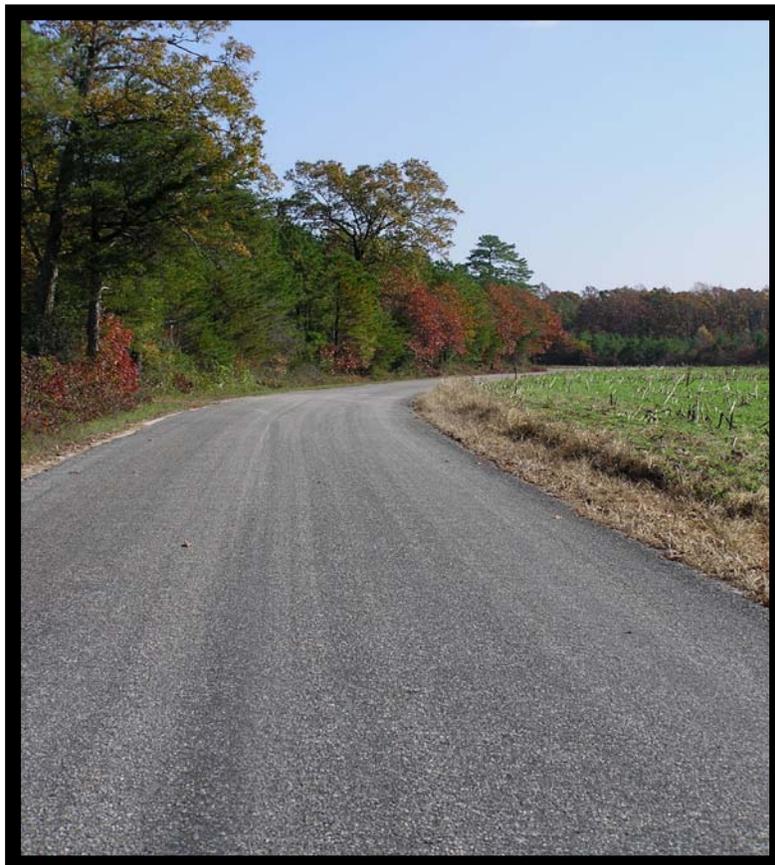




Surface Treatment Certification Study Guide



PREFACE

This manual has been prepared as a practical guide for VDOT Technicians, Inspectors, and Contractors. The information included herein is generally compatible with current VDOT specifications, instructions and test methods, **however it should not be considered a source book for specifications.**

Use this manual only as a guide and reference to supplement the specifications.

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Virginia Department of Transportation Surface Treatment Certification School Agenda

Instructor: Kevin Chisnell

7:30 – 8:00	Registration
8:00 – 11:00	Surface Treatment
11:00 – 12:30	Exam

CHAPTER 1

GENERAL

INTRODUCTION

Surface Treatment is also known as Chip Seal and is defined as an asphalt-aggregate application. Generally, the depth of the application is less than one inch and may be placed over any roadway surface – granular or existing pavement.

SURFACE TREATMENT USAGE

Low traffic primary and secondary routes are generally selected for Surface Treatment as well as some interstate or primary shoulders. Surface Treatment is used as an economical preventative maintenance tool to:

- Prevent surface water from infiltrating the foundation courses of pavements that are weathered or cracked.
- Provide a skid-resistant surface to pavements that are slippery due to wear and polishing of surface aggregates.
- Restore life to dry and weathered pavements where raveling might occur.

The life of a structurally sound pavement can be extended 5-7 years with a well constructed Surface Treatment. “Structurally sound” meaning the pavement has only infrequent non-severe deficiencies such as minor cracking or little to no rutting. Surface Treatment follows the contour of the road and will fail if placed on unstable material.

TYPES OF SURFACE TREATMENT

SINGLE SEAL TREATMENT

Single seal treatment is an application of approximately 0.30 gallons per square yard (gal/yd²) of asphalt emulsion, followed by approximately 15 to 20 pounds per square yard (lb/yd²) of cover aggregate (generally an #8 or #8P).

BLOTTED SEAL COATS OR MODIFIED SEALS

Treatments that have more than one application of asphalt and aggregate are called Blotted Seal Coats or Modified Seals. A fine aggregate is placed on top of the initial seal to blot or choke the coarse aggregate.

- **Type B Blotted Seal (Modified Single Seal)**

For a Type B blotted seal, an asphalt emulsion is placed at approximately 0.17gal/yd², followed by an application of 15 to 20 lb/yd² of #8's. After rolling, 0.15 gal/yd² of emulsion is placed, and then 9 to 11 lb/yd² of #9's or "clean" sand is applied and rolled.

- **Type D Blotted Seal (Modified Triple Seal)**

For a Type D blotted seal, an application of asphalt, cutback or asphalt emulsion is placed, followed by an application of cover (coarse) aggregate. This step is performed three times and the process completed with a final application of asphalt, cutback or asphalt emulsion, a layer of blot (fine aggregate) and a final roll.

INSPECTION OF EXISTING PAVEMENT

IDENTIFYING PAVEMENT DEFECTS

When a section of pavement is selected as a candidate for Surface Treatment, deficiencies need to be identified and evaluated. Surface Treatments are not intended to bridge weak spots or mask underlying pavement defects.

Here are some deficiencies to look for when evaluating a pavement for resurfacing:

- Potholes
- Raveling
- Cracking
- Broken edges
- Deformations such as rutting or pushing
- Surface condition which may be flushed, dry or weathered



Cracking



Broken Edges and Potholes

Good drainage is necessary for water to quickly leave the immediate vicinity of the roadbed. Make sure all ditches and other drainage areas are open and at a level below the bottom of the subbase or top of the subgrade.

Proper repair of the deficiencies in the existing surface is essential before the Surface Treatment construction begins to prevent substandard performance or even failure of the application. Make all repairs well ahead of the Surface Treatment application to allow time for consolidation under traffic.

CHAPTER 2 EQUIPMENT

Good construction practices include using the proper equipment, operated by trained and qualified personnel. Virginia Department of Transportation requires that a Certified Surface Treatment Technician be present on a Surface Treatment operation. (Ref. *VDOT Road & Bridge Spec. Special Provision, Asphalt Surface Treatment – Maintenance July 5, 2007*)

Surface Treatment requires several pieces of specialized equipment for construction: an asphalt distributor, aggregate spreader, rollers and a power broom. Before a project begins, make sure all equipment is in good mechanical condition. Check for worn parts that could effect the application and verify that the equipment is clean and calibrated whenever necessary. The Virginia Department of Transportation (VDOT) must approve the equipment prior to performance of the work. (Ref. *VDOT Road & Bridge Spec. Section 314.04*)

ASPHALT DISTRIBUTOR

The most important piece of equipment on a Surface Treatment job is the asphalt distributor. Improper application of an asphalt emulsion can cause a treatment to fail. An asphalt distributor's function is to uniformly apply the liquid asphalt at the specified rate and temperature. It must be able to maintain this rate regardless of the changes in the grade or direction of movement.



The distributor must have the capability of uniformly applying asphalt material on variable widths of surface up to 15 feet at readily controlled rates from 0.05 to 2.0 gal/yd² with uniform pressure. The variation from the specified rate is not allowed to exceed 0.02 gal/yd². (Ref. *VDOT Road & Bridge Spec. Section 314.04*)

Equipment for the distributor includes:

- Thermometer to measure the temperature of the liquid asphalt in the tank
- Heater to heat the asphalt material to the specified temperature range
- Power-driven pump
- Power unit to operate the pump
- Full circulation spray bars adjustable laterally and vertically
- Positive shut-off control
- Nozzle system through which the asphalt is forced under pressure
- Tachometer, pressure gauges, volume measuring devices or a calibrated tank

Displays in the distributor include selectable readouts for the pump; gallons per minute, feet per minute, application rate, spray bar length, distance traveled, and gallons sprayed. There are also digital readouts displaying the temperature of the asphalt in the tank, flow, speed calibration, spray bar width, hour meter and total area sprayed.

There must be a connection on the distributor for a hand sprayer to be used to cover variable width areas, patches and other areas where spray bar application is impractical or would result in excessive asphalt material. (Ref. *VDOT Road & Bridge Spec. Section 314.04*)

DISTRIBUTOR CALIBRATION

The asphalt distributor should be calibrated at the beginning of the job.

Spray Nozzles

Streaking is the most common problem associated with faulty asphalt distribution. It is discernible by the alternating narrow longitudinal bands of excessive and then insufficient asphalt. This problem can be caused by one or more of the following situations:

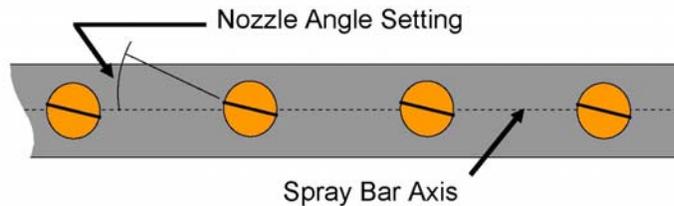
- Clogged distributor nozzles
- Improper pump pressure
- Interference of asphalt spray by nearby nozzles
- Improper spray bar height

All of these things should be monitored daily and whenever streaking is taking place.

Check all nozzles for nicked or damaged edges. Replace any damaged nozzles since this could cause a distorted spray fan. Make sure all nozzle openings are the same size and the manufacturer's recommendations are followed for proper sizing. Use special end nozzles to insure correct and uniform coverage.

The angle of the long axis of the spray nozzles is usually set at 15-30 degrees with respect to the spray-bar axis. This type of setting prevents the spray fans from interfering with each other.

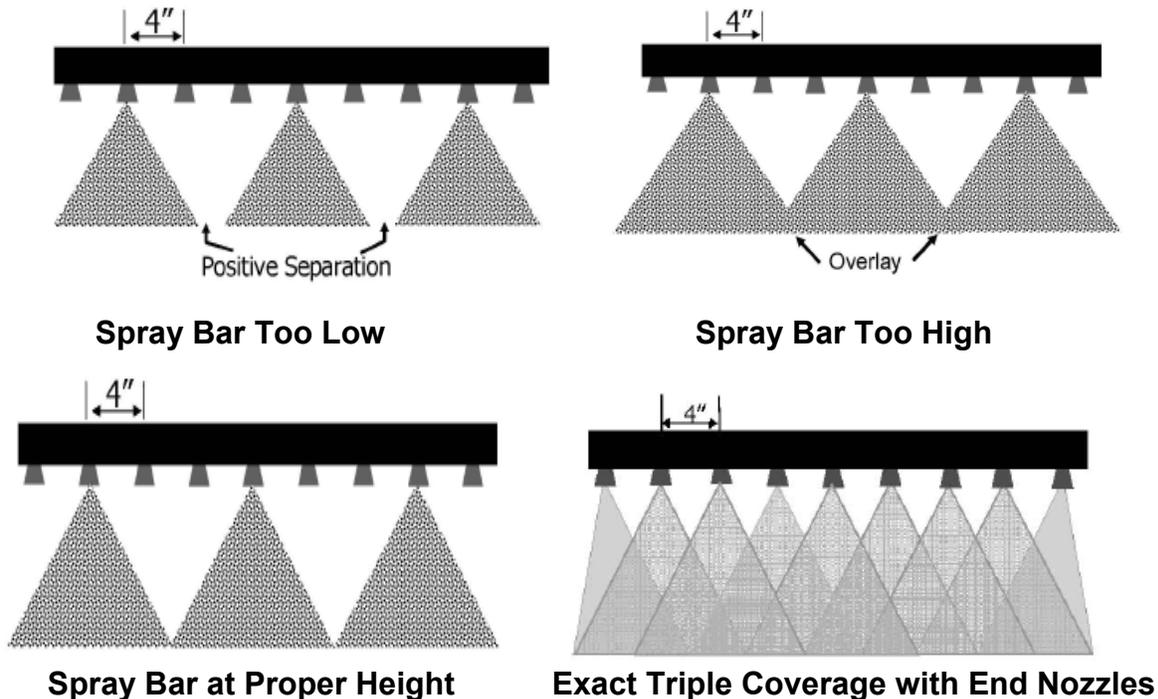
Some operators set end nozzles at a different angle (60-90 degrees) with respect to the spray-bar in an attempt to obtain a good edge. This should be discouraged, since it will cause a fat streak on the edge and starve the adjacent spray fan of asphalt emulsion.



When adjusting the spray nozzles, use the special wrenches furnished by the manufacturers. Visually adjusting the proper nozzle angle is difficult and should be avoided. Always use the correct nozzles for the material application being used.

Correct spray bar height setting is a vital factor for proper asphalt distribution. If the bar is set too high, wind may distort the spray fans; too low and the spray may overlap causing a non-uniform distribution of asphalt. The illustration below shows the steps for the spray bar height calibration (for a 4 inch nozzle spacing).

Using the center section of the spray bar, leave every third nozzle open, close all others. Spray a short pattern and evaluate it. Repeat until correct coverage is obtained.



When all nozzles are opened, exact triple lap of the spray fans is achieved.

Bitumeter

The bitumeter is an instrument on the distributor that measures speed and distance. Generally the bitumeter is one of two types: a wheel-type, mounted on a retractable frame or an infrared type. The read-out in the cab registers feet per minute, total distance traveled and gallons per square yard.

Periodically check the bitumeter to ensure accurate measuring of speeds when spraying asphalt emulsion.

- This can be done by measuring and marking off a 1000 foot section of a straight and level length of road.
- Drive the distributor at a constant speed over this length and time the trip with a stopwatch.
- Next, calculate the speed in feet per minute and compare with the dial reading recorded during the run.
- Repeat this procedure for several other speeds, some slower and some faster than the speed to be used for spraying.
- Plot any errors found at various speeds on a graph (keep with the distributor) so they may be applied when using the distributor for future applications.

AGGREGATE SPREADER



The aggregate spreader's function is to uniformly apply the aggregate at the specified application rate over the newly applied asphalt. There are three types of aggregate spreaders; truck mounted, pull-behind, and the most commonly used the self-propelled.

AGGREGATE SPREADER CALIBRATION

Use the manufacturer's instructions to adjust and calibrate the spreader. During the application, it is important to make periodic checks to ensure that quantities specified are being achieved. Here are two quick ways to accomplish this.

Method One:

This method is used before job start up.

- Lay a one square yard piece of burlap down in front of the spreader. (Do not lay burlap on top of the emulsion.)
- After making a pass with the spreader, carefully lift the burlap and weigh the aggregate.
- This gives you the application rate of the aggregate in pounds per square yard.

Method Two:

This test can be used for emulsion and aggregate quantity check during application.

- Weigh and record the weights of two pans and two – one square foot metal plates.
- Place the plates in front of the surface treatment operation.

Be careful to place the plates so that they are not in the wheel path of the equipment.

ENSURE SAFETY - NOTIFY ALL PERSONNEL THE TEST IS BEING CONDUCTED.

- Allow the distributor to apply asphalt, at the specified rate, onto the plates.
- Pick up one of the plates and place in the corresponding tared pan.
- Next, make a pass with the aggregate spreader over the remaining plate.
- Pick up this plate and place in the other tared pan.
- Weigh each plate and pan, fill out the worksheet and perform the calculations to determine the asphalt distribution rate and aggregate distribution rate.

Calculations for this worksheet are covered in Chapter 5.

Application Worksheet

(Rev. 4/02)

Surface Treatment Application Worksheet

Test No.	ST8D06	Source	Design Quantities
District	Staunton	Aggregate	Joe's Quarry 15/10
County	Augusta	Asphalt	ABC Asphalt, Inc 0.17/0.15
Route	222	Air Temp	67°F Surface Temp 72°F
Location	WBL	Date	4/25/06

Type Seal:

- Single Seal Modified Single Seal (Blot B) Modified Double Seal (Blot C) Modified Triple Seal (Blot D)
 First Course Second Course Third Course Blot Coat

Asphalt Formula: $\frac{(B - A) \times 9}{8.41} = \text{Asphalt in gal/sq yd.}^*$ **A = tare wt. of asphalt pan & plate** **B = wt. of pan, plate and asphalt**

$$\frac{(B \ 4.015 - A \ 3.871) \times 9}{8.41} = 0.15 \text{ gal/sq yd}^*$$

* If allowed to break and set, divide by residual asphalt content (approx. 0.65)

Aggregate Formula: $D - (C + (B - A)) \times 9 = \text{agg. in lbs/sq yd}$ **C = tare wt. of aggregate pan & plate** **D = wt. of pan, plate, asphalt & agg.**

$$D \ 5.289 - [(C \ 3.001 + (B \ 4.015 - A \ 3.871))] \times 9 = 19.3 \text{ lbs/sq yd}$$

ROLLERS

The function of the roller is to embed the aggregate into the freshly sprayed asphalt emulsion. If the aggregate is not embedded firmly, it will be thrown or whipped off the pavement by traffic. The embedment is accomplished by rolling the aggregate, using at least one pneumatic (rubber-tire) roller. VDOT specifications call for at least one pneumatic roller and additional rollers may be required, either a tandem steel-wheel or steel 3-wheel. If a combination of types of rollers is used, make the last pass with the steel-wheel roller to ensure a smooth mat.



Pneumatic Roller Specifications:

- Self- propelled
- Capable of applying 200-350 psi per inch of gross load
- Maintain 90 psi minimum tire pressure
- Speed – 5 mph maximum

Steel Wheel Roller Specifications:

- Weight - 8 ton minimum
- Speed - 3 mph maximum



(Ref. VDOT Road & Bridge Spec. -Section 312.03)

POWER BROOM



The rotary power broom is used to clean the road prior to the application, removing any dust, dirt or other debris from the existing pavement and after application to remove loose aggregate. Brush bristles are usually made of fiber, steel or nylon. Since the power broom is operated at an angle, the bristles tend to wear at an angle. Check them often for wear to make certain that even pressure is being applied to the roadway for a thorough sweeping.

TRUCKS

Inspect the trucks to be used on a Surface Treatment project to confirm they are in good working order. The beds should be free of debris and contaminants. Haul trucks must be equipped with a tarp. For safety reasons, it is desirable to use tarps that can be extended by mechanical means over the bed of the truck without the driver having to climb up on the sides of the vehicle to unroll the tarp. Enough trucks should be available to ensure that the operation can progress without interruption. Frequent stops and starts may cause variations in the asphalt spray distribution and the rate of aggregate coverage resulting in a non-uniform surface.

CHAPTER 3

MATERIALS

The materials used in Surface Treatments are asphalt (PG binders, cutback asphalts or emulsions) and aggregates.

ASPHALT EMULSION

Generally in Virginia, a Cationic Rapid Set (CRS) emulsion meeting the Type II coating ability is specified for surface treatments. Some localities prefer a latex modified emulsion (CRS-2L). This emulsion has a latex modifier (minimum 2.5% by weight), which provides increased adherence between the asphalt and aggregate. The type and grade will be specified in the contract.

EMULSION SPECIFICATIONS

Asphalt emulsions should adhere to the aggregate, cure rapidly, and the base asphalt binder should be viscous enough to resist run-off. Emulsions must meet the coating ability requirements of the *VDOT Road & Bridge Specifications Section 210.02*. It is the contractor's responsibility to ensure the compatibility of the asphalt emulsion and cover aggregate (excluding the blot seal) prior to beginning the Surface Treatment application and any other time as deemed necessary by the engineer. This is accomplished by testing the materials in accordance with the (Virginia Test Method) VTM-65 Compatibility Test (See page 50). Each asphalt and aggregate combination must be tested in the presence of the engineer.

The test steps are:

- Thoroughly mix two hundred grams of SSD aggregate with thirty grams of emulsion.
- Place on roofing felt and spread to a uniform thickness.
- Immediately sprinkle $\frac{3}{4}$ of a quart of water over the sample until the water running off the sample is clear, very near clear or when all of the water is used (within 5 minutes).
- Visually evaluate the coating of the aggregate. To pass, the sample must have a shiny black and tacky surface, and show not signs of stripping. If the aggregate is not fully coated, the test fails.

If 5 percent or less of the aggregate particles are not coated, a reference test will be run to verify that the failing results are due to poor mixing.

Temperature

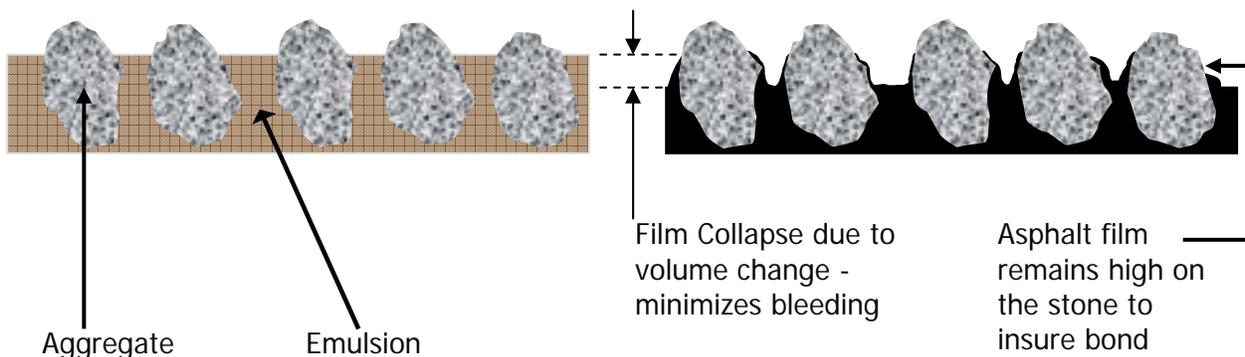
Since the temperature of emulsion is critical to a uniform application, check each distributor load coming from the tanker to the project. Monitor temperatures even more closely during cooler weather.

Blotted seal coats have an application temperature range of 160°F to 175°F. (*Special Provision for Blotted Seal Coats*)

Application temperature requirements for liquid asphalt are found in the *VDOT Road & Bridge Specifications Section 310 Table III-1*.

WATER

Of all the factors influencing emulsion, “breaking” is the most important one with regard to the electro-chemical charge in the emulsion. Breaking is the evaporation of water which allows bonding between the aggregate and emulsion. Water lowers the application temperature which provides less of a hazard to personnel. It also allows for a reduction in volume between the time of application and the final seal coat which reduces bleeding.



Before Breaking

After Breaking

AGGREGATES

Crushed stone, gravel, and lightweight aggregate are used in Surface Treatment construction. The aggregate selected must meet certain criteria; size, shape, cleanliness, and surface properties. It is important that the aggregate not be used within 24 hours of washing. All aggregates for a specified route or group of sub-division routes must all come from the same source, unless permitted by the engineer. (*Ref. VDOT Road & Bridge Special Provision for Asphalt Surface Treatment – Maintenance, July 5, 2007*).

AGGREGATE PROPERTIES

Size – The aggregates should be uniform in size (gap graded) so the Surface Treatment will have only one layer of aggregate. If there is much difference between the largest and the smallest particles, the asphalt film may totally cover the smaller sizes and prevent proper embedment of the larger particles. If this happens, the coarser stones may be whipped off easily by high speed traffic.

VDOT uses No.8 or No.8P aggregate for surface treatment applications. The gradation requirements are shown below.

Aggregate Gradation

Sieve size	# 8	8P
1/2 “	Min. 100	Min. 100
3/8”	84 – 100	75 – 100
No. 4	10 – 40	5 – 30
No. 8	Max. 8	Max. 5
No. 16	Max. 5	

Shape – Ideally the aggregate particles should be cubicle in shape. A large amount of flat and elongated particles is undesirable because they may be completely covered if enough asphalt is used to hold the cubical particles.

Cleanliness – Clean aggregate is extremely important. If the particles are dusty or coated with silt or clay, the asphalt will not adhere to the aggregate, resulting in loss of cover material and too much asphalt on the surface.

Surface Properties – Aggregates must be non-polishing where specified. Wear by traffic over a time will cause aggregate to become smooth or polished resulting in slippery pavement surfaces.

The cover material should be Saturated Surface Dry (SSD). This helps to promote a bond between the aggregate and the emulsion. However, a “wet” (free water on the surface of the aggregate) aggregate will cause dilution of the asphalt and the treated road will flush or bleed.

Fine Aggregate

Fine aggregates used for the blot coat may be a natural sand or manufactured aggregate. This material must be a No. 9 aggregate, with no more than 5% of the material passing the No. 200 sieve by washed analysis.

CHAPTER 4

CONSTRUCTION

SURFACE TREATMENT DESIGN OBJECTIVES

Surface Treatment must be designed to hold the stone but not so much that it will bleed. The stone should be placed one layer in thickness for the width of the roadway. The contractor will design the component materials according to VTM-66 (See Appendix B Page 50).

Before rolling and traffic, the aggregate lies in an unarranged state with approximately 50% voids between particles. After compaction and traffic, the aggregate becomes positioned to with approximately 15 to 20% voids. By design, those voids should be filled 2/3 to 3/4 full of asphalt. Aggregate size and dry-rodded voids will affect the application rate of the aggregate. Aggregate porosity, current surface condition and amount of traffic may affect the amount of emulsion placed.

WEATHER LIMITATIONS

Suitable weather conditions play a very important role in achieving a good Surface Treatment application. Hot asphalt emulsions depend on the evaporation of water for their curing and adhesion. It is important to consider temperature, humidity, wind speed, plus the possibility of precipitation before applying Surface Treatment. High humidity, low temperature and rainfall will adversely affect setting rates and curing.



Surface Treatment must not be placed when roadway surfaces are wet or if the air temperature is below 50°F or the surface temperature is below 70°F. The contractor is responsible for measuring the surface temperature of the roadway before placement begins using a calibrated infrared thermometer. (Ref. *VDOT Road & Bridge Specifications Section 314.03*)

TRAFFIC CONTROL

Pre-construction traffic layouts are provided in the Special Provisions for chip seal schedules. Contractor maintenance and protection responsibilities for traffic control include, but are not limited to the placement of signs and the use of flaggers and pilot trucks. To prevent damage to the roadway surface during the delivery and application process, delivery equipment and the pilot truck speed limits should be kept to a maximum 15 mph.

Traffic may not be allowed on seal treatment until the asphalt material has sufficiently cured to carry traffic without damage to the treatment. For modified single seal and modified double seal, no traffic, including delivery trucks are allowed on the treatment until after the blot coat material has been placed and rolled.

(Ref. VDOT Road & Bridge Special Provision for Asphalt Surface Treatment – Maintenance, July 5, 2007)

CLEANING THE PAVEMENT



Always clean the edges of the existing roadway before the Surface Treatment application. This permits adhesion of the new asphalt to the old pavement. Use the rotary power broom to remove all dust, dirt and other debris from the existing pavement.

After the Surface Treatment application is complete, sweep loose aggregate from the roadway

surface, using light pressure. Ideally this should be done early in the morning before the pavement temperature rises to prevent dislodgment of embedded particles.

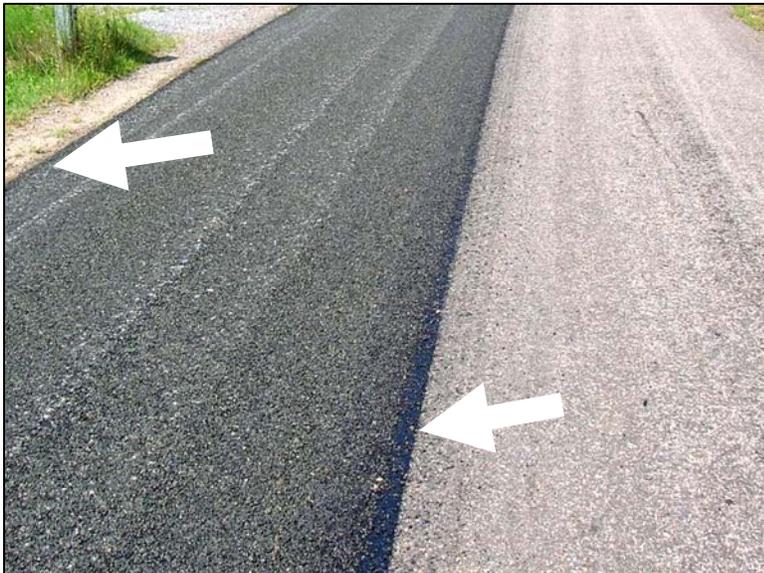
(Ref. VDOT Road & Bridge Spec. -Section 312.03)

CONSTRUCTION PROCEDURES

The roadway has been repaired, the materials are stockpiled, the equipment is calibrated and in place, weather conditions are right and traffic control is in place. Here are the basic steps for application:

- Sweep the pavement with a power broom.
- Spray the asphalt emulsion at the specified application rate.
- Spread the cover aggregate immediately behind the distributor at the specified rate.
- Roll the cover aggregate immediately behind the aggregate spreader, achieving proper embedment.
- Sweep excess aggregate off the Surface Treatment.

Avoid rough and unsightly transverse joints by starting and stopping the asphalt and aggregate spread on building paper at least 3 feet wide and the length equal to that of the spray bar plus 1 foot. Have the distributor moving forward at the proper application speed at the time the spray bar is opened. After the application, remove the paper and dispose of it in a legal manner. *(Ref. VDOT Road and Bridge Specifications - Section 312.04)*



Make sure the spread of the asphalt material is not more than 6 inches wider than the width covered by the cover material from the spreader. Immediately following asphalt application, apply the cover material in full-lane widths up to 12 feet. If there are deficient areas, correct it by adding more material.

(Ref. VDOT Road and Bridge Specifications Section 312.04)

During the asphalt application, take precautions to prevent spattering adjacent items. Never clean or discharge the distributor into ditches, borrow pits, onto shoulders, or along the right of way. When the equipment is not being use, park it so that the spray bar or mechanism will not drip asphalt material on the surface of the roadway. *(Ref. VDOT Road & Bridge Spec. -Section 312.04)*

MAINTENANCE, PROTECTION AND PERFORMANCE OF WORK

The contractor is responsible for the maintenance and protection of the seal treatment on the roadway for a period of 48 hours after application. Maintenance includes distributing more cover material over the pavement surface to absorb free asphalt and cover any area lacking adequate cover aggregate.

In the event a failure occurs prior to acceptance, the contractor is responsible for repairing or replacing the failed treatment as directed by the Engineer, at no additional cost to the Department. (*Ref. VDOT Road & Bridge Special Provision for Asphalt Surface Treatment – Maintenance, July 5, 2007*)

COMMON CONSTRUCTION PROBLEMS

RIDGING AT THE JOINTS

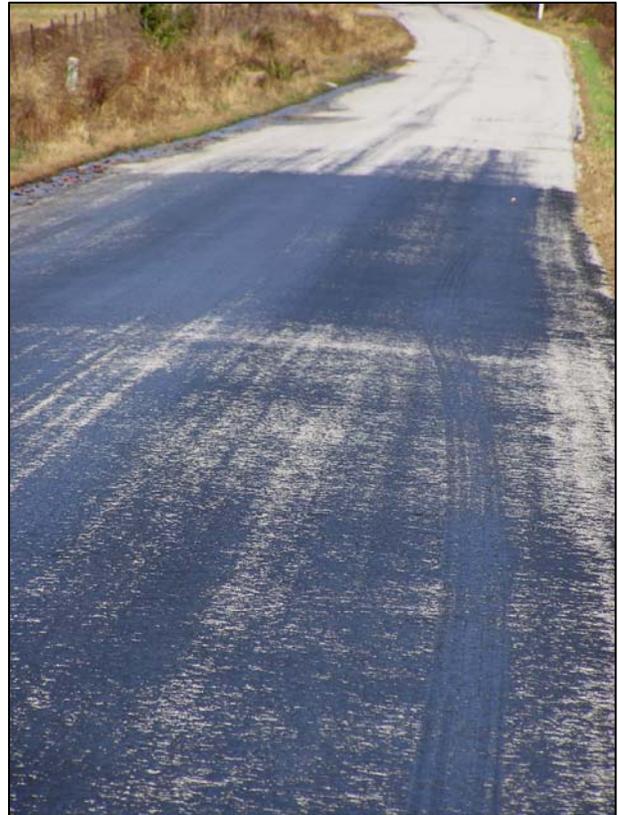
Ridging is the buildup of asphalt and aggregate, usually found on or near the centerline. This is caused by improper overlap of passes by the distributor.

STREAKING

Streaking is the non-uniform application of asphalt emulsion. This is caused by improper adjustment of the spray bar or incorrect pump pressure. Keeping check on the spray bar height, proper maintenance of the distributor, and keeping the nozzles clean can prevent this from occurring. Streaking is not just an unsightly appearance, but greatly reduces the service life of the pavement through loss of cover aggregate.

BLEEDING OR FLUSHING

An abundance of asphalt on the surface is called “bleeding” or “flushing”. Causes include too much binder (emulsion) for the amount of aggregate or too little aggregate is used. Bleeding may occur when too much binder is used for the amount of traffic or the old surface has bled through to the surface. This could be the result of these issues not taken into account during design of the mix. Patching not done well in advance of treatment is another reason for the pavement bleeding.



LOSS OF COVER AGGREGATE

Loss of cover aggregate occurs when the applied aggregate does not adhere to the binder. There are many causes for this:

- Spreader too far from distributor
- Dry or dusty aggregate
- Not rolled immediately
- Too much cover aggregate
- Fast traffic on roadway too soon
- Porous old pavement that absorbs old asphalt
- Improper asphalt distribution

CHAPTER 5

CALCULATIONS

DETERMINING ASPHALT DISTRIBUTOR SPEED NEEDED

To determine the required speed of an asphalt distributor in **feet per minute**:

$$S_f = \frac{9 \times S_{bo}}{W \times R}$$

To determine the required speed of an asphalt distributor in **miles per hour**:

$$S_m = \frac{9 \times S_{bo}}{88 \times W \times R}$$

Where:

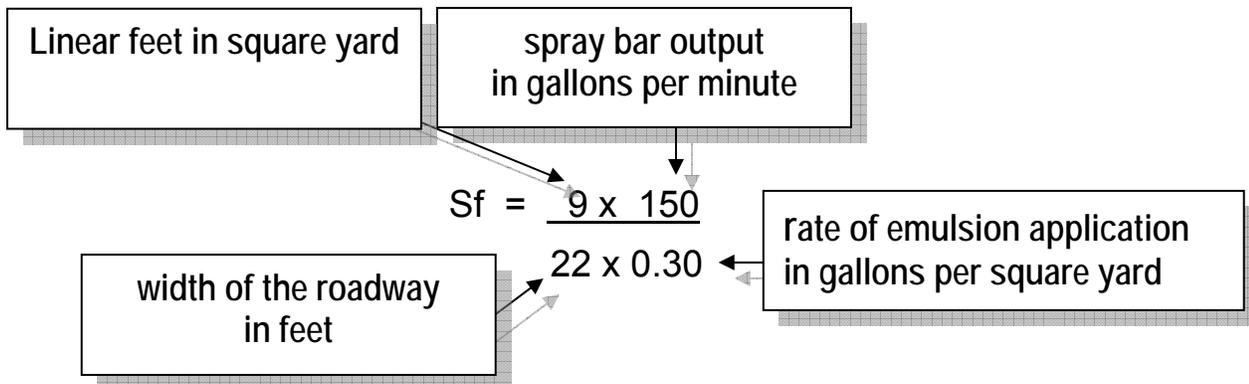
- S_f = Speed in feet per minute
- S_m = Speed in miles per hour
- S_{bo} = Spray bar output in gallons per minute
- W = Width of roadway in feet
- R = Rate of application in gallons per square yard

EXAMPLE - Feet per Minute:

Determine the required distributor speed in feet per minute to apply an emulsion to a **22**-foot wide roadway at the rate of **0.30** gal/yd². The spray bar output is **150** gal/min.

Use the formula:

$$S_f = \frac{9 \times S_{bo}}{W \times R}$$



$$S_f = \frac{9 \times 150}{22 \times 0.30} = \frac{1350}{6.6} = 204.545 \text{ round to } \mathbf{205 \text{ ft/min}}$$

EXAMPLE – Miles per Hour:

Determine the required distributor speed in miles per hour to apply an emulsion to a **22** -foot wide roadway at the rate of **0.30** gal/yd². The spray bar output is **150** gal/min.

Use the formula:

$$S_m = \frac{9 \times S_{bo}}{88 \times W \times R}$$

$$S_m = \frac{9 \times 150}{88 \times 22 \times 0.30} = \frac{1350}{580.8} = 2.32 \text{ round to } \mathbf{2 \text{ mph}}$$

Asphalt Distributor Speed Calculations

Problem No. 1

Determine the required distributor speed in feet per minute to apply an emulsion to a **15-** foot wide roadway at the rate of **0.30** gal/yd². The spray bar output is **175** gal/min.

Problem No. 1A

Using the information above, determine the required distributor speed in miles per hour .

Problem No. 2

Determine the required distributor speed in feet per minute to apply an emulsion to an **11-** foot wide roadway at the rate of **0.31** gal/yd². The spray bar output is **155** gal/min.

Problem No. 2A

Using the information above, determine the required distributor speed in miles per hour .

DETERMINING QUANTITIES NEEDED

To determine the total gallons of asphalt or the total pounds of aggregate needed for a surface treatment application, use this formula:

$$T = \frac{L \times W \times R}{9}$$

Where:

L = Length of spread in feet

R = Rate of application (asphalt in gallons per sq. yd. or aggregate in lb. per sq. yd.)

W = Width of roadway

T = Total gallons or pounds

NOTE: To convert the pounds of aggregate to tons, divide the total pounds by 2000.

Remember: 1 mile = 5280 feet

ASPHALT QUANTITY

EXAMPLE:

How many gallons of asphalt (emulsion) are needed to cover **1** mile of a **22**-foot wide roadway applied at the rate of **0.30** gal/yd²?

Use the formula:

$$T = \frac{L \times W \times R}{9}$$

width of roadway in feet

length of spread in feet
1 mile = 5280 ft.

rate of emulsion application
in gallons per square yard

$$T = \frac{5280 \times 22 \times 0.30}{9}$$

$$T = \frac{34848}{9} = \mathbf{3872 \text{ gallons of asphalt}}$$

Asphalt Emulsion Quantity Calculations

Problem No. 3

How many gallons of asphalt (emulsion) are needed to cover **1** mile of a **20-foot** wide roadway applied at the rate of **0.30** gal/yd²?

Problem No. 4

How many gallons of asphalt (emulsion) are needed to cover **1** mile of a **18-foot** wide roadway applied at the rate of **0.29** gal/yd²?

AGGREGATE QUANTITY

To find tons of aggregate needed:

$$T = \frac{L \times W \times R}{9} \quad \text{to find total pounds of aggregate}$$

Then convert the pounds to tons by dividing the total pounds of aggregate by 2000.

Where:

L = Length of spread in feet

R = Rate of application pounds per square yard

W = Width of roadway

T = Total pounds

Remember: 1 mile = 5280 feet

EXAMPLE:

How many tons of cover stone are needed to cover **1** mile of a **22**-foot wide roadway at an application rate of **15** lbs./yd²?

Using the formula:

$$T = \frac{L \times W \times R}{9}$$

$$T = \frac{5280 \times 22 \times 15}{9}$$

$$T = \frac{1742400}{9} = 193600 \text{ pounds of stone}$$

Convert the pounds to tons by dividing by 2000

$$\frac{193600}{2000} = \mathbf{96.8 \text{ tons of stone}}$$

Aggregate Quantity Calculations
Problem No. 5

How many tons of cover stone are needed to cover **1** mile of a **20**-foot wide roadway applied at the rate of **9** lb/yd²?

Problem No. 6

How many tons of cover stone are needed to cover **1** mile of a **22**-foot wide roadway applied at the rate of **17** lb/yd²?

Determining Application Rate of the Distributor and Aggregate Spreader

Determine if the asphalt distributor and aggregate spreader are applying materials at the specified rate. Use the formulas shown below.

Application of a modified single seal (Blot B). The weights were as follows:

First course (CRS -2 and 8P)

- A = Tare weight of asphalt pan & plate 2.875 lbs
- B = Weight of pan, plate and asphalt 3.037 lbs
- C = Tare weight of aggregate pan & plate 2.881 lbs
- D = Weight of pan, plate, asphalt and agg 4.919 lbs

First Course
 Second Course
 Third Course
 Blot Coat

Asphalt

Formula: $\frac{(B - A) \times 9}{8.41} = \text{Asphalt in gal/sq yd.}^*$

A = wt. of asphalt pan & plate (tare wt.)

B = wt. of pan, plate and asphalt

$$\frac{(B \ 3.037 - A \ 2.875) \times 9}{8.41} = 0.17 \text{ gal/sq yd}^*$$

* If allowed to break and set, divide by residual asphalt content (approx. 0.65)

Step #1 (B - A)
3.037 - 2.875 = 0.162

Step #2 (B - A) x 9
0.162 x 9 = 1.458

Step #3 $\frac{1.458}{8.41} = 0.173$ or **0.17**

Aggregate

Formula: $(D - [C + (B - A)]) \times 9 = \text{agg. in lbs/sq yd}$ C = wt. of aggregate pan & plate (tare wt.) D = wt. of pan, plate, asphalt & agg.

$$(D \ 4.919 - [C \ 2.881 + (B \ 3.037 - A \ 2.875)]) \times 9 = 16.9 \text{ lbs/sq yd}$$

Start Here For Aggregates

Step #2 [C + (B - A)]
2.881 + 0.162 = 3.043

Step #1 (B - A)
3.037 - 2.875 = 0.162

Step #3 (D - [C+(B-A)])
(4.919 - 3.043) = 1.876

Step #4 (D-[C+(B-A)]) x 9 =
1.876 x 9 = 16.884

Surface Treatment Application Worksheet

Problem No. 7

Determining Application Rate of the Distributor and Aggregate Spreader

Determine if the asphalt distributor and aggregate spreader are applying materials at the specified rate. Use the formulas shown below. This application is a modified single seal (Blot B)

FIRST COURSE

CRS -2 and 8P

A = Tare weight of asphalt pan & plate	3.093 lbs
B = Weight of pan, plate and asphalt	3.253 lbs
C = Tare weight of aggregate pan & plate	3.045 lbs
D = Weight of pan, plate, asphalt and agg	5.188 lbs

Single Seal Modified Single Seal (Blot B) Modified Double Seal (Blot C) Modified Triple Seal (Blot D)

First Course Second Course Third Course Blot Coat

Asphalt

Formula: $\frac{(B - A) \times 9}{8.41} = \text{Asphalt in gal/sq yd.}^*$

A = tare wt. of asphalt pan & plate

B = wt. of pan, plate and asphalt

$$\frac{(B \quad - \quad A \quad) \times 9}{8.41} = \quad \text{gal/sq yd}^*$$

* If allowed to break and set, divide by residual asphalt content (approx. 0.65)

Aggregate

Formula: $D - (C + (B - A)) \times 9 = \text{agg. in lbs/sq yd}$

C = tare wt. of aggregate pan & plate

D = wt. of pan, plate, asphalt & agg.

$$D \quad - \quad [\quad C \quad + \quad (B \quad - \quad A \quad) \quad] \times 9 = \quad \text{lbs/sq yd}$$

Problem No. 8

Determining Application Rate of the Distributor and Aggregate Spreader

Determine if the asphalt distributor and aggregate spreader are applying materials at the specified rate. Use the formulas shown below. This application is a modified single seal (Blot B)

BLOT COAT

CRS-2 and #9

A = Tare weight of asphalt pan & plate	2.997 lbs
B = Weight of pan, plate and asphalt	3.136 lbs
C = Tare weight of aggregate pan & plate	2.881 lbs
D = Weight of pan, plate, asphalt and agg	4.270 lbs

Single Seal Modified Single Seal (Blot B) Modified Double Seal (Blot C) Modified Triple Seal (Blot D)

First Course Second Course Third Course Blot Coat

Asphalt
Formula:

$$\frac{(B - A) \times 9}{8.41} = \text{Asphalt in gal/sq yd.}^*$$

A = tare wt. of asphalt pan & plate

B = wt. of pan, plate and asphalt

$$\frac{(B \quad - \quad A \quad) \times 9}{8.41} = \quad \text{gal/sq yd}^*$$

* If allowed to break and set, divide by residual asphalt content (approx. 0.65)

Aggregate

Formula: $D - (C + (B - A)) \times 9 = \text{agg. in lbs/sq yd}$

C = tare wt. of aggregate pan & plate

D = wt. of pan, plate, asphalt & agg.

$$D \quad - \quad [\quad C \quad + \quad (B \quad - \quad A \quad) \quad] \times 9 = \quad \text{lbs/sq yd}$$

SURFACE TREATMENT CHECK LIST

SURFACE TREATMENT CHECK LIST

District	_____	Contract Number	_____
Residency	_____	Contractor	_____
Route	_____	Date	_____
Location From	_____	Type	_____
Location To	_____	Application Rate	_____

	Spec. No.	YES	NO
Does the type and grade of liquid asphalt comply with the contract requirements?	310.02		
Does the liquid asphalt material application temperature conform to the requirements of the table for Liquid Asphalt Application Temperature?	310.03(1)		
During the asphalt application, has care been taken to prevent spattering adjacent items?	310.03(2)		
When not in use, the distributor(s) parked so that the spray bar or mechanism will not drip asphalt on the surface of the traveled way?	310.03(3)		
Has the existing asphalt been patched, cleaned and rendered free from irregularities to the extent necessary to provide a reasonably smooth and uniform surface?	310.03(4)		
Have the vertical edges of the existing pavement that are adjacent to new pavement been cleaned to permit adhesion of the new asphalt?	310.03(5)		
Has the asphalt been applied at the specified rate per square yard?	310.03(6)		
Has the tack coat been applied in accordance with the same weather limitations that apply to the course being placed?	310.03(7)		
Do the cover materials conform to the requirements of specifications on aggregate materials?	310.03(8)		
Has the area to receive the application of asphalt material been cleaned of dust, mud and foreign matter?	312.04(1)		
Have the skipped areas and deficiencies been corrected?	312.04(3)		
Is the length of spread of asphalt regulated by the quantity of cover material loaded into trucks?	312.04(4)		
Is the spread of asphalt no more than 6 inches wider than the width of the cover material being applied?	312.04(5)		
Is the cover material applied in full –lane widths up to 12 feet immediately following asphalt application?	312.04(6)		
Does the rolling begin immediately after the cover material is applied?	312.04(7)		
Is the wearing surface of the seal being maintained and excess material is swept off the surface by the means of rotary broom as required or directed by the Engineer?	312.04(8)		

SURFACE TREATMENT CHECK LIST – Continued

		YES	NO
Is the contractor complying with the weather limitations for application of various surface treatments?	314.03		
Do the spreaders, distributors and rollers conform to the requirements for equipment in the specifications for surface treatment?	314.04		
Is the liquid asphalt, cover aggregate, and fine aggregate in conformance with the material requirements of Section II of the Special Provisions?	SP-BSC(II)		
Are the application rates for the asphalt and aggregate material in accordance with those shown on the plans or altered as directed by the Engineer?	SP-BSC(III)1		
During the application, was the temperature of the liquid asphalt material maintained between 160°F and 175°F?	SP-BSC(III)2		
Is each application of liquid asphalt material immediately followed by an application of aggregate?	SP-BSC(IV)1		
Is the aggregate immediately rolled by one pass if a self-propelled steel wheel roller which weighs between 6 and 8 tons if tandem type or between 8 and 10 tons if three wheel type?	SP-BSC(IV)2		
Is the blot coat applied with a self-propelled aggregate spreader of an approved design and immediately rolled one pass with a self-propelled roller?	SP-BSC(IV)3		

Comments

Inspectors Signature

SURFACE TREATMENT STUDY QUESTIONS

1. Name the two components that make up Surface Treatment.
 - A. Soil and cement
 - B. Emulsion and asphalt
 - C. Asphalt and aggregate

2. How soon should cover material be applied after the asphalt emulsion application?
 - A. Immediately
 - B. Within the hour
 - C. Wait 24 hours
 - D. Wait at least 1 hour

3. Surface Treatment drastically increases the load strength of a pavement.
 - A. True
 - B. False

4. How soon after aggregate application does a Surface Treatment need to be rolled?
 - A. Within 24 hours
 - B. Immediately
 - C. Within an hour
 - D. Within 12 hours

5. The maximum speed for rubber tire rollers is:
 - A. 5 mph
 - B. 10 mph
 - C. 25 mph
 - D. 5280 fpm

6. Where do you find the maximum temperature allowance for liquid asphalt?
 - A. Road & Bridge Specifications – Section 315.04
 - B. The Book of Standards
 - C. Road & Bridge Specifications – Section 310.03
 - D. The Manual of Instructions

STUDY QUESTIONS

Continued

7. Applying a Surface Treatment prevents the intrusion of water into the foundation courses that are weathered or cracked.
 - A. True
 - B. False

8. The distributor's allowable variation from the specified rate of application shall not exceed:
 - A. $\pm 1\%$
 - B. 1.0 gal/yd²
 - C. 0.02 gal/yd²
 - D. 0.05 to 2.0 gal/yd²

9. The minimum temperature for CRS-2 is:
 - A. 70°F
 - B. 160°F
 - C. 350°F
 - D. 175°F

10. Aggregate may be hauled directly from the washing plant and used in Surface Treatment:
 - A. True
 - B. False

11. The maximum allowable width of exposed asphalt after aggregate application is:
 - A. 6 inches
 - B. 1 foot
 - C. 1%
 - D. 15 inches

STUDY QUESTIONS

Continued

12. The speed of the delivery equipment and pilot truck is limited to:
- A. 3 mph
 - B. 5 mph
 - C. 10 mph
 - D. 15 mph
13. Asphalt emulsion for Surface Treatment shall be:
- A. Cationic rapid set
 - B. Meet Type II coating requirements
 - C. Be compatible with cover aggregate
 - D. All of the above
14. Why should the existing roadway be cleaned before applying a Surface Treatment application?
- A. To keep the equipment clean
 - B. To ensure that the asphalt adheres to the aggregate
 - C. To ensure that the equipment runs smoother
 - D. To prevent the asphalt from spattering on adjacent items
15. When should Surface Treatment not be placed?
- A. Surface is wet, or air temperature is below 50°F or the surface temperature is below 70°F.
 - B. Air temperature is below 70°F or the surface temperature is below 50°F
 - C. Air temperature is below 70°F or the surface temperature is below 75°F

APPENDIX A

Virginia Department of Transportation

Road & Bridge SPECIFICATIONS & SPECIAL PROVISIONS

SECTION 310—TACK COAT

310.01—Description.

This work shall consist of preparing and treating an existing asphalt or concrete surface with asphalt in accordance with the requirements of these specifications and in reasonably close conformity with the lines shown on the plans or as established by the Engineer.

310.02—Materials.

Asphalt for tack coat shall be CRS-1, CRS-2, CRS-1h or CSS-1h and conform to the requirements of Section 210. CMS-2, conforming to the requirements of Section 210, may be used during the winter months. With the exception of CMS-2, asphalt for tack coat may be diluted with 50 percent water provided that resulting material produces a uniform application of the tack.

310.03—Procedures.

Equipment for heating and applying asphalt shall conform to the requirements of Section 314.04(b). The maximum application temperature of liquid asphalt shall conform to the requirements of Table III-1.

The existing surface shall be patched, cleaned, and rendered free from irregularities to the extent necessary to provide a reasonably smooth and uniform surface. Unstable corrugated areas shall be removed and replaced with suitable patching materials. The edges of existing pavements that are to be adjacent to new pavement shall be cleaned to permit adhesion of asphalt.

TABLE III-1
Liquid Asphalt Application Temperature

Grade	Max. Temperature (°F)
RC-70	180
RC-250	220
RC-800	225
RC-3000	290
MC-70	180
MC-250	220
MC-800	255
MC-3000	290
AC-5	300
AC-10	300
AC-20	300
AC-40	300
RS-2	175
SS-1h	180

AE-4	150
CRS-2	175
CSS-1h	180
CMS-2	200
CRS-1h	175
CRS-1	175

Tack material shall be uniformly applied with a pressure distributor conforming to the requirements of Section 314.04(b). Hand spray equipment shall not be used except in areas inaccessible by a pressure distributor. Undiluted asphalt shall be applied at the rate of 0.05 to 0.10 gallons per square yard. Diluted asphalt shall be applied at the rate of 0.10 to 0.15 gallons per square yard.

The tack coat shall be applied in a manner to offer the least inconvenience to traffic and permit one-way traffic without pickup or tracking of the asphalt.

The tack coat shall not be applied immediately prior to the course being placed. The tack coat shall be applied in accordance with the same weather limitations that apply to the course being placed. The quantity, rate of application, temperature, and areas to be treated shall be approved prior to application.

During the application of asphalt, care shall be taken to prevent spattering adjacent items. The distributor shall not be cleaned or discharged into ditches or borrow pits, onto shoulders, or along the right of way. When not in use, equipment shall be parked so that the spray bar or mechanism will not drip asphalt on the surface of the traveled way.

310.04—Measurement and Payment.

Tack coat, when a pay item, will be measured in gallons and will be paid for at the contract unit price per gallon. When not a pay item, the cost thereof shall be included in the price for other appropriate pay items.

Patching will be paid for at the contract unit price for the various items used unless a reconditioning item is included in the Contract.

Payment will be made under:

Pay Item	Pay Unit
Tack coat	Gallon

SECTION 312—SEAL COAT

312.01—Description.

This work shall consist of applying asphalt followed by applying cover material in accordance with the requirements of these specifications and in reasonably close conformity with the lines shown on the plans or as established by the Engineer.

312.02—Materials.

- (a) **Asphalt** may be changed one viscosity grade by the Engineer during construction at no change in the contract unit price. Asphalt shall conform to the applicable requirements of Section 210.
- (b) **Cover material** shall conform to the applicable requirements of Section 203. Lightweight aggregate shall conform to the requirements of Section 206. Cover material shall not be hauled directly from a washing plant for immediate use in the work.

312.03—Equipment.

The following equipment or its equivalent is required:

- (a) equipment for heating and applying asphalt conforming to the requirements of Section 314.04(b)
- (b) a rotary power broom
- (c) at least one pneumatic tire roller. Additional rollers that may be required may be tandem steel wheel or three-wheel rollers weighing at least 8 tons. The pneumatic tire roller shall be self-propelled, and the gross load adjustable to apply 200 to 350 pounds per inch of rolling width as directed. Tires shall be designed for a tire pressure of at least 90 pounds per square inch. Steel wheel rollers shall be operated at a maximum speed of 3 miles per hour, and pneumatic tire rollers at a maximum speed of 5 miles per hour.
- (d) a mechanical roller-type hopper or a self-propelled aggregate spreader of an approved design

312.04—Procedures.

The rates of application of materials shall be determined in accordance with the method described in Education Series No. 12 of the Asphalt Institute entitled *Asphalt Surface Treatments Construction Techniques*.

The weather limitations specified in Section 314.03 shall apply to seal coat work.

Seal coating operations shall not be started until the surface is thoroughly compacted and cleaned of dust, mud, and foreign matter and the section to be sealed has been approved by the Engineer.

Asphalt shall be applied by means of a pressure distributor in a uniform continuous spread over the section to be treated and within the temperature range given in Table III-1. A strip of building paper at least 3 feet in width and having a length equal to that of the spray bar of the distributor plus 1 foot shall be used at the beginning of each spread. If the cutoff is not positive, the use of paper may be required at the end of each spread. The paper shall be removed and disposed of legally. The distributor shall be moving forward at the proper application speed at the time the spray bar is opened. Skipped areas and deficiencies shall be corrected. Junctions of spreads shall be carefully made to ensure a smooth riding surface.

The length of the spread of asphalt shall be regulated by the quantity of cover material in loaded trucks on the project.

The spread of asphalt shall be not more than 6 inches wider than the width covered by the cover material from the spreading device. Asphalt shall not be allowed to chill, set up, dry, or otherwise impair retention of the cover material.

During asphalt application, care shall be taken to prevent spattering adjacent items. The distributor shall not be cleaned or discharged into ditches or borrow pits, onto shoulders, or along the right of way. When not in use, equipment shall be parked so that the spray bar or mechanism will not drip asphalt material on the surface of the traveled way.

Immediately following asphalt application, cover material shall be applied in full-lane widths up to 12 feet. Laps shall be made only at lane dividers or at the crown of the roadway. Successive laps at lane dividers and the roadway crown shall be staggered from 3 to 6 inches. Spreading shall be accomplished in a manner so that the tires of the truck or aggregate spreader do not contact the uncovered and newly applied asphalt.

If directed, cover material shall be moistened with water to eliminate or reduce dust coating of aggregate. Moistening shall be done the day before the use of aggregate.

Immediately after cover material is spread, deficient areas shall be covered by additional material. Rolling shall begin immediately behind the spreader and shall consist of at least three complete coverages.

After application of cover material, the wearing surface shall be lightly broomed or otherwise maintained until cured as directed. Maintenance of the surface shall include distributing cover material over the surface to absorb free asphalt and cover any area deficient in cover aggregate. Maintenance shall be conducted so as not to displace embedded material. Excess material shall be swept from the surface by means of rotary brooms as required or as directed by the Engineer.

312.05—Measurement and Payment.

Seal coat will be paid for at the contract unit price per gallon for liquid asphalt and per ton for cover material. **Liquid asphalt** will be measured in gallons and **cover material** will be measured in tons, complete-in-place, in accordance with the requirements of Section 109.01. These prices shall include furnishing and applying materials and maintaining the treatment.

Payment will be made under:

Pay Item	Pay Unit
Liquid asphalt	Gallon
Cover material (Type)	Ton

SECTION 314--PENETRATION SURFACE COURSES

314.01--Description.

This work shall consist of constructing a wearing surface of crushed stone, slag, or crushed gravel penetrated with asphalt in accordance with the requirements of these specifications and in reasonably close conformity with the lines shown on the plans or as established by the Engineer.

314.02--Materials.

- (a) **Asphalt** may be changed one viscosity grade by the Engineer during construction at no change in the contract unit price. Asphalt shall conform to the applicable requirements of Section 211.
- (b) **Aggregate** shall be crushed stone, slag, or crushed gravel that conforms to the applicable requirements of Section 203. Aggregate shall not be hauled directly from a washing plant and used in the work.
- (c) **Fine aggregate** shall be Grading B sand conforming to the requirements of Section 202.

314.03--Weather Limitations.

Penetration courses shall not be placed when surfaces are wet, when the air temperature is below 50°F , or when the surface temperature is below 70°F. The Contractor shall furnish a properly calibrated infrared instrument for the purpose of measuring the surface temperature and shall measure the surface temperature prior to placement.

314.04--Equipment.

Equipment shall be approved prior to performance of the work. Equipment that will handle the materials and produce the completed course or courses in accordance with the requirements of these specifications is acceptable.

- a) **Spreaders:** Spreaders for coarse aggregate shall be self-propelled spreading and leveling machines or spreader boxes equipped with shoes or runners of sufficient width and length to preclude damage or displacement of the subgrade or other courses.

The mechanical spreader for the fine aggregate shall conform to the requirements of Section 312.03.

- (b) **Distributor:** The distributor shall be so designed, equipped, maintained, and operated that asphalt at the specified temperature range may be applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gallons per square yard. Distributor equipment shall include a tachometer, pressure gages, accurate volume-measuring devices or a calibrated tank, and a thermometer for measuring temperatures of the contents of the tanks. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically. The distributor shall be equipped with a positive shutoff control that will prevent lapping at the junction of two applications. When necessary, the distributor shall be equipped with a positive means of deflecting the spray to prevent coating of adjacent structures and appurtenances.

A connection shall be provided and hand spraying equipment shall be used to cover variable width areas, patches and other areas where spray bar application is impractical or would result in excessive asphalt material.

- (c) **Rollers:** The number, type, and mass of rollers shall be sufficient to compact the mixture to the required density.

314.05--Procedures.

Cover material shall be applied in full-lane widths up to 12 feet. Laps shall be made only at lane dividers or at the crown of the roadway. Successive laps at lane dividers and the crown of the roadway shall be staggered from 3 to 6 inches.

Conditioning of the road surface shall conform to the requirements of Section 312.04.

(a) Rates of Application:	Asphalt (gal/yd ²)	Aggregate (lb/yd ²)
Light courses		
Coarse aggregate No. 56		60-139
Asphalt for penetration	0.75-1.20	
Choke aggregate		
No. 68, or		20-30
No. 78, or		22-28
No. 8, or		18-25
Grading B sand		10-15
Asphalt for seal	0.15-0.30	
Seal aggregate No. 78, or		22-28
Seal aggregate, No. 8		18-25
Heavy courses		
Asphalt for tack coat	0.10-0.20	
Coarse aggregate, No. 56		140-200
Asphalt for penetration	1.30-1.80	
Choke aggregate, No. 68		20-30
Asphalt for seal	0.20-0.35	
Seal aggregate, No. 78 or		22-28
Seal aggregate, No. 8		18-25

(b) **Sequence and Methods:**

1. If deemed necessary or specified, a tack coat shall be applied in accordance with the requirements of Section 310 immediately prior to the application of coarse aggregate.
2. The coarse aggregate shall be uniformly spread on the prepared base or surface at the specified rate of application. This application shall be mixed and shaped by the use of multiple-blade road planers or other approved equipment.

Immediately following mixing and shaping operations, the surface shall be rolled with a 10 ton, three-wheel or tandem steel wheel roller and, for a heavy penetration surface course, uniformly choked with No. 68 aggregate. The surface will be tested by the Engineer using

a 10 foot straightedge. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall be not more than 1/4 inch. Humps or depressions exceeding the specified tolerance shall be corrected. For a light penetration course, the coarse aggregate shall be uniformly choked with the fine aggregate.

3. The prepared course shall be penetrated with asphalt at the rate specified and immediately covered with the choke aggregate. Rolling operations shall immediately follow the application of covering aggregate and shall continue until the treatment is bonded. Subsequent rolling and applications of covering aggregate, if required, shall be performed on successive days following the application.
4. After the penetration course has cured, a seal coat shall be applied and rolled.

314.06--Measurement and Payment.

Asphalt will be measured in gallons aggregate and cover material will be measured in tons, complete-in-place, in accordance with the requirements of Section 109.01. Penetration surface course will be paid for at the contract unit price per gallon for asphalt and per ton for aggregate and cover material. These prices shall include furnishing and applying materials and maintaining the treatment.

Payment will be made under:

Pay Item	Pay Unit
Liquid asphalt	Gallon
Cover material (Type)	Ton
Aggregate (No.)	Ton

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
BLOTTED SEAL COATS

August 1, 1991c
Reissued July 9, 2002c

I. DESCRIPTION - This work shall consist of application of asphalt surface treatment in accordance with this provision and in reasonably close conformity with the line and grade shown on the plans, in the contract or designated by the Engineer.

Type B Blotted Seal is defined as two applications of liquid asphalt material, one application of cover aggregate and one application of blot fine aggregate.

Type C Blotted Seal is defined as three applications of asphalt material, two applications of cover aggregate and one application of blot fine aggregate.

Type D Blotted Seal is defined as four applications of asphalt material, three applications of cover aggregate and one application of blot fine aggregate.

II. MATERIALS - Liquid asphalt materials shall conform to Section 210 of the Specifications.

Cover aggregate shall conform to Section 203 of the Specifications.

Fine aggregate for blotting shall conform to Section 202 minimum Grading B of the Specifications except that material shall have no more than 5% passing the 200 sieve by washing.

III. APPLICATION - Application rates for asphalt and aggregate material shall be as shown on the plans. These rates of application are approximate only and such rates may be altered at the direction of the Engineer. During application, liquid asphalt material shall be maintained between 160 - 175°F. Cover material shall be applied to a reasonably complete coverage of only one aggregate depth over the treated surface.

IV. CONSTRUCTION METHODS shall be in accordance with the Asphalt Surface Treatment special provision and the following provisions:

Each coat of liquid asphalt material shall be applied to existing surface and immediately followed by an application of aggregate.

Aggregate shall be rolled one pass immediately with a self-propelled steel wheel roller. The roller weight shall be between 6 and 8 tons for tandem type and between 8 and 10 tons for the three wheel type.

Blot coat shall be applied with a self-propelled aggregate spreader of approved design and shall be rolled one pass immediately with a self-propelled roller.

V. METHOD OF MEASUREMENT AND BASIS OF PAYMENT - Blotted seal coat will be measured and paid for in square yards for type specified complete-in-place, which price shall be full compensation for furnishing and applying liquid asphalt material, cover material and blot fine aggregate, protection of treatment, rolling, brooming and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:	Pay Item	Pay Unit
	Blotted Seal Coat (Type)	Square Yard

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
ASPHALT SURFACE TREATMENT
(Maintenance)

July 5, 2007

I. DESCRIPTION

This work shall consist of the application of a single or multiple course of asphalt surface treatment in accordance with the Specifications and as specified herein.

II. DEFINITION OF TERMS

Seal Treatment is defined as one application of asphalt material and one application of cover aggregate.

Modified Single Seal is defined as two applications of asphalt material, one application of cover aggregate and one application of blot fine aggregate.

Modified Double Seal is defined as three applications of asphalt material, two applications of cover aggregate and one application of blot fine aggregate.

III. MATERIALS

The Contractor shall demonstrate the compatibility of the asphalt emulsion and cover aggregate (excluding the blot seal) prior to construction of the surface treatment. This testing shall be conducted in accordance with VTM-65 in the presence of the Engineer for each asphalt and aggregate combination. In addition, the Contractor shall conduct the compatibility test at least once a week on stockpiled materials and any additional test, as deemed necessary by the Engineer. Compatibility test results shall be submitted to the Engineer. All material combinations shall pass the compatibility test unless waived in writing by the Engineer.

If during the life of this project excessive loss of cover aggregate occurs, the Engineer may suspend the work in accordance with the requirements of Section 108 of the Specifications until the cause of the loss of cover material is corrected.

(a) **Asphalt Materials** shall conform to Section 210 of the Specifications except as specified herein.

CRS-2 shall be a rapid setting cationic emulsified asphalt when tested in accordance with ASHTO T59 Testing Emulsified Asphalt. CRS-2 shall meet the requirements of Type II coating ability.

CRS-2h shall conform to CRS-2 except that the penetration shall be 40 to 100.

RC-250 when permitted during the period of May 1 to October 1 shall meet the requirements of Type I coating ability. When permitted during the period of October 1 to May 1 the requirements of Type II coating ability shall apply.

CRS-2L (Latex Modified Asphalt) shall meet the physical requirements of asphalt material Type CRS-2, as modified herein. A minimum of 2.5 percent (by weight) of styrene-butadiene rubber (SBR) solids shall be incorporated into the emulsified asphalt. The latex modified emulsified asphalt shall be homogeneous and shall conform to the following requirements:

TESTS	Min.	Max.
Visc., Saybolt Furol, 122° F, sec.	100	400
Storage Stability Test, 24 hour, %	-	1.0
Classification Test	Passes	-
Particle Charge Test	Positive	-
Sieve test, 20 mesh, %	-	0.2
Distillation:		
Oil distillate, by vol. of emulsion, %	-	3
Residue, %	65	-
Tests on Residue from Distillation:		
Penetration, 77° F, 100 g., 5 sec.	100	250
Ductility, 77° F, 5 cm/minute, cm	100	-
Softening Point, ° F, (AASHTO T 53-89)	100	-
*Elastic Recovery	50	-

*Elastic Recovery Test: Condition the ductilometer and samples to be treated at 50 degrees F. Prepare the brass plate, mold and briquette specimen in accordance with AASHTO T51. The molds shall be the non-tapered type used for Force Ductility Testing. Keep the specimen at the specified test temperature of 50 degrees F for 85-90 minutes. Immediately after conditioning, place the specimen in the ductilometer and proceed to elongate the sample to 20 cm at a rate of pull of 5 cm per minute. After the 20 cm elongation has been reached, stop the ductilometer and hold the sample in its elongated position for five minutes. After five minutes, clip the sample approximately in half by means of scissors or other suitable cutting device. Let the sample remain in the ductilometer in an undisturbed condition for one hour. At the end of this time period, retract the half sample specimen until the two broken ends touch. At this point note the elongation (E) in cm. Calculate the percent recovery by the following formula:

$$\% \text{ recovery} = \frac{20 - E}{20} \times 100$$

Modifiers shall not be post-added to the finished emulsion. All modifiers shall be incorporated, during the milling process (co-milled) at the manufacturing facility.

The Contractor shall provide written certification of the test results.

- (b) **Cover Material** - Coarse and Fine aggregate shall conform to Section 203 and 202 of the Specifications. Coarse aggregate shall be a minimum Grade B. Lightweight aggregate shall conform to the requirements of Section 206 of the Specifications except

as noted herein. For light weight aggregate when the material passing the No. 200 sieve by washing is dust of fracture, the percentage of deleterious material shall not exceed 1.7 percent. Crushed stone shall only be used on roads of Traffic Groups VI and above unless the surface treatment consists of modified single seal treatment or modified double seal treatment. Aggregates shall not be used within 24 hours of washing. Aggregate from more than one source shall not be furnished for a specified route or a group of sub-division routes unless permitted by the Engineer.

The following modifies the aggregate material as defined in Section 203 of the Specifications:

Designation	Modification
N	Non-polishing material only
L	Lightweight
G	Washed gravel only

Notes:

Where 8N is specified, it shall meet the gradation requirements of No. 8P.

Where 8L is specified it shall meet the following gradation:

Sieve Size	Percent Passing
1/2	100
3/8	75-100
No. 4	10-40
No. 8	max. 5

Where 8G is specified, it shall meet the gradation requirements of No. 8P.

IV. PROCEDURES

Weather limitations for asphalt surface treatment work shall be in accordance with the requirements of Section 314 of the Specifications. The Contractor shall have a certified Surface Treatment Technician present during the surface treatment operation.

The Contractor shall use one steel wheel roller and one pneumatic-tire roller on modified single seal, modified double seal and seal treatments using CRS-2L asphalt material, in a sequence approved by the Engineer. These treatments shall be subjected to a minimum of one complete pass of each type of roller on either the cover aggregate or the blot seal coat.

- (a) **Seal Treatment** shall conform to the requirements of Section 312 of the Specifications. When seal treatment is specified, the Contractor shall protect the cover aggregate from traffic until the asphalt material has sufficiently cured to carry traffic without damage to the treatment.

The rate of application shall be in accordance with VTM-66. The rate of application for the cover aggregate and asphalt emulsion shown in the contract are approximate and the actual rate shall be determined by the Contractor and approved by the Engineer.

After the roadway has been treated and cured, the Contractor shall lightly broom the surface to remove any excessive aggregate in accordance with the requirements of Section 312.04 of the Specifications and as directed by the Engineer. Brooming shall be performed in such a manner as not to damage the embedded aggregate material.

- (b) **Modified Single Seal and Modified Double Seal Treatments**, when specified, shall be lightly broomed on the surface by the Contractor to remove any excessive aggregate in accordance with the requirements of Section 312.04 of the Specifications and as directed by the Engineer. Brooming shall be performed in such manner as not to damage the embedded aggregate material.

No traffic, including delivery trucks, shall be allowed on modified seal treatments until after the blot coat material has been placed and rolled.

1. **Modified Single Seal Treatment**

- a. Approximately 0.17 gallons per square yard of asphalt material, of the type specified, shall be applied to the existing surface immediately followed by an application of approximately 15 pounds per square yard of aggregate size No. 8P. The aggregate shall be spread uniformly (one aggregate deep) over the treated surface.

The aggregate shall be rolled immediately at least once with a self-propelled roller of an approved design. When a continuous uninterrupted modified single seal treatment train method is employed, rolling of the initial aggregate course may be omitted.

- b. Immediately after the seal coat has been rolled in accordance with IV.(b)1.a., herein a blot seal coat consisting of approximately 0.15 gallons per square yard of asphalt material, of the type specified, shall be applied to the surface treated pavement followed by a uniform application of approximately 10 pounds per square yard of fine aggregate. The fine aggregate shall be Grading A, B or F natural or manufactured in accordance with Section 202 or No. 9 aggregate in accordance with Section 203 of the Specifications, except that the material shall have no more than 5 percent passing the No. 200 sieve by washed analysis. An increase in the application rate for blotter material may be necessary when using natural sand and if the desired results are not achieved with this material, the Engineer may require the use of manufactured sand. Fine aggregate from more than one source shall not be used intermittently. The fine aggregate shall be applied by the use of a self-propelled aggregate spreader of approved design. The blot coat shall be rolled immediately at least once with a self-propelled roller of an approved design. At least 48 hours after the blot coat application, the roadway surface shall be lightly broomed as directed by the Engineer.

2. **Modified Double Seal Treatment**

- a. Two applications of asphalt material and cover aggregate shall be applied in accordance with Section IV.(b)1.a. herein, except that at least one complete pass shall be made with the roller after each aggregate application.
- b. A blot coat shall be applied in accordance with IV.(b)1.b. herein.

The application temperature for liquid asphalt material shall conform to Table III-1 of Section 310 of the Specifications, except that the minimum application temperature for CRS-2 and CRS-2L shall be 160 degrees F.

- (c) **Prime Coat**, when specified, shall be applied in accordance with Section 311 of the Specifications. When cover material is specified, rolling shall be performed in accordance with the requirements of Section 312 of the Specifications.

The prime coat shall be permitted to cure prior to the next application of asphalt.

During the period between application of the prime coat and the seal coat, the primed surface shall be kept in repair. Holes, ravels, and areas deficient in primer shall be patched and repaired with asphalt-treated materials by penetration methods or other approved procedures.

- (d) **Maintenance, Protection and Performance of the Work** - The Contractor shall be responsible for the maintenance and protection of the seal treatment on the roadway for a period of 48 hours after application.

The Contractor shall exercise control of the delivery and application of the surface treatment materials to prevent damage to the roadway surface. The speed of the delivery equipment and pilot truck shall be limited to a maximum 15 miles per hour. The maintenance and protection shall include, but not be limited to, the placement of signs; the use of flaggers and pilot trucks; and placement of additional asphalt and aggregate material. In the event a failure occurs prior to acceptance, the Contractor shall repair or replace the failed treatment as directed by the Engineer, at no additional cost to the Department.

V. **EQUIPMENT**

(a) **Asphalt Distributors and Aggregate Spreaders**

1. Distributors and spreaders shall be calibrated by the Contractor in the presence of the Engineer prior to placing surface treatment; to ensure an even and accurate spray, and aggregate distribution.
2. Asphalt distributors shall be equipped with proper spray nozzles including end nozzles for the application rate specified, to provide uniform coverage throughout the width of the application.

(b)Rollers

1. One steel wheel roller and one pneumatic-tire roller shall be used on modified single seal, modified double seal and seal treatment using CRS-2L asphalt material. The steel wheel roller weight shall be between 6 and 8 tons for the tandem type and between 8 and 10 tons for the three-wheel type.
2. Two pneumatic-tire rollers shall be used on the conventional type seal treatment.

VI. MEASUREMENT AND PAYMENT

Liquid asphalt material for seal treatment will be measured and paid for in accordance with Section 312 of the Specifications.

Aggregate for seal treatment will be measured and paid for in square yards on a plan quantity basis, which price bid shall include furnishing and applying aggregate, protection of the asphalt surface treatment and all incidentals necessary to complete the work. Authorized increases or decreases to the plan quantity will be adjusted in accordance with Section 109 of the Specifications.

Modified single seal and **modified double seal** treatments will be measured and paid for in square yard on a plan quantity basis, which price bid shall include all cost for furnishing and applying liquid asphalt material and cover aggregate, protection of the asphalt surface treatment and all incidentals necessary to complete the work. Authorized increases and decreases to the plan quantities will be adjusted in accordance with Section 109 of the Specifications.

Brooming, when requested by the Engineer, will be paid at a rate of **\$20.00** per hour for each power broom required. The price shall include power broom, operator, fuel, maintenance, traffic control and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Aggregate (type)	Square Yard
Modified Single Seal	Square Yard
Modified Double Seal	Square Yard

APPENDIX B

VIRGINIA TEST METHODS

Virginia Test Method – 65

Aggregate-Asphalt Compatibility Test for Surface Treatment

November 1, 2000

1. Scope

- 1.1 The Compatibility Test is used to determine the stripping of emulsified asphalt from aggregate.
- 1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Apparatus

- 2.1 Scale, capable of weighing 1000 grams accurate to within ± 1.0 gram.
- 2.2 Suitable heavy gauge steel round bottom bowl to contain the sample during mixing.
- 2.3 Long-handle spoon of sufficient length to project 100 mm or more out of round bottom bowl during stirring.
- 2.4 Supply of 150 mm (appr.) squares cut from smooth (14-27 kg) roofing felt.
- 2.5 Quart (0.95 L) can with 18 holes (3 mm) in lid for sprinkling water.

3. Procedure

- 3.1 To a total of 200 grams of minimum SSD (Saturated Surface Dry) condition aggregate add 30 grams (15%) of emulsion. Stir until completely coated. (Max. 30 sec.). Place on roofing felt and spread to uniform thickness (Approx. depth of top size aggregate) and immediately sprinkle water over sample until water running off sample is clear, very nearly clear, or when 3/4 of a quart (700 ml) of water is used, observe coating after sprinkling with water (within 5 minutes). To pass a sample must have a glossy black and tacky surface. Also, the sample shall show no signs of stripping. If aggregate is not fully coated it fails this test.

In case there is a question of a very small amount of 5% or less aggregate not coated a reference test shall be run to determine if this is due to not being fully coated during mixing. The reference test shall be run on 400 grams of aggregate of 20 percent emulsion. On half of the sample after mixing shall be placed on the roofing felt and not sprinkled. The other half shall be sprinkled as described in Section 3.1. If the sprinkled portion looks like the unsprinkled portion the test will be considered fully coated.

4. Report

- 4.1 Pass or Fail

**VTM-65
AGGREGATE ASPHALT COMPATABILITY TEST
FOR SURFACE TREATMENT**

SAMPLE NO.	DATE	
TERMINAL	LOCATION	
AGGREGATE SOURCE	AGGREGATE GRAMS	
TYPE EMULSION	% EMULSION	
SAMPLED FROM:	TERMINAL TANK #	PROJECT #
% RESIDUAL ASPHALT		
SAMPLE GLOSSY BLACK	YES / PASS	NO / FAIL
SAMPLE TACKY WHEN CHECKED BY HAND CONTACT:	YES / PASS	NO / FAIL
COATING:	100% / PASS	LESS THAN 100% / FAIL
RUN BY:	TELEPHONE NO.	

Virginia Test Method – 66

Surface Treatment Design – (Asphalt Lab)

November 1, 2000

1. Scope

- 1.1 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Procedures

- 2.1 Method MS-19 as published by The Asphalt Institute - procedure shall be followed, except as modified below:

PART 1 - SIEVE ANALYSIS

Delete the following sieve: 1/4" - 0.250 (6.3 mm – 6.4 mm)

PART 2 - FLAKINESS INDEX

Sizes of slots for each aggregate fraction MS-19, Appendix D, Figure D-2.

Delete the following slot sizes:

<u>Sieve Size</u>	<u>Slot Width, in./mm.</u>
1" - 3/4" (25 mm – 19 mm)	0.525 (13.3 mm)
3/4" - 1/2" (19 mm – 12.5 mm)	0.375 (9.5 mm)
1/4" - No. 4 (6.3 mm – 4.75 mm)	0.131 (3.33 mm)

Change slot from -3/8" + 1/4" (0.184) to -3/8" + #4 (0.184) (- 9.5 mm + 6.3 mm (4.67 mm)

C. 6.13

W = Rodded weight of cover aggregate lb/ft³ (kg/m³). (AASHTO Method T19).

APPENDIX C ANSWERS

Asphalt Distributor Speed Calculations

Problem No. 1

Determine the required distributor speed in feet per minute to apply an emulsion to a **15-** foot wide roadway at the rate of **0.30** gal/yd². The spray bar output is **175** gal/min.

$$S_f = \frac{9 \times S_{bo}}{W \times R} = \frac{9 \times 175}{15 \times 0.30} = \frac{1575}{4.5} = \mathbf{350 \text{ ft/min}}$$

Problem No. 1A

Using the information above, determine the required distributor speed in miles per hour .

$$S_m = \frac{9 \times S_{bo}}{88 \times W \times R} = \frac{9 \times 175}{88 \times 15 \times 0.30} = \frac{1575}{396} = 3.97 \text{ or } \mathbf{4 \text{ mph}}$$

Problem No. 2

Determine the required distributor speed in feet per minute to apply an emulsion to an **11-** foot wide roadway at the rate of **0.31** gal/yd². The spray bar output is **155** gal/min.

$$S_f = \frac{9 \times S_{bo}}{W \times R} = \frac{9 \times 155}{11 \times 0.31} = \frac{1395}{3.41} = \mathbf{409.09 = 409 \text{ ft/min}}$$

Problem No. 2A

Using the information above, determine the required distributor speed in miles per hour .

$$S_m = \frac{9 \times S_{bo}}{88 \times W \times R} = \frac{9 \times 155}{88 \times 11 \times 0.31} = \frac{1395}{300.08} = \mathbf{4.64 = 5 \text{ mph}}$$

Asphalt Emulsion Quantity Calculations

Problem 3

How many gallons of asphalt (emulsion) are needed to cover 1 mile of a 20-foot wide roadway applied at the rate of 0.30 gal/yd²?

$$\frac{T = L \times W \times R}{9} = \frac{5280 \times 20 \times 0.30}{9} = \frac{31680}{9} = 3520 \text{ gal}$$

Problem 4

How many gallons of asphalt (emulsion) are needed to cover 1 mile of a 18-foot wide roadway applied at the rate of 0.29 gal/yd²?

$$\frac{T = L \times W \times R}{9} = \frac{5280 \times 18 \times 0.29}{9} = \frac{27561.6}{9} = 3062.4 \text{ gal}$$

Aggregate Quantity Calculations Problem No. 5

How many tons of cover stone are needed to cover **1** mile of a **20**-foot wide roadway applied at the rate of **9** lb/yd²?

$$\frac{T = L \times W \times R}{9} = \frac{5280 \times 20 \times 9}{9} = \frac{950400}{9} = 105600 \text{ pounds}$$

$$\frac{105600}{2000} = \mathbf{52.8 \text{ tons}}$$

Problem No. 6

How many tons of cover stone are needed to cover **1** mile of a **22**-foot wide roadway applied at the rate of **17** lb/yd²?

$$\frac{T = L \times W \times R}{9} = \frac{5280 \times 22 \times 17}{9} = \frac{1974720}{9} = 219413$$

$$\frac{219413}{2000} = \mathbf{109.7 \text{ tons}}$$

Surface Treatment Application Worksheet

Problem No. 7

Determining Application Rate of the Distributor and Aggregate Spreader

Determine if the asphalt distributor and aggregate spreader are applying materials at the specified rate. Use the formulas shown below. This is a Modified Single Seal (Blot B)

FIRST COURSE

CRS -2 and 8P

- A = Tare weight of asphalt pan & plate 3.093 lbs
- B = Weight of pan, plate and asphalt 3.253 lbs
- C = Tare weight of aggregate pan & plate 3.045 lbs
- D = Weight of pan, plate, asphalt and agg 5.188 lbs

Single Seal Modified Single Seal (Blot B) Modified Double Seal (Blot C) Modified Triple Seal (Blot D)

First Course

Second Course

Third Course

Blot Coat

Asphalt
Formula:

$$\frac{(B - A) \times 9}{8.41} = \text{Asphalt in gal/sq yd.}^*$$

A = tare wt. of asp

Asphalt

$$\frac{3.253 - 3.093}{8.41} \times 9 = 1.44 \qquad \frac{1.44}{8.41} = 0.171 \text{ or } 0.17$$

$$\frac{(B \ 3.253 - A \ 3.093) \times 9}{8.41} = \underline{0.17} \text{ gal/sq yd}$$

* If allowed to break and set, divide by residual asphalt content (approx. 0.65)

Aggregate

Formula: $D - (C + (B - A)) \times 9 = \text{agg. in lbs/sq yd}$

C = tare wt. of aggregate pan & plate

D = wt. of pan, plate, asphalt & agg.

$$D \ 5.188 - [C \ 3.045 + (B \ 3.253 - A \ 3.093)] \times 9 = \underline{17.8} \text{ lbs/sq yd}$$

Step 1 $3.253 - 3.093 = 0.16$	Step 2 $3.045 + 0.16 = 3.205$	Step 3 $5.188 - 3.205 = 1.983$	Step 4 $1.983 \times 9 = 17.847 \text{ or } 17.8$
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Problem No. 8

Determining Application Rate of the Distributor and Aggregate Spreader

Determine if the asphalt distributor and aggregate spreader are applying materials at the specified rate. Use the formulas shown below.

Blot Coat

CRS -2 and #9

- A = Tare weight of asphalt pan & plate 2.997 lbs
- B = Weight of pan, plate and asphalt 3.136 lbs
- C = Tare weight of aggregate pan & plate 2.881 lbs
- D = Weight of pan, plate, asphalt and agg 4.270lbs

Single Seal Modified Single Seal (Blot B) Modified Double Seal (Blot C) Modified Triple Seal (Blot D)

First Course Second Course Third Course Blot Coat

Asphalt
Formula:

$$\frac{(B - A) \times 9}{8.41} = \text{Asphalt in gal/sq yd.}^*$$

A = tare wt. of asphalt

Asphalt

$$\frac{3.136 - 2.997 \times 9}{8.41} = 1.251 \quad \frac{1.251}{8.41} = 0.148 \text{ or } 0.15$$

$$\frac{(B \ 3.136 \ - \ A \ 2.997 \) \times 9}{8.41} = \underline{0.15} \text{ gal}$$

* If allowed to break and set, divide by residual asphalt content (approx. 0.65)

Aggregate

Formula:

$$D - (C + (B - A)) \times 9 = \text{agg. in lbs/sq yd}$$

C = tare wt. of aggregate pan & plate

D = wt. of pan, plate, asphalt & agg.

$$D \ 4.270 \ - \ [\ C \ 2.881 \ + \ (B \ 3.136 \ - \ A \ 2.997 \) \] \times 9 = \underline{11.3} \text{ lbs/sq yd}$$

Step 1 3.136 - 2.997 = 0.139

Step 2 2.881 + 0.139 = 3.02

Step 3 4.270 - 3.02 = 1.25

Step 4 1.25 x 9 = 11.25 or 11.3

Study Question Answers

1. Name the two components that make up Surface Treatment.
C. Asphalt and aggregate
2. How soon should cover material be applied after the asphalt emulsion application?
A. Immediately
3. Surface Treatment drastically increases the load strength of a pavement.
B. False
4. How soon after aggregate application does a Surface Treatment need to be rolled?
B. Immediately
5. The maximum speed for rubber tire rollers is:
A. 5 mph
6. Where do you find the maximum temperature allowance for liquid asphalt?
C. Road & Bridge Specifications – Section 310.03
7. Applying a Surface Treatment prevents the intrusion of water into the foundation courses that are weathered or cracked.
A. True
8. The distributor's allowable variation from the specified rate of application shall not exceed:
C. 0.02 gal/yd²
9. The minimum temperature for CRS-2 is:
B. 160°F

Study Question Answers (continued)

10. Aggregate may be hauled directly from the washing plant and used in surface treatment:
B. False

11. The maximum allowable width of exposed asphalt after aggregate application is:
A. 6 inches

12. The speed of the delivery equipment and pilot truck is limited to:
D. 15 mph

13. Asphalt emulsion for Surface Treatment shall be:
D. All of the above

14. Why should the existing roadway be cleaned before applying a Surface Treatment application?
B. To ensure that the asphalt adheres to the aggregate

15. When should Surface Treatment not be placed?
A. Surface is wet, or air temperature is below 50°F or the surface temperature is below 70°F.