pavement surface conditions, then the test section should be broken up to include a representative section of each surface condition. The test sections shall be treated with various amounts of material, up to a maximum amount that the pavement can absorb. The application rate shall not exceed that which the pavement can absorb within 24 hours. Testing shall be conducted on samples obtained from the top [9 millimeters] [3/8 inch] of each of these treated areas to measure the viscosity or phase angle and thus determine the desired application rate. The samples of treated material shall be obtained no sooner than 24 hours after application of [rejuvenator] [rejuvenator/sealer]. An application rate shall be selected by the Contractor to obtain the specified reduction in asphalt viscosity or phase angle, and to ensure that all the material penetrates into the pavement surface within

24 hours. Application of the [rejuvenator] [rejuvenator/sealer] shall not begin until the test sections have been evaluated and the required application rate has been approved by the Contracting Officer.

3.4.2 Sampling

Sampling of the test section shall be performed before and after the pavement has been rejuvenated. In order for enough asphalt cement to be recovered, a minimum of three 150-millimeter (6-inch) cores will be required. Comparative cores taken before and after treatment should be taken close to the same locations, at a minimum within the same paving lane and within 0.5 meter (1 foot) of each other. Samples taken from the treated test section areas shall be taken no sooner than 24 hours after application of the [rejuvenator] [rejuvenator/sealer].

3.4.3 Testing

An independent testing laboratory approved by the Contracting Officer shall conduct testing. Tests shall be conducted to extract the bituminous binder according to ASTM D 2172 and recover according to ASTM D 1856 or ASTM D 5404. The change in viscosity or phase angle shall be determined for each application rate of [rejuvenator] [rejuvenator/sealer] in the test section from tests conducted on samples taken before and samples taken after the pavement surface has been rejuvenated. Viscosity of the bituminous material shall be measured in accordance with ASTM D 2170 or ASTM D 2171/AASHTO T 202 as applicable. The phase angle of the bituminous material shall be measured in accordance with AASHTO T 315.

-- End of Section -

DISTRIBUTION LIST

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SPECIAL INTEREST ORGANIZATIONS

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