1 Description

3M Liquid Pavement Marking Series 5000 (“Series 5000”) is a pavement marking binder that has been designed for use in durable roadway and highway pavement markings. Series 5000 is a 2:1 ratio, two-component, 100 percent solid polyurea coating material that rapidly cures to full hardness after application. Series 5000 can be used with a variety of optics packages to meet a range of retroreflective performance needs.
For long-line applications, Series 5000 is applied using a mobile, truck-mounted, self-contained pavement marking machine (Figure 1). This pavement marking machine is specifically designed for application of two-component liquid materials and reflective media in continuous or skip patterns.

![Figure 1. LPM application truck.](image)

Intersection and transverse markings may be applied using any 2:1 ratio application equipment. However, due to the fast track-free time of Series 5000, any optics application must be done using equipment that is capable of applying optics immediately following binder application. Contact 3M Technical Service (800-553-1380) for guidance on transverse applications.

## 2 Surface Preparation

Proper application of Series 5000 is essential for the successful completion of a pavement marking project. Following the application procedures described below will contribute significantly to the success of your 3M All Weather Paint pavement marking project.

### 2.1 Temperature

Only apply Series 5000 when air and road temperatures are 30 °F (-1 °C) or higher.

**Target Start-up Component Temperatures:**

- Part A (LPM 5000/5001/5005): 130-140 °F (54-60 °C)
- Part B (LPM 5050): 120 °F (49 °C)

### 2.2 Moisture

Road surfaces must be clean and dry prior to application of Series 5000. Road surfaces must be free of dew, frost, and any other visible moisture. After periods of prolonged rainfall, use extra caution to verify that pavement is completely dry prior to application.

### 2.3 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. The pavement surface must be blown with high-pressure, high-velocity, 120 psi, 185 cfm air to remove any loose material prior to application of Series 5000. Use a grinder or shotblaster to remove any automotive fluids, such as oil or grease, contaminating the application surface.
2.4 Portland Cement Concrete (“PCC”)

Any curing compound present on new Portland Cement Concrete must be completely removed prior to application of Series 5000. Sandblasting, shotblasting, and grinding are acceptable methods for removing curing compounds.

New concrete typically has a weak surface layer of a powder-rich Portland cement material, known as laitance, on its top surface. Even if a new concrete surface has not been treated with a curing compound, the new surface still must be prepared using a grinder, sandblaster, or shotblaster to remove the layer of laitance and expose a solid concrete surface with better surface integrity.

Temporary paint is occasionally applied over concrete prior to removal of curing compound. In such instances, both temporary paint and curing compound must be removed prior to application of Series 5000.

2.5 Asphalt Cement Concrete (“ACC”) Surfaces

Series 5000 can be applied directly to existing ACC surfaces.

2.6 Chip Seal or Slurry Seal

Series 5000 can be applied to chip seal or slurry seal surfaces that have set per manufacturer’s instructions.

2.7 Existing Pavement Markings

Series 5000 can be applied over any type of well-adhered existing pavement marking. Poorly adhered existing pavement markings must be removed to expose a minimum of 80 percent of the pavement surface prior to application of Series 5000. Existing pavement markings should be removed using an abrasive removal method such as grinding, shotblasting, or sandblasting.

![Figure 2. Poor removal - Reduce speed of equipment to remove more of the existing marking.](image)

![Figure 3. Good removal - Existing markings completely removed.](image)

3 Material Thickness and Elements/Bead Application Rates, Storage, and Handling

Applying Series 5000 to the proper thickness and using correct reflective media application rates are essential to the achievement of optimally performing finished markings.
3.1 Material Thickness and Application Requirements

The required application thickness for Series 5000 varies with the roughness of the pavement surface to which it is being applied.

The pavement marking installer is responsible for meeting the thickness requirements presented in Table 1.

Table 1. Series 5000 application thicknesses for different pavement surface types.

<table>
<thead>
<tr>
<th>Surface Description or Use</th>
<th>Series 5000 Liquid Binder Thickness (1 inch = 1000 mils) &amp; Usage Ratesa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth (variation ≤ 0.125&quot;) pavement (asphalt, concrete, grooved or surface treatment)</td>
<td>20 to 25 mils (240-220 lineal feet per gallon of 4-inch line width)</td>
</tr>
<tr>
<td>Textured or variation ≥ 0.125” pavement (open graded, large stone mixes, tined or sawn concrete, chip seal)</td>
<td>25 to 30 mils (190-160 lineal feet per gallon of 4-inch line width)</td>
</tr>
<tr>
<td>Well worn existing markings</td>
<td>20 to 25 mils (240-220 lineal feet per gallon of 4-inch line width)</td>
</tr>
<tr>
<td>For use as temporary markings (prior to application of durable pavement marking)</td>
<td>10 to 15 mils (480-320 lineal feet per gallon of 4-inch line width)</td>
</tr>
</tbody>
</table>

a. Application rates calculated using a conversion of 231 cubic inches per US liquid gallon.

Prior to starting a project, apply a line of Series 5000, without optics, to a smooth, flat surface and check the thickness of the material laid using a wet mil thickness gauge. Adjust application speed as necessary to achieve the proper material thickness.

An alternative method for checking thickness is to apply a test line of Series 5000, without optics, to a piece of 3M Duct Tape or other release liner material, and allow it to cure. After curing, peel the Series 5000 test line off the tape or liner and check its thickness using a caliper gauge or micrometer.

3.2 Reflective Media Application Rates

3M Connected Roads All Weather Elements (“Elements”) and glass bead application rates are shown in Table 2 and Table 3, respectively.

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

<table>
<thead>
<tr>
<th>Units</th>
<th>Minimum for Smooth Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds per 4-inch lineal foot</td>
<td>0.018</td>
</tr>
<tr>
<td>Pounds per mile, 4-inch width</td>
<td>93</td>
</tr>
<tr>
<td>Grams per 4-inch lineal foot</td>
<td>8</td>
</tr>
<tr>
<td>Grams per square foot</td>
<td>24</td>
</tr>
<tr>
<td>Grams per square meter</td>
<td>260</td>
</tr>
<tr>
<td>Pounds per gallon - 20 mils ~ 240 ft/gal</td>
<td>4.2</td>
</tr>
<tr>
<td>Pounds per gallon - 25 mils ~ 190 ft/gal</td>
<td>3.4</td>
</tr>
<tr>
<td>Pounds/100 Sq ft</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Table 3. Second drop glass bead or Black Beauty® application rates.

<table>
<thead>
<tr>
<th>Units</th>
<th>Glass Beads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds per 4-inch linear foot</td>
<td>0.033-0.053 lbs/4-inch lf</td>
</tr>
<tr>
<td>Grams per 4-inch linear foot</td>
<td>15-24 grams/4-inch lf</td>
</tr>
<tr>
<td>Pounds per gallon 20 mils ~ 240 ft/gal</td>
<td>8.0-12.8 lbs/gal</td>
</tr>
<tr>
<td>Pounds per gallon 25 mils ~ 190 ft/gal</td>
<td>6.4-10.0 lbs/gal</td>
</tr>
<tr>
<td>Pounds /100 sq ft</td>
<td>9.9-15.9 lbs/100 sq ft</td>
</tr>
<tr>
<td>Temporary applicationa</td>
<td>10.6-17.0 lbs/gal</td>
</tr>
<tr>
<td>Pounds per gallon 15 mils, 320 lineal 4-inch feet per gallon</td>
<td>15.8-25.4 lbs/gal</td>
</tr>
</tbody>
</table>

a. Note: For temporary markings, use treated AASHTO M247 Type 1 glass beads
The minimum Elements application rates presented in Table 2 are for smooth or dense pavement surfaces. The values presented in Table 2 have been chosen because they provide good initial wet and/or dry reflectivity and match the longevity, or restripe frequency, of the pavement marking binder system to which Elements are installed. To accommodate their greater longevities, durable marking binder systems require greater quantities of Elements to maintain longer-term wet/dry performance.

Note: The surface areas of rough pavement surfaces (open-graded mixes, large stone aggregate mixes, etc.) can be up to 50 percent greater than that of a flat surface. As a result, rough surfaces require the use of greater quantities of materials (binder, Elements, and beads) to achieve comparable coverages.

3.3 Reflective Media Delivery Rate Calibration

If the line width and track speed required for proper liquid binder application are known, the required catch weight for a defined time period can be calculated.

Prior to starting a Series 5000 pavement marking project, check the bead and Elements calibrations by catching the reflective media delivered by the guns over a specific period of time, usually 15-30 seconds, and measuring the volumes of the reflective media caught. Compare the measured values to the appropriate calibration rate tables, available from the truck or bead gun manufacturer, to verify that the reflective media application volumes are correct (Figure 4).

Figure 4. Equipment for calibrating reflective media application rates.

Note: Call 3M Technical Service with other questions about 3M optics calibrations 1-800-553-1380.

Consult your truck’s and spray/bead gun’s operators manuals, available from the truck and bead/spray gun manufacturers, respectively, for more specific information regarding spray tip selection, desired spray width, vehicle speed, and application thickness. Application guidelines vary between manufacturers and models.

4 Groove Applications of Series 5000

Series 5000 can be applied to a properly prepared groove cut into the pavement surface. 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 groove applications of Series 5000, see 3M Information Folder 5.18, Application Guidelines for Pavement Markings in Grooved Pavement Surfaces.
5 General Equipment Operating Procedures

Maintain spray guns, bead and Elements guns, trucks, and other equipment in good working order both before and during application to avoid application problems.

Proper application of Series 5000 with a liquid pavement marking truck requires that the temperatures and pressures of the component materials be monitored and maintained to ensure they are consistently delivered at a volumetric ratio of 2:1 throughout the application. Temperature monitoring is also important because overheating the component materials can be dangerous and result in inferior applications.

For information regarding converting liquid pavement marking trucks to Series 5000 from other two-part, 2:1 liquid pavement marking systems, please refer to Appendix A.

General operating procedures to be followed when applying Series 5000 markings are described below.

5.1 Test Spray

Before starting application operations, lay down a test line in a location where the line 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 5. Tar paper layout for test line application.](image)

Prepare for application operations by performing all start-up procedures, as described by the truck manufacturer. Once start-up procedures are complete, heat Series 5000 component materials to their proper application temperatures. When proper temperatures have been achieved and application is ready to begin, trigger the spray gun while collecting the spray in a bucket and check the spray fan.
When checking the spray fan, look for a uniform, symmetrical, steady, pulse-free spray pattern (Figure 6). The spray fan must not have “fingers” or “bands”. If the spray fan appears to be uniform, proceed with application of test line on tar paper or road surface.

Figure 6. Check spray fan.

Following the application of the test line, verify that the line conforms to the thickness requirements described in Section 3 “Material Thickness and Elements/Bead Application Rates.” Check the cure speed according to the procedure outlined in the Section 5.3 “Check Cure Time,” below. Also check the bead and Elements coverages for uniformity across the entire width of the line. Adjust the bead and Elements guns as necessary.

Check the timings of the bead and Elements guns to ensure they start and stop applying material only when positioned to deliver beads and elements to the freshly applied binder. Adjust timings using the bead advance/retard control as necessary. After all required adjustments have been made, apply another test line to verify that all adjustments have been made correctly.

5.2 Spray Tip Cleaning

After Series 5000 delivery has been verified to be within the required specifications, application can begin.

During application, each time the truck and mix chamber are stopped for 30 seconds or longer, the spray tip must be cleaned to prevent hardening of the binder and clogging of the spray gun.

After longer shut-down periods, use carburetor cleaner and a brass wire brush to clean the spray tip. Always lock the spray gun before cleaning the tip. Spray carburetor cleaner directly onto, and up into the spray tip (Figure 7), then use the brass wire brush to remove any build-up and clean out the tip (Figure 8).

Figure 7. Clean the spray tip with carburetor cleaner.  
Figure 8. Clean the spray tip with a brass wire brush.
Spray into a bucket again before proceeding with application to expel any residual carburetor cleaner from the tip. When spraying into the bucket, always check the spray fan. If the spray is not uniform, the tip may be dirty. Replace or clean the tip and repeat the procedure described above until a uniform spray pattern is achieved before resuming application.

It is always a good practice to regularly and periodically clean the applicator spray tip during application to keep it clean and free of material build-up. A clean tip will help ensure a consistent and high quality application.

5.3 Check Cure Time

Checking newly applied Series 5000 binder for proper cure time on the road can be very helpful in quickly identifying application problems.

Begin checking the cure of the marking three to ten minutes after it has been applied to the road. To check the cure, drag a sharp steel object, such as a screwdriver, across the new material in an elongated “X” pattern (Figure 9), that covers two to three feet of the line. Verify that the marking is curing uniformly across the entire width of the line.

![Figure 9. Check for proper cure.](image)

Move down the line and check the cure using this method every two to three feet to completely check a 30-40 foot segment of the new line for proper cure.

When properly cured, the sharp object should result in no scratching after 10 minutes. If after 20 minutes the newly laid line continues to show signs of an incomplete cure, stop the application and determine the cause of the cure problem.

Applying Series 5000 in dry climates, those with very low relative humidity levels, may require longer cure times to achieve complete cures. However, the time required to achieve a track-free condition in such environments will remain unchanged.

With adequate training and experience, a proper cure can be recognized within two to three minutes of application. Check cure time throughout the day, especially after tank refills and truck maintenance activities.

5.4 Material Handling and Storage

Store Series 5000 components in a cool, dry, well ventilated, indoor area, at a temperature of 40–100 °F (4–38 °C). Use within one (1) year of date of receipt. Temperatures of more than 100 °F (38 °C) can cause containers containing Part B to pressurize and possibly rupture.
Pick-up and disposal of empty drums are the responsibility of the user. For more information, see Appendix B, “Series 5000 Safe Handling Procedures.”

Avoid loading pavement marking materials from barrels into the Series 5000 truck tanks if precipitation is an imminent possibility. Water must not be allowed to contaminate either of the Series 5000 liquid components or either of the reflective media. When loading materials, use a dedicated/clean dip tube when loading Series 5050, Part B of the Series 5000 system, through the opening in the top of the barrel. **Note: Load Part B by entire drum increments whenever possible (loading of partial drums should be avoided)**. The truck tank containing Series 5050 must be pressurized with dry nitrogen or dry air immediately after loading. After loading into the truck tank, loosely screw the bung on the empty Series 5050 drum. Tightly closing the bung will cause pressure to build-up in the drum. Keep the hoses used to transfer Series 5000 components to truck tanks clean and free of any build-up. If material hardens in the transfer hoses it can be transferred to the truck tanks and clog the system.

Do not run tanks dry. Running tanks dry allows air to enter the system and causes application problems.

Review the safety and handling procedures outlined in Appendix B, “Series 5000 Safe Handling Procedures.”

All vehicles with Series 5000 components on board must also have the relevant Safety Data Sheets (SDSs) on board and accessible while transporting Series 5000. Use materials within one year of date of receipt.

### 6 Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the SDSs and Article Information Sheets for important health, safety, and environmental information. Follow all precautions on the SDS, including the use of personal protective equipment during the filling, use, and cleaning of application equipment. This product is intended for outdoor use. Application in tunnels or enclosed areas may necessitate the use of additional precautions. To obtain SDSs and Article Information Sheets for 3M products, go to 3M.com/SDS, contact 3M by mail, or for urgent requests call 1-800-364-3577.

### 7 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](http://www.3M.com/roadsafety).

For situations not specifically covered in this folder, or questions regarding application of 3M Liquid Pavement Marking Series 5000, 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.

### 8 Literature References

- **3M IF 5.23** 3M™ Connected Roads All Weather Elements Application Guidelines for 3M Connected Roads All Weather Elements
- **3M PB AWP** 3M™ All Weather Paint
- **3M PB AWT** 3M™ All Weather Thermoplastic
- **3M PB CR AWE** 3M™ Connected Roads All Weather Elements

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

For more specific information regarding how to convert trucks to Series 5000 from other two-part, 2:1 liquid pavement marking systems, please contact 3M Technical Service at 1-800-533-1380 prior to conversion. Tanks, heaters, and hoses must be inspected before any Series 5000 material is added to the application system to ensure the absence of any solids that could lead to blockages after the change-over.

1 Polyurea System Change Over

Drain the liquid components (Part A and Part B) separately into their original containers, or into clean new containers. Drain as thoroughly as possible. Immediately add Series 5000 Part A to the 2 part tank and Part B to the 1 part tank. The Part B tank (the 1 part tank) must be pressurized with dry nitrogen or dry air immediately after loading. Next, slowly operate the pump system to remove any polyurea materials remaining in the tanks, heaters, hoses (including recirculation hoses), and tips. Once all of the old polyurea materials have been removed from the truck, begin to recirculate and heat the Series 5000 components in preparation for the test spray.

2 Epoxy System Change Over

The chemistries of epoxy and polyurea systems are not compatible. This means that trucks previously used for epoxy applications must be cleaned more thoroughly prior to being filled for polyurea applications. For truck conversion, please follow the truck manufacturer’s clean-out procedures before attempting to use it with Series 5000.

Procedure for flushing epoxy Part A from trucks prior to filling with Series 5000:

Empty tanks to the lowest level possible and follow the truck manufacturer’s clean-out procedures before using it with Series 5000.

After completing the manufacturer’s clean-out procedure, immediately add Series 5000 Part A to the 2 part tank and Part B to the 1 part tank. The Part B tank (the 1 part tank) must be pressurized with dry nitrogen or dry air immediately after loading. Next, slowly operate the pump system to remove any epoxy materials remaining in the tanks, heaters, hoses (including recirculation hoses), and tips. Once all of the old epoxy materials have been removed from the truck, begin to recirculate and heat the Series 5000 components in preparation for the test spray.
Appendix B

Series 5000 Safe Handling Procedures

1 Safe Handling Procedures

Before handling any chemical product, read all Safety Data Sheets (SDSs) and labels, which contain the following information:

1.1 Precautions for safe handling

Do not handle until all safety precautions have been read and understood. Do not breath dust/fumes/gas/mist/vapors/spray.

Do not allow Series 5000 to contact eyes, skin, or clothing. Do not eat, drink, or smoke when working with this product. Thoroughly wash with soap and water after handling. Contaminated work clothing should be kept on site. It must not be allowed to leave the work-site. Avoid release of Series 5000 into the environment.

Wash contaminated clothing before reuse. Avoid contact with oxidizing agents (e.g. chlorine, chromic acid, etc.) Use personal protective equipment (gloves, respirators, etc.) as required.

1.2 Hazard Statements

Potential results of improper handling:

- Serious eye damage
- Severe skin burns and blisters
- Allergic skin reaction
- Respiratory irritation
- Suspected carcinogen
- Damage to organs through prolonged or repeated exposure: the respiratory system in particular

1.3 Suggested First Aid

Inhalation:

Remove person to fresh air. Get immediate medical attention.

Skin Contact:

Immediately wash exposed area with soap and water. Remove contaminated clothing. Get immediate medical attention. Wash clothing before reuse. Avoid contact with oxidizing agents (e.g. chlorine, chromic acid, etc.)

Eye Contact:

Immediately flush eye with large amounts of water for at least 15 minutes. Remove contact lenses if easily done. Continue flushing eye. Immediately get medical attention.

If Swallowed:

Rinse mouth. Do not induce vomiting. Get immediate medical attention.
2 Mixers

If Part A has been exposed to temperatures greater than 100 °F, it may require remixing. Check for separation prior to use.

2.1 Mixer Specifications

a Motor: 1/2 to 2 hp air or electric
b Mounting: six inch integrated tote mount
c Bottom impeller with four bladed collapsible impellers: minimum 14” diameter (no more than 14 inches from bottom of tote)
d Middle impeller with bladed collapsible impellers: minimum 14” diameter
e Minimum shaft length: 32”
f Minimum diameter: ¾”

Mixing and agitating in a tote can be challenging. Please read and carefully follow the instructions provided by the mixer manufacturer in the product’s user manual before proceeding.

Always abide the instructions provided by the mixer manufacturer in the mixer’s user manual.

3 Handling of Empty Drums and Totes

Drums and totes must be empty prior to pickup by disposal company:

- Do NOT put any trash in empty drums.
- Leave one drum liner only in every drum.

Emptying of drums and tote pickups are the responsibility of the contractor. For further drum and tote disposal information, and for drum disposal company contact information, contact your 3M technical service representative or 3M application engineer.

4 Cleanup and Waste Handling

- Proper handling and disposal of all waste is the responsibility of the contractor.
- Follow all local, state, and federal regulations for proper waste handling.
- Safe handling procedures apply to all liquid waste materials, cleanup rags, and similar items.
- Solid waste, such as cured Series 5000 components, should be collected in a bucket before startup and may be disposed of in an ordinary landfill, provided no liquid material remains.
- All waste containing liquids must be incinerated.
- The use of Dibasic Esters¹ (DBE) as cleaners generates liquid waste of “non-regulated” transportation status.
  - To maintain non-regulated transportation status, Series 5000 and DBE must not be contaminated with traditional solvents.
  - Pumpable materials (liquids only) should be kept separate from rags and other solid waste.
- Cleanup with solvents like methylene chloride, methyl ethyl ketone, or acetone will result in the production of hazardous liquid waste of “regulated” transportation status.
- For further waste handling and waste disposal company information, contact your 3M technical service representative or 3M application engineer.

¹ Contact DuPont at 800-231-0998 to locate a DBE distributor in your area.
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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