

# **CHAPTER 5 PREFORMED THERMOPLASTIC**

## **OBJECTIVES**

- 1) Preformed Thermoplastic
- 2) Components
- 3) Material Characteristics
- 4) Application Methods
- 5) Application Considerations
- 6) Inspection And Quality Control

## **PREFORMED THERMOPLASTIC**

Preformed thermoplastic is a durable pavement marking system where thermoplastic symbols and legends are supplied in their final form and shape. Typically, the marking is supplied in large pieces, which are put together as a giant puzzle. Preformed thermoplastic pavement marking material combines the convenience of preformed markings with the performance qualities of hot applied thermoplastic. This heavy-duty intersection grade pavement marking material is ideal for high traffic areas where maximum wear and tear is present. Various brands are applied differently, so it is important to be familiar with the installation instructions for the type you are using. Always follow manufacturer instructions.

### **Type of Materials**

There are two basic types of preformed thermoplastic markings:

- 1) Don't require preheating the road surface to a given temperature
- 2) Require preheating the road surface to a certain temperature

## **COMPONENTS**

Preformed thermoplastic markings are composed of pigments, reflective glass beads, fillers, binders and additives.

### **Pigments**

Pigments are primarily used to impart color and to provide some chemical property, such as UV stability. Titanium dioxide is typically added to provide a white color. Lead chromate or organic pigment is typically added to provide a yellow color. Because of environmental and health concerns, the use of lead chromate compounds in pavement marking material is being eliminated.

### **Reflective Glass Beads**

Preformed thermoplastic is produced at the factory with a certain percentage of beads intermixed within the melted material. Additional beads are also added to the surface of the material when it is applied.

### **Fillers**

Fillers are typically a pigment and also provide bulk. Once the necessary color has been obtained, fillers such as a mixture of calcium carbonate, sand, and other inert materials are used to provide the volume of filler to give the necessary durability.

### **Binders (Resins)**

Binders are thermoplastic; they melt when heat is applied. The binder holds the pigments, reflective beads, and fillers together. Heat is used to form the initial shape. The material does not change chemically on heating and application.

### **Additives**

Additives such as plasticizers are added to control flow characteristics. Because the plasticizer can burn away, overheating and excessive reheating of preformed thermoplastic can affect the durability and overall quality of the marking.

### **Solvents**

Preformed thermoplastic pavement markings contain no solvents. It is the heating process that transforms the thermoplastic material from a solid into a liquid.

## **MATERIAL CHARACTERISTICS**

Other factors that should be considered when using preformed thermoplastics are packaging, shelf life and primers/sealers.

### **Packaging**

Linear preformed thermoplastic is packaged in 3 to 4 foot long strips in sturdy cardboard boxes. Symbols are manufactured in pieces so they may be packaged and shipped easily.

### **Shelf Life**

Preformed thermoplastic has a shelf life of one year when stored inside at a temperature between 35°F and 95°F. Due to the heavy weight of the thermoplastic, no more than 25 packs shall be stacked on top of one another.

### **Primers/Sealers**

Primers/Sealers are used as a “bridge” between preformed thermoplastic and the surface where preformed thermoplastic will not readily adhere such as worn old HMA. Essentially, the primer bonds to the surface, and the thermoplastic bonds to the primer. In order to prevent moisture from entering under the marking on PCC, it is important to seal the surface with a primer/sealer before the marking is installed. This will help prevent failures during freeze/thaw periods. Follow manufacturer recommended installation instructions to ensure that the correct type of primer/sealer is used.

### **Application Methods**

Preformed thermoplastic can be applied with a propane-fueled heat torch. When you arrive at the work location, review the temperature conditions, weather conditions, and pavement conditions to make sure that the preformed thermoplastic can be successfully applied based on manufacturer recommendations. If the situation does not comply with the manufacturer's recommendations, it is recommended that you wait until conditions improve before installing the preformed thermoplastic.

### **Heat Torch**

This method of application ensures that proper heat is applied to the preformed thermoplastic for a good bond to the road surface.

The flame of the propane fueled heat torch should be moved in a fan shaped pattern to ensure even heating of the material. To obtain the best results, the torch should be moved in a slow even motion approximately 4 to 12 inches over the material. It is helpful to keep the wind at your back so the heat will be carried across the marking.

### **Application on HMA**

- 1) Thoroughly clean the application area. All loose particles (sand, dust, and other debris) must be removed. Utilize a power blower or compressed air if possible. Otherwise, sweep the entire area completely.



**Figure 5.1**

Cleaning pavement prior to application

- 2) Ensure that no moisture is present prior to positioning the preformed thermoplastic material on the pavement surface. A heat torch may be used to remove moisture.
- 3) If required, preheat the surface to the temperature recommended by the manufacturer. Not all types of preformed thermoplastic require preheating.

- 4) Position the preformed thermoplastic on the pavement surface. Position all connecting parts of the marking on the road with the exposed beaded side up. Make sure the marking is properly placed and that there are no gaps between the segments of legends and symbols.



**Figure 5.2**  
Placement of material

- 5) Begin heating the material by moving the torch slowly and steadily over the material. Move the heat torch in a sweeping motion, approximately 2 feet wide over the marking, at a height of 4 to 12 inches so that heat is evenly distributed across the marking, slowly melting the material. The preformed thermoplastic material must be heated throughout the process to achieve a bond with the pavement.



**Figure 5.3**  
Arrow symbol being applied by heat torch.

- 6) As you heat the preformed thermoplastic, monitor the visual signs or temperature requirements. It is important not to “overheat” the material otherwise the top coating of beads will sink into the preformed thermoplastic and be less retroreflective initially.

- 7) Inspect the freshly applied preformed thermoplastic marking to ensure that complete bonding has occurred over the entire area. After the preformed thermoplastic has cooled to near ambient temperature, try to lift an edge or cut an area in the interior of the material with a chisel where it appears to have been heated the least. Try to lift a portion of the material; if the material can be lifted without evidence of asphalt on the underside, insufficient heat has been applied. Simply reapply heat until adequate bonding has occurred. This is called an “adhesion test.”



**Figure 5.4**  
Adhesion test being performed

- 8) When performing the adhesion test on material applied on PCC roads, you should see a thin layer of the material adhering to the road surface. After performing the adhesion test, remember to reheat the tested area.
- 9) Additional reflective beads should be hand cast on top of the marking as preformed thermoplastic will cool and set rapidly within a few minutes of application. If desired, setting time can be accelerated with a spray of cool water or hand casting of additional reflective glass beads on top of the marking.

#### **Application on PCC or Old HMA**

- 1) Follow steps 1, 2 and 3 as stated above for application on HMA. Worn, polished concrete should be ground or milled so the surface becomes rough.
- 2) Lay out the marking pattern using chalk or crayon as required for guidance.
- 3) Apply primer/sealer to areas outlined in chalk or crayon. Allow the primer/sealer to dry until it will not transfer to the finger when touched. The more porous the surface, the more sealer is required. **Caution: Do not accelerate the drying process by using an open flame. The sealer may be flammable at this stage.**
- 4) It is important to apply primer/sealer to the entire area where the preformed thermoplastic will be applied.
- 5) Continue with steps 4 through 9 as stated above for application on HMA.

## **APPLICATION CONSIDERATIONS**

The pavement surface must be dry before applying preformed thermoplastic or primer/sealer. The pavement surface must also be free of dirt, dust, chemicals, and oily substances. Do not apply on top of any existing marking materials other than thermoplastic. However, first remove any loose thermoplastic and ensure that no moisture is present. If the old thermoplastic is oxidized (powdery surface), grind or heat it and scrape the top surface so fresh material is exposed. A primer/sealer may be required on PCC or old HMA. Make sure to follow manufacturer instructions. When applying preformed thermoplastic caution should be taken if loop detectors or other utilities are in the location.

Most preformed thermoplastic materials may be applied at air temperatures down to 35°F. However, surface temperature is critical and must conform to manufacturer recommendations.

Protective clothing shall be worn during the installation of preformed thermoplastic pavement marking materials. The protective clothing shall consist of leather boots or work shoes, and long pants (note: synthetic fabrics should be avoided). General safety rules should be followed when using propane.

## **INSPECTION AND QUALITY CONTROL**

A vital component of quality assurance is inspection and quality control before, during, and after application. Regardless of the method of installation, there are some absolutes that must be followed.

The following factors must be addressed in order to achieve good application:

- Sufficient heating of the material during application
- Ambient and surface conditions
- Reflective bead embedment

Never leave the job site without performing the adhesion test (refer to Application on HMA Step 7, under Application Methods) to test the bond between the HMA and the material. Any deviation from manufacturer recommendations may result in application failures and shall be properly documented if unavoidable. Figure 5.5 is a troubleshooting guide for preformed thermoplastic application problems.

<b>Figure 5.5 - PREFORMED THERMOPLASTIC APPLICATION TROUBLESHOOTING</b>			
<b>PROBLEM</b>	<b>CAUSE</b>	<b>EFFECT</b>	<b>REMEDY</b>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Surface is not clean</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Clean with blower to remove surface debris</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Moisture in road surface</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Heat road to remove moisture</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Non-conforming existing marking. (i.e. tape, paint, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Remove or install before or behind old marking</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Deteriorating road surface</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Resurface</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Too little heating</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Visual signs/ temperature should be observed</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Deicing chemicals on road surface</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Power wash area or wait till after rain to install</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Dated Material</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Rotate stock / 1 year shelf life</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Curing agents on Portland Concrete Cement</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Blast or power wash</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Worn polished aggregates on road surface</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Grind and blow clean</li> </ul>
Bonding / Adhesion	<ul style="list-style-type: none"> <li>• Lack of sealer</li> </ul>	<ul style="list-style-type: none"> <li>• Poor surface bond - low durability</li> </ul>	<ul style="list-style-type: none"> <li>• Use sealer</li> </ul>
Low or No Retroreflectivity	<ul style="list-style-type: none"> <li>• Too little or too much heat</li> </ul>	<ul style="list-style-type: none"> <li>• Glass beads not embedded enough or sunken into material</li> </ul>	<ul style="list-style-type: none"> <li>• Look for visual signs when heating</li> </ul>
Low or No Retroreflectivity	<ul style="list-style-type: none"> <li>• No surface beads/ poor hand casting</li> </ul>	<ul style="list-style-type: none"> <li>• Glass beads too few and unevenly distributed</li> </ul>	<ul style="list-style-type: none"> <li>• Use shaker to apply beads evenly</li> </ul>
Low skid resistance	<ul style="list-style-type: none"> <li>• Too much heat</li> </ul>	<ul style="list-style-type: none"> <li>• Glass beads buried into material</li> </ul>	<ul style="list-style-type: none"> <li>• Look for visual signs</li> </ul>
Low skid resistance	<ul style="list-style-type: none"> <li>• No surface beads/ poor hand casting</li> </ul>	<ul style="list-style-type: none"> <li>• No beads to assist with skid resistance</li> </ul>	<ul style="list-style-type: none"> <li>• Use shaker to apply beads evenly</li> </ul>
Smearing and discoloration	<ul style="list-style-type: none"> <li>• Opened to traffic before marking has cooled down</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced visibility</li> </ul>	<ul style="list-style-type: none"> <li>• Use reflective glass beads or water to cool material down or wait until cool</li> </ul>

<b>PERFORMED THERMOPLASTIC APPLICATION TROUBLESHOOTING-continued</b>			
<b>PROBLEM</b>	<b>CAUSE</b>	<b>EFFECT</b>	<b>REMEDY</b>
Discoloration of newly installed marking	<ul style="list-style-type: none"> <li>• Tracking from new HMA</li> <li>• Oil dripping or other chemical spills</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced visibility</li> </ul>	<ul style="list-style-type: none"> <li>• Use additional reflective beads to protect the new marking</li> </ul>
Gaps between individual pieces not melted together	<ul style="list-style-type: none"> <li>• Too little heat</li> <li>• Shelf life exceeded</li> <li>• Individual pieces not touching before heating</li> </ul>	<ul style="list-style-type: none"> <li>• Poor adhesion</li> <li>• Poor appearance</li> </ul>	<ul style="list-style-type: none"> <li>• Heat more</li> <li>• Rotate stock</li> <li>• Make sure pieces are touching before heating</li> </ul>

**Figure 5.5**

## VIRGINIA DOT REFERENCES

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See Appendix A for the following:

### **VIRGINIA DOT ROAD & BRIDGE SPECIFICATION BOOK**

#### Section 246.01 thru 246.02 (a)

(a) Color Requirements

For all other information see the Manufacturers Material Safety Data Sheets (MSDS) and Application Instructions.

#### Section 512.03 (n)

(n) Construction Pavement Message Markings

#### Section 704.01 thru 704.03 (a)

704.01 thru 704.03 Description, Material Types, and Procedures

(a) Pavement Markings (First paragraph after Table VII-1) Message Markings

For all other information see the **Manufacturers Material Safety Data Sheets (MSDS) and Application Instructions.**

Preformed Thermoplastics are currently being qualified through NTPEP test procedures. No specifications have been established in the VDOT Road & Bridge Book at this time.

## Chapter 5 Preformed Thermoplastic Review Questions

1. There is no need to add glass beads to newly applied preformed thermoplastic since they are intermixed with the material at the factory.
  - a) True
  - b) False
  
2. When stored inside at a temperature between 35°F and 95°F, preformed thermoplastic has a shelf life of
  - a) 6 months
  - b) 3 months
  - c) 1 year
  - d) 18 months
  
3. Preformed thermoplastic is considered to be a:
  - a) durable pavement marking
  - b) non-durable pavement marking.
  
4. When preformed thermoplastic has been positioned on the pavement, it is necessary to heat only the edges of the material to achieve a good bond with the pavement.
  - a) True
  - b) False
  
5. When a small portion of freshly applied preformed thermoplastic has been chiseled up to inspect for bonding with the pavement, it should \_\_\_\_\_ on the underside.
  - a) be clean
  - b) have some asphalt stuck to it
  - c) look powdery