Recommend Approval: Assistant Division Chief 2-8-12 Date Division Chief 2/8/12 Date	Maryland Department of Transportation State Highway Administration Office of Materials Technology MARYLAND STANDARD METHOD OF TESTS	
Approved: Director 03/12/12 Date	TEST FOR THERMOPLASTIC MATERIALS	MSMT 614

SCOPE:

These procedures are used to evaluate white and yellow thermoplastic materials used for traffic markings, which include abrasion resistance, bond strength, cracking resistance and percent glass beads.

ABRASION RESISTANCE

MATERIALS AND EQUIPMENT:

1. Balance conforming to the requirements of M 231, Class B.
2. Taber Abraser equipped with H-22 calibrade wheels and 500 g weights.
3. Three 4 in. square Taber S-16 steel specimen plates.
4. Distilled water.
5. Primer for the thermoplastic material.

TEST PROCEDURE:

1. Thoroughly clean the steel specimen plates with solvent; then apply a thin coating of primer and allow it to dry.
2. Draw down a sample of the thermoplastic material on the steel specimen plates and cool to room temperature.
3. Weigh each prepared steel specimen plate to within 0.001 g.
4. Subject each prepared steel specimen plate to 200 cycles in the Taber Abraser while keeping the surface wet with drops of distilled water.
5. Remove the steel specimen plate from the Taber Abraser and allow to air dry; and then reweigh.

CALCULATIONS:

$L = W_1 - W_2$

where:

L = weight loss, g,

W_1= weight of specimen prior to abrasion, and

W_2= weight of specimen after abrasion.

REPORT:

Report the average weight loss to the nearest 0.001 g.

CRACKING RESISTANCE

MATERIALS AND EQUIPMENT:

1. Concrete panel 12 x 18 x 3 in.
2. Water bath maintained at room temperature.
3. Freezer maintained at 0 F.
4. Primer for the thermoplastic material.

TEST PROCEDURE:

1. Apply a thin coating of primer to the concrete panel and allow it to dry.
2. Apply the thermoplastic material 125 mils thick to the primer surface by draw down and cure for 24 hours at room temperature.
3. Place the specimen in the water bath for 18 hours.
4. Place the specimen immediately into the freezer for 3 hours.
5. Return the specimen to the water bath for 2 hours.
6. Observe the thermoplastic material for visual cracking or loss of adhesion.

REPORT:

Report the findings of the visual inspection.

PERCENT GLASS BEADS

MATERIALS AND EQUIPMENT:

1. Balance conforming to M 231, Class B.
2. Oven maintained at 110 ±2 C.
3. Muffle furnace maintained at 450 ±10 C.
4. Hot plate having a range up to 320 C with stirring capability.
5. A 3 in. diameter No. 325 sieve.
6. A 50 mL graduated cylinder.
7. A 50 mL porcelain evaporating dish.
8. A 250 mL and a 400 mL beaker.
9. Glass stirring rods.
10. Desiccator.
11. Dishwasher detergent.
12. Hydrochloric acid.
13. Distilled water.
14. Bromoform.
15. Acetone.
16. Denatured ethyl alcohol.
17. Magnetic stirrer with Teflon stirring bars.
18. Agate pestle.
19. Brush.
20. Standard grid top adjustable flame burner.

21. Wooden paint stirring sticks.

22. Mantle heater for 500 mL size friction top cans.

23. 500 mL friction top can.

24. Steel beaker tongs.

25. High capacity heat resistant gloves.

26. Metal cups 39 mm dia. x 9 mm deep for x-ray analysis specimens.

TEST PROCEDURE:

1. Fill a 500 mL friction top can with granular or chunks of block thermoplastic.

2. Melt in mantle heater until fluid making sure sample is well mixed using wooden stirring stick.

3. Pour one 1 1/2 x 2 3/8 in. block sample, one 1 1/2 in. round sample on paper clip and two samples in small metal x-ray analysis cups, 39 mm dia. x 7 mm depth.

4. Weigh approximately 20 g of the block sample to the nearest 0.001 g in the tared porcelain evaporating dish and heat it on a ring stand over a grid top adjustable flame burner until all flame and smoking ceases.

5. Ash in the muffle furnace till no further black carbon is visible.

6. Place the evaporating dish with remaining ash in the desiccator, cool to room temperature, and reweigh. The ash or residue consists of pigment, beads, and sand.

7. Carefully grind up the residue in the evaporating dish with the Agate pestle. Make sure the residue is loose and powdery.

8. Divide the sample into two approximately equal parts. Part A is used for glass bead determination. Part B is retained as a backup sample to Part A.

9. Weigh a 250 mL breaker.

10. Transfer Part A of the sample into the weighed 250 mL beaker and weigh.

11. Add 100 mL of distilled water and 1 g of detergent and magnetic stirring bar. After stirring on the magnetic stirrer for 15 minutes, allow the solids to settle.

12. Carefully decant and discard most of the detergent solution. Wash approximately 10 times with distilled water by stirring, decanting, and discarding most of the water each time without removing the solids until water is clear.

13. Add approximately 100 mL of hydrochloric acid. After reaction ceases, boil for 20 minutes with constant stirring using the stirring bar.

14. Cool and then repeat the washing as described in Step 12, making sure no residue is left with beads.

15. Dry the beaker and sample for 3 hours or until dry in the oven maintained at 110 C. Cool and reweigh. The remaining residue is beads and possibly some sand or cracked glass particles. Usually the sand, etc. is an insignificant amount. Calculate the percent beads.

NOTE: Steps 16 through 21, are only required as a once a year check per manufacturer on a random basis; unless suspect of having a significant amount of insoluble residue other than the beads which will be visible.

16. Pour 100 mL of bromoform into another beaker, add 20 mL of ethyl alcohol, and mix thoroughly.

17. Pour 50 mL of the bromoform/ethyl alcohol solution into the 50 mL graduated cylinder. Add the sand and bead residue into the graduated cylinder, stir, and let settle.

18. Weigh the No. 325 sieve and set it on the 400 mL beaker. Pour approximately 25 mL from the 50 mL graduated cylinder through the sieve.

19. Refill the remainder of the 50 mL graduated cylinder with more of the bromoform/ethyl alcohol solution. Stir, allow the solution to settle, and re-pour 25 mL through the sieve. The residue retained on the sieve is the glass beads.

20. Wash the beads on the sieve with ethyl alcohol and then with acetone.

21. Dry the sieve and beads for one-half hour in the oven maintained at 110 C located in a small explosion proof hood. Cool to room temperature in the desiccator and weigh. Calculate the weight of glass beads.

CALCULATIONS:

$$B = \frac{b}{S} \times \frac{A}{a} \times 100$$

where:

B = glass beads, percent,

b = weight of beads derived from Part A of sample ash,

S = original weight of thermoplastic sample,

A = ash weight of thermoplastic sample, and

a = ash weight used in Part A of sample.

NOTE: The weight of the glass beads (b) will usually come from Step 15 except when Bromoform separation is performed; then it will come from Step 21.

REPORT:

Report the amount of glass beads to the nearest whole percent.