Appendix C

Virginia Test Method - 94
Quality Control Testing of Pavement Markings
November 1, 2000

1. Scope

This method of test outlines five (5) procedures for quality control testing of pavement markings:

A) Checking for moisture in the pavement
B) Determination of the wet film thickness of liquid markings
C) Determination of film thickness for thermoplastic markings
D) Determination of application rate of glass beads applied by pressurized spray or drop-on methods
E) Visual Inspection

2. Apparatus

The apparatus required for each procedure is outlined in the appropriate section below.

3. Procedures

A) Checking for moisture in the pavement

There are two methods described in this section. Method 1 is to be used prior to application of markings. Method 2 is only to be used during thermoplastic application.

Method 1

a) Apparatus

6 x 6 inches (or larger) clear or dark plastic square

Duct tape

b) Procedure

Select a location representative of the pavement surface where markings are to be applied. Secure all edges of the plastic to the pavement surface with the duct tape.

After a period of time, check for condensation of moisture on the underside of the plastic. The appropriate time between taping and inspecting the plastic will vary with ambient conditions; If moisture is present it will be drawn out more quickly in a sunny location than in the shade. However, shady areas are more likely to contain moisture. Always choose a test location that represents the "worst case" scenario. Generally, a minimum of twenty (20) minutes is recommended. The presence

of moisture on the underside of the plastic indicates that there is moisture in the pavement surface. The pavement should be retested after sufficient drying time.

Used for Determining Presence of Moisture in Pavement Surface During Thermoplastic Application

Method 2

a) Apparatus

#15 Tar paper

Duct tape

b) Procedure

Select a location where markings are to be applied. Place the tar paper on the pavement surface. Secure the tar paper to the surface with the duct tape such that it will not be displaced when the thermoplastic is applied.

Apply the marking material to the tar paper. Wait approximately one (1) minute to allow any moisture in the pavement to condense onto the tar paper. Carefully remove the tar paper from the pavement. (Thermoplastic is applied from 400° to 475°F. Work gloves should be worn.)

Inspect the underside of the tar paper for condensation of moisture. Presence of moisture on the tar paper indicates that there is moisture in the pavement surface. The pavement should be retested after sufficient drying time.

B) **Determination of the wet film thickness of liquid marking materials**

This procedure is to be used to verify the thickness of all liquid pavement marking materials, except thermoplastic, immediately following application thereof.

a) Apparatus

calibrated wet mil gauge

* sample plate (sheet metal - 4″x 6″, 20 to 40 mils thick)

piece of cloth

b) Procedure

Select a level location in the path of where the markings are to be applied. Place the plate on the pavement surface and secure it with the duct tape such that it will not be displaced when the marking is applied.

This test cannot be performed on a sample that contains glass beads. The glass bead gun must be turned off prior to application of the marking material to the sample plate.

Apply the marking material to the sample plate using the equipment being evaluated.

Thickness is specified in wet mils for all liquid markings except thermoplastic. Thus, all thickness measurements must be performed while the material is still wet.

Immediately after application, press the gauge firmly into the paint film at a 90°F angle. Withdraw the gauge vertically. Note the deepest tooth having paint on it and the next higher tooth that is not coated. The wet film thickness lies between these two teeth. Care must be taken not to press too hard as this may indent the sample plate and give a false reading.

If the paint only covers a portion of the bottom surface of the tooth, wipe the gauge clean using a soft cloth and repeat the test in another location

Read the thickness from the gauge.

The gauge should be cleaned with a cloth immediately after taking the reading. Consistent cleaning will prevent build-up of dried material.

C) **Determination of film thickness for thermoplastic marking materials**

This determination is made on the dried film. One of the two following methods is to be used depending on the quantity of voids in the substrate. The specified thickness is defined as the amount of material thickness above the surface of the roadway. Method 1 is to be used for dense graded substrates or when using an extrusion die applicator. Method 2 is to be used for any type of applicator when the substrate is open graded and a substantial amount of material lies below the effective plane of the pavement surface.

Method 1

a) Apparatus

Calipers accurate to .001 inch

* sample plate (sheet metal – 4″ x 6″, 40 to 60 mils thick)

Duct Tape

b) Procedure

Measure and record the thickness of the sample plate. Select a location in the path of where the markings are to be applied. Place the plate on the pavement surface and secure it with the duct tape such that it will not be displaced when the marking is applied.

This test will not be accurate when performed on a sample that contains drop-on or pressure applied glass beads. The glass bead gun or dispenser must be turned off prior to application of the marking material to the sample plate.

Apply the marking material to the sample plate using the equipment being evaluated.

Thermoplastic is applied from 400° to 475°F. Wait until the sample cools sufficiently to be moved without flowing. Carefully remove the sample plate from the pavement. Work gloves should be worn.

Using the calipers, measure the total thickness of the thermoplastic and the sample plate. Subtract the panel thickness from the total thickness to obtain the thickness of the applied material.

NOTES FOR B & C ABOVE:

1 - The samples obtained from the procedures B and C above should be inspected for even material thickness across the entire cross-section of the plate and even edges when viewed from above as detailed in (E) below.

2 - The methods of sampling outlined above may also be used to collect samples for visual inspection of glass bead distribution and embedment as outlined in (E) below.

3 - The section of marking where the thickness samples were obtained does not contain glass beads. When it has thoroughly dried cooled or cured, a new marking with glass beads should be applied over the test marking.

*Specified dimensions for length and width of sample plate are <u>minimums</u>. Larger sizes may be required for certain applications, ie. double yellow lines, or where operator skill dictates.

The specified thickness of the sample plate (40 to 60 mils) must be maintained: A thinner plate will deform while taking readings and produce false results. A plate thicker than that specified (ie. sign stock) will alter the distance between the gun and the pavement. This can also result in false readings.

<u>Method 2</u>

Under Development

D) **<u>Determination of application rate of glass beads applied by pressurized spray or drop-on methods</u>**

There are two methods for making this determination:

Method 1 may only be performed after verifying the speed at which the pavement marking equipment <u>actually travels</u> to achieve the proper wet film thickness of the applied marking.

Use of Method 2 is not limited.

Development of Table 1

Calibration of the pavement marking equipment involves determining the appropriate pressure and speed required to achieve the appropriate wet film thickness. Once this speed is established the pressure of the glass bead gun is adjusted to deliver the appropriate quantity of beads per gallon of material.

Table 1 is based on the following: A line that is 4 inch wide at 15 wet mils that is 320 feet long takes 1 gallon of material. Therefore, properly calibrated equipment will deliver the specified quantity of beads in the time it takes to travel 320 feet. Table 1 simply converts the speed in MPH to the time it takes to travel 320 feet. Since the specified quantity of beads (ie. 6 lb/gal for paint) should be delivered in the time it takes to travel 320 feet, the values in Table 1 apply to all bead guns set up to cover 4 inch lines for any specified application rate.

Method 1

a) Apparatus

Calibrated 1 gallon bucket. This bucket is graduated in 1 pound increments beginning at 4 pounds. (Graduations may be marks, indentions or drilled holes.)

Stopwatch

b) Procedure

Determine the time required to dispense the specified quantity of beads from Table 1.

Position the bucket under the bead gun such that all beads dispensed will be caught in the bucket.

Turn on the bead gun for the time increment from Table 1 (The pressure must be at the same setting that is used while applying markings.)

Compare the level of beads in the bucket with the appropriate graduation.

If there is a difference of 1/2 inch or greater between the level of the beads and the mark, adjustments must be made to the equipment to close this gap.

TABLE 1

Vehicle Speed mph	Time to Dispense Specified Quantity of Glass Beads (seconds)
4	54.5
5	43.6
6	36.4
7	31.2
8	27.3
9	24.2
10	21.8
11	19.8
12	18.2
13	16.8
14	15.6
15	14.5
16	13.6
17	12.8
18	12.1

Method 2

This method utilizes Table 2. This table converts the various specification quantities per gallon to units of pounds per linear foot for a 4 inch. line.

a) Apparatus

Canvas Sample Bag
String
Scales or balance accurate to ± 0.01 lb.
Stopwatch

b) Procedure

Mark a distance on the roadway between 50 and 350 feet.

Weigh the sample bag and record.

Tie the sample bag onto the bead gun. Operate the equipment in the same manner as if markings were being applied except that the paint gun should be turned off while collecting the bead sample.

Weigh the sample bag and beads.

Subtract the weight of the sample bag from the weight of the sample bag and beads.

Referring to Table 2, calculate the minimum weight of beads for the distance traveled. The actual weight collected must equal or exceed this value.

Table 2	
Glass Bead Application Rate per Linear Foot For a Four Inch Line	
Specified Application Rate (lb / gal)	**Glass Beads per Linear Ft. (lbs. / L.F.)**
6	0.0188
8	0.025
10	0.03125
25	0.0781
Spec. = 7 lbs./100 Sq.Ft. Equivalent = 7 lbs./300 L.F. (for Thermoplastic)	0.0233

Example

Given: Thermoplastic markings are being applied. A 4.12 lb. sample is collected over a distance of 175 feet.

Calculate the beads required:

Table 2 yields 0.0233 lb/lf for thermoplastic.

175 x 0.0233 = 4.08 lb (minimum)

Since the amount collected exceeds 4.08 lb, this is a passing test.

E) **Visual Inspection**

Knowing material quantities does not assure that everything was distributed correctly. This procedure provides guidelines for the visual inspection of pavement markings. Markings which do not meet the criteria stated below fail this procedure and should be rejected.

Visual inspections are made with regard to one of two (2) items: the marking itself or the glass beads.

1) The Marking

a) The location of markings should be compared with the plans and/or the Manual of Uniform Traffic Control Devices (MUTCD). Markings that do not conform to these requirements are unacceptable.

b) Markings must be of the specified width.

c) Markings must be checked for even thickness. This may be done by either inspecting the samples taken for thickness measurements or viewing the marking directly on the pavement. With either method, look for uneven thickness in the cross-section of the marking.

2) The Glass Beads

Glass beads applied to the pavement markings are to be evaluated for correct distribution and embedment

Distribution of Glass Beads

a) Beads should cover the entire marking.

b) Beads should be evenly distributed across the entire marking.

c) All beads should either be embedded into the marking with little or no loss onto the adjacent pavement.

Embedment of Glass Beads

a) Visual evaluation of bead embedment should be made on the marking to the road surface. The specifications for bead embedment are general. It is not feasible to obtain exact percentages of buried vs. non-buried beads.

   Generally, a marking that fails the visual inspection for bead embedment exhibits one of the following conditions:

   1) Most or all the beads are buried in the marking material.

   2) Beads are insufficiently buried (most or all beads are on the surface of the marking).

   3) "Pulsed" beads - This is caused by rapid fluctuations in the delivery of the beads to the gun.

   4) Most or all beads are on one side of the marking.