

Transportation Safety Division

# 3M™ All Weather Thermoplastic Pavement Markings Application Guidelines

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## 1 Description

3M All Weather Thermoplastic is a traffic marking system consisting of a high performance thermoplastic, 3M Connected Roads All Weather Elements (“Elements”), and a second drop of glass beads. 3M All Weather Thermoplastic has been designed for use as long line markings and delivers exceptional levels of all weather reflective performance in thermoplastic markings.

### 1.1 Elements

Elements are supplied as mixtures of dry and wet reflecting Elements. Elements are applied at the first drop of a double-drop process.

### 1.2 Thermoplastic

3M All Weather Thermoplastic has been specifically formulated to work with Elements as part of a matched component system. It is supplied in granular form.

## 2 Equipment Description

3M All Weather Thermoplastic is applied using specialized mobile trucks or application carts specifically designed to apply molten thermoplastic materials and double drop reflective media in continuous and skip-line patterns. 3M All Weather Thermoplastic may be applied using the three following methods:

### Screed Application

Material is delivered from a trough or shoe and applied at a minimum thickness of 90 mils (2.3 mm). Layers as thin as 90 mils (2.25 mm) may be used when the thermoplastic is being applied over existing pavement markings.

### Extrusion (or ribbon) Application

Material is applied with an auger or under pressure. Extrusion methods generally apply layers with thicknesses of 90 mils (2.25 mm) or more.

### Spray Application

Air assisted pressurized application.

3M All Weather Thermoplastic is best applied at thicknesses of at least 90 mils (2.25 mm). If thinner applications are being considered, contact 3M Technical Service at 800-553-1380 for further information, including application conditions and restrictions.

**Note:** Target thicknesses for all application methods depend on both agency requirements and the roughness of the pavement surface.

### Melt Vessel

The thermoplastic melt vessel must be capable of providing continuous uniform heating to the thermoplastic at a normal operating temperatures of 400-440 °F (204-215 °C) and it must be equipped with a thermostatic temperature control to maintain the operating temperature. The melt vessel must also sufficiently agitate the molten thermoplastic material to maintain a homogeneous mixture without stratification.

## 3 Surface Preparation

Successful completion of a 3M All Weather Thermoplastic pavement marking project requires proper conditions and that proper application techniques be used. Following the application procedure described below will contribute significantly to the success of your 3M All Weather Thermoplastic pavement marking project.

**Note:** Contact 3M Technical Service at 800-553-1380 for questions regarding surface preparation methods.

### 3.1 Temperature

3M All Weather Thermoplastic systems should be applied only under the following temperature conditions:

#### Screed or Extrusion applications

Air and pavement temperatures of at least 50 °F (10 °C) and rising.

#### Spray applications

Air and pavement temperatures of at least 55 °F (13 °C) and rising.

**Note:** Wind (wind chill) can accelerate cooling. Do not apply 3M All Weather Thermoplastic when wind chill temperatures are 45 °F (7 °C) or lower, regardless of the atmospheric temperature. Also note that shaded pavement can be cooler than the ambient temperature.

## 3.2 Moisture

Road surfaces must be clean and dry prior to the application of 3M All Weather Thermoplastic. After periods of prolonged rainfall, use extra caution to verify that the pavement is completely dry prior to application. Avoid applying thermoplastic where dew is present.

## 3.3 Quick Moisture Test

Tape a 12"x12" square of clear plastic wrap on an area exposed to sunlight. (Shaded areas can produce unreliable results.) Examine the underside of the plastic wrap after 15-30 minutes. If moisture is present, delay application until no moisture is noted for the test.

## 3.4 Oil, Debris and Dust

The pavement surface must be free of oil, dirt, dust, grease, and all other similar foreign materials at the time of application.

To ensure a clean surface, it should be blown with a high-velocity high-pressure air source (185 cfm, 90 psi) to remove any loose material prior to application of 3M All Weather Thermoplastic. Use a grinder or shot blaster to remove any automotive fluid surface contamination, such as oil or grease.

**Note:** Refer to the [3M Road Surface Guide](#) for surface preparation guidelines for questionable road surfaces.

## 3.5 New Asphalt Cement Concrete (ACC)

3M All Weather Thermoplastic may be applied directly to new ACC surfaces. Thermoplastic can be applied as soon as the asphalt material has cooled and can support the weight and movement of the application equipment. New asphalt surfaces must be free of excess oils and asphalt emulsions for thermoplastic pavement markings to adhere properly.

In general, new asphalt should be open to traffic for 3-7 days before laying thermoplastic markings. This helps prevent tracking of asphalt onto the surfaces of markings.

## 3.6 Chip Seal or Slurry Seal

3M All Weather Thermoplastic can be applied to chip seal or slurry seal surfaces. Allow slurry seal surfaces to completely cure per manufacturer's instructions prior to thermoplastic application. New chip seal surfaces must be swept clean of all loose aggregate prior to thermoplastic application. Incorporating a waiting period between the application of the chip seal and the application of the thermoplastic is beneficial, as it allows vehicles to wear off loose aggregate and improves thermoplastic adhesion to the road surface.

## 3.7 Application Over Existing Pavement Marking Tape

For best results, remove any existing pavement marking tape to expose at least 80% of the pavement surface before applying 3M All Weather Thermoplastic. Existing pavement markings should be removed using methods such as grinding, shot blasting, or sand blasting.

## 3.8 Application Over Existing Liquid-Applied Markings

3M All Weather Thermoplastic may be applied over most existing liquid pavement markings provided existing lines are well worn, have few intact beads, and are well anchored to the pavement surface. Existing liquid pavement marking lines with substantial bead coverage should be lightly ground to roughen their surfaces.

## 3.9 Application Over Temporary Paint

3M All Weather Thermoplastic can be applied over existing latex or water based temporary pavement marking paint provided the temporary paint is adequately adhered to the road surface. Existing temporary paint should have been applied at a dry mil thickness of 7-8 mils or less, be well worn, and have minimal glass bead presence. If existing temporary markings are epoxy or oil-based paint, they should be removed prior to application of 3M All Weather Thermoplastic.

### 3.10 New Portland Cement Concrete (PCC)

Contact 3M Technical Service at 800-553-1380 for guidance on any PCC application.

### 3.11 Thermoplastic Application into Grooved Pavement

3M All Weather Thermoplastic can be applied into properly prepared grooves cut into pavement surfaces. Applying pavement marking products into grooves provides several benefits, including enhanced protection of the pavement marking and retroreflective media from snowplow damage.

For more information regarding applying 3M All Weather Thermoplastic into grooves, see [3M Information Folder 5.18](#), “Guidelines for Pavement Marking Applications in Grooved Pavement Surfaces.”

### 3.12 Primer Application

Primer may be required when applying 3M All Weather Thermoplastic over existing pavement marking materials or old pavement surfaces. Contact 3M Technical Service at 800-553-1380 for further information regarding the use of primer when applying 3M All Weather Thermoplastic to worn surfaces or over existing markings.

## 4 Application Rates

3M All Weather Thermoplastic must be applied at the proper thickness and all reflective media must be applied properly, and at correct rates, to achieve markings with optimal performance characteristics.

**Note:** Thermoplastic application requirements vary depending on pavement roughness. Pavement mixes with large aggregates, such as those used for open-grade friction courses and stone matrix asphalt mixes, require higher thermoplastic application rates than smoother pavement surfaces to achieve the same thickness above the pavement surface and prevent voids.

### 4.1 Thermoplastic Application Thickness

The 3M All Weather Thermoplastic pavement marking system requires a minimum binder thickness of 90 mils (2.25 mm). This minimum thickness is typically used when refurbishing existing pavement markings. However, the target binder thickness for a particular project will depend on agency requirements and the roughness of the pavement surface to which the markings are being applied.

**Note:** Contact 3M Technical Service at 800-553-1380 for any applications requiring thicknesses of less than 90 mils (2.25 mm).

Prior to starting a project, apply a line of thermoplastic at a test location and verify that the required binder thickness is being applied.

To check the thickness of the thermoplastic being applied, lay a test line on a flat metal sheet and allow the thermoplastic to cool. After cooling, check the thickness of the material using a micrometer or metal plates of known thickness.

### 4.2 Reflective Media Application Rates

Glass bead and Elements application rates are shown in Tables 1 and 2, respectively. General Equipment

**Table 1.** Glass bead application rates.

Units	Utah Blend	Type 3
Pounds per 4-inch lineal foot	0.048	0.026
Grams per 4-inch lineal foot	22	12
Pounds per 100 square foot	14.4	7.8
Grams per square meter	710	388

**Table 2.** 3M Connected Roads All Weather Elements application rates for smooth surfaces.

Element Application Rates	
Units	Minimum for Smooth Surface
Pounds per 4-inch lineal foot	0.018
Pounds per mile, 4-inch width	93
Grams per 4-inch lineal foot	8
Grams per square foot	24
Grams per square meter	260

### Operating Procedures

Consult your application equipment operator's manual and the appropriate bead/Elements gun operator's manual (available from the thermoplastic application equipment manufacturer and bead/Elements gun manufacturer, respectively) for specific limits regarding vehicle speeds and thermoplastic thicknesses. Application settings vary with equipment make and model; only employ those settings that have been specified by your equipment manufacturer for your specific application equipment.

Maintaining application equipment in good working order before and during applications helps avoid application issues.

When operating trucks, material temperatures and pressures must be maintained within acceptable ranges to effectively and consistently apply the thermoplastic.

**Note:** Inconsistent thermoplastic temperature and application speed controls can lead to markings with inconsistent appearances and properties.

Below are some general operating procedures that should be followed when applying 3M All Weather Thermoplastic.

## 4.3 3M All Weather Thermoplastic Application Temperature (on the Road)

### Ideal Application Temperature Range:

400 °F (204 °C) to 420 °F (215 °C)

### Maximum Temperature:

440 °F (227 °C)

**Note:** For further information regarding application temperatures above 420 °F (215 °C) contact 3M Technical Service at 800-553-1380.

**Note:** Use a non-contact thermometer for temperature monitoring.

## 4.4 Number of Reheats Allowed:

Granular Thermoplastic: **3 to 4**

Block Thermoplastic: **2**

**Note:** 3M All Weather Thermoplastic is supplied in a granular form only.

### Application Speed:

8 mph (13 km/h) maximum. Limit speed to prevent beads and Elements from rolling.

**Bead and Element Calibration for Trucks:**

Prior to starting a project, check bead and Elements calibrations using a pan to catch reflective media delivered from guns for a set period of time, usually 15-30 seconds. After collecting for a set period of time, pour the reflective media into a large graduated cylinder to determine the volume. Compare collected volumes to calibration rate tables, available from the truck or bead gun manufacturer, to verify that the reflective media application rates are correct (see Figure 1). For skip dash applications, verify that the bead and Elements delivery guns have been set so that they start and stop at the correct times relative to the liquid applicator. Adjust timings using the bead advance/retard controls as necessary. After all of the required adjustments have been made, apply another test line to verify that all application parameters have been adjusted correctly.

**For Carts:**

Run a short line at a fixed speed over a catch pan while delivering beads only, then do the same for Elements only. Weigh the recovered materials in the pan or measure their volumes using a graduated container.



Figure 1. Calibration tools.

## 5 Test Line Application

Before starting application operations, lay a test line in a location where it can be safely checked for adherence to product specifications. Apply the test line to the road or place a long, narrow sheet of heavy duty tar paper on the road and apply a test line to the tar paper (Figure 5).



Figure 2. Tar paper layout for test line application.

After applying the test line, verify that it conforms to the thickness requirements outlined in the Sections 4.1 and 4.2 of this document. Inspect the test line for width consistency, as well as uniformity of bead and Element coverages across its entire width. Adjust the thermoplastic applicator head and/or bead/Elements guns as necessary.

**Note:** Re-calibrate whenever application speed is changed.

## 5.1 Inspection

Inspect the final applied line to ensure that it is of high and consistent quality. Final line inspection should examine:

1 Width

Correct and consistent – line must conform to agency requirements.

2 Thickness

Measure using milled bars, plates of a known thickness, or by another approved method.

3 Color

Line must look consistent and lack any evidence of scorching.

4 Glass bead and Element embedment

Must be 50-60%. Inspect using a 7-10x magnifying glass.

5 Glass bead and Elements distribution

Must be even across the width of the marking

**Note:** 1/4" (6.4 mm) margins may be used for Elements distribution.

6 Skip lengths and distance between skip lines

Both must meet agency requirements and be consistent.

7 Adhesion

ACC – While line is still pliable, pry at its edge with a screw driver or knife. Properly adhered thermoplastic will remove with asphalt attached.

PCC – Using a hammer, strike the line with a glancing blow. The line will shatter if not adequately adhered.

**Note:** If hammer method is used to test markings on asphalt surfaces, inspect chips for attached asphalt. The presence of asphalt on chips indicates good adhesion to an ACC surface.

8 Reflectivity

Use an approved retroreflectometer capable of measuring retroreflectivity using a 30 meter geometry. If wet reflectivity measurements are required, they should be taken using an external beam type unit.

## 5.2 Application Record

Application records should be kept for each project. Each application records should include, lot identification codes for all materials used, the date of application, location of application, calibration results, weather conditions, etc. Application records can be helpful if questions ever arise about a marking or application.

## 6 Storage and Handling

Store all thermoplastic, Elements, and beads in a clean, dry area. Wet materials must be allowed to dry before use.

Before use, inspect for and remove any box residue, debris, or wrapping material present unless it is to be part of the final mix.

Use materials within 12 months of date of receipt.

## 7 Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Safety Data Sheets (SDS) and Article Information Sheets for important health, safety, and environmental information. To obtain SDSs and Article Information Sheets for 3M products, go to [3M.com/SDS](http://3M.com/SDS), contact 3M by mail, or for urgent requests call 1-800-364-3577.

## 8 Disposal

Dispose all materials in accordance with local, state or province, and federal or country requirements.

## 9 Other Product Information

Always confirm that you have the most current version of the applicable product bulletin, information folder, or other product information from 3M's Website at <http://www.3M.com/roadsafety>.

For situations not specifically covered in this folder, or questions regarding application of 3M All Weather Paint, it is the responsibility of the installer to contact the appropriate 3M sales representative or 3M Application Engineer at 1-800-533-1380 for guidance.

## 10 Literature References

<a href="#">3M IF 5.18</a>	3M™ Stamark™ Pavement Marking Tape and Liquid Pavement Markings Application Guidelines for Pavement Markings in Grooved Pavement Surfaces
<a href="#">3M IF 5.23</a>	3M™ Connected Roads All Weather Elements Application Guidelines
<a href="#">3M PB AWP</a>	3M™ All Weather Paint
<a href="#">3M PB AWT</a>	3M™ All Weather Thermoplastic
<a href="#">3M PB CR AWE</a>	3M™ Connected Roads All Weather Elements
<a href="#">3M Road Surface Guide</a>	

ASTM Test Methods are available from ASTM International, West Conshohocken, PA.



# Appendix A

## 3M All Weather Thermoplastic Troubleshooting Guide

Issue	Possible Causes	Solutions
Smooth or lightly dimpled surface appearance	Bead and/or Elements sink too deep	Adjust thermoplastic temperature. Move Elements and bead guns back from the thermoplastic discharge.
Glassy or smooth surface appearance	No beads or Elements; or malfunctioning applicator gun	Repair bead or Elements gun, increase bead rate, move bead gun, check bead coating.
Cratered surface	Beads or Elements popped out	Increase thermoplastic temperature and re-check bead/Elements coating, move bead/ Elements gun closer to the thermoplastic gun.
Rough edges	Thermoplastic temperature too low, resulting in poor adhesion, mechanical problem, moisture in pavement	Check thermoplastic temperature, check application equipment, reduce application speed on rough surfaces, check for presence of moisture and stop application if present.
Uneven edges	Thermoplastic temperature too high, resulting in flowing material on uneven road surface	Reduce thermoplastic temperature if flowing observed.
Off-color appearance	Scorching/burning of material, caused by overheating, too many reheats or contamination with yellow-colored thermoplastic	Discard material, check temperatures, thoroughly clean applicator.
Stretched or pulled appearance	Thermoplastic applied too cold or too fast	Check temperature and application speed.
Bubbly/severely dimpled/ pitted/ pinhole appearance	Moisture present in pavement or presence of undried primer, resulting in poor bond, air trapped in pavement surface	Stop operation, check for moisture or allow primer to dry and cure. Check for proper temperature and reduce application speed to avoid trapped air.
Cracks in finished line	Reflection cracking from road surface, misaligned applicator trough/shoe, thickness too low, overheating	Check trough and shoe for proper alignment, check thermoplastic thickness and adjust as necessary, check temperature.
Grooved or scarred appearance	Plugged thermoplastic discharge nozzle	Check for foreign material or hardened thermoplastic and remove.
Thermoplastic appears too thick and does not flow properly	Too many reheats, temperature too low, contamination by material previously stored in the pot	Check temperature and agitation, clean out unit; especially if different thermoplastic type has previously been used.
Reflectivity is uneven or inconsistent	Variable bead/Elements application, poor or excessive embedment	Check thermoplastic temperature. Check calibration for bead/Elements application. Inspect bead/ Elements applicator discharge for plugging and consistent application across width of line.
Grinding noise from thermoplastic, screen clogged with beads and/or Elements	Thermoplastic tank has insufficient agitation to keep beads and Elements suspended (thermoplastic is too hot for agitation)	Maintain higher agitation at all times. Keep temperature in range of 385-420 °F (196-215 °C).
Adhesion failure at pavement	Contaminants or moisture at pavement surface, application temperature too low, application speed too high, pavement temperature too low	Check for contaminants and moisture. Check application temperature and agitation rate. Reduce application speed. Check if primer should be used for application surface. Check pavement temperature.
Glazed surface appearance	Beads/Elements not sufficiently embedded - thermoplastic temperature too low or too thin, bead or Elements gun too far from thermoplastic discharge point, pavement temperature too low	Check temperature and bead/Elements gun position, check thickness, check pavement temperature.

## For Information or Assistance

Call: 1-800-553-1380

In Canada Call:

1-800-3M HELPS (1-800-364-3577)

## Internet:

<http://www.3M.com/roadsafety>

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**Transportation Safety Division**  
3M Center, Building 0225-04-N-14  
St. Paul, MN 55144-1000 USA

Phone 1-800-553-1380  
Web [3M.com/roadsafety](http://3M.com/roadsafety)

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