Road Surface Guide

for 3M™ Stamark™ Pavement Marking Tapes
Introduction

Note: This guide uses definitions for distress that were derived from the U.S. Army Corps of Engineers Technical Report M-294 “Pavement Maintenance Management for Roads and Parking Lots,” 1981. Many of the definitions have been modified to reflect conditions most typically found on our nation’s roadways.

This 3M Road Surface Guide is a tool for determining the suitability of pavements for application of 3M™ Stamark™ Pavement Marking Tapes. It describes a wide range of pavement conditions for both Asphalt Cement Concrete (ACC) and Portland Cement Concrete (PCC), from newly treated to severely distressed, and for each provides a “go” or “no go” recommendation for application of Stamark Tape.

For specific questions about tape application procedures, consult 3M Information Folder 5.7 for Pavement Surface Preparation and Application Techniques for 3M Stamark Tapes.

Integration with 3M Climate Guide and 3M Adhesion Guide

This guide is designed to be used with the 3M Adhesion Guide and the 3M Climate Guide to determine the best applications for Stamark tapes based on adhesion reliability, and to clarify when and where Stamark tapes should not be used. The 3M Adhesion Guide ranks applications for each product type based on road characteristics, application technique, and the season of the year. The Climate Guide and the Road Surface Guide further define the application window by establishing start and end dates for the application season based on location, and by eliminating certain applications from the window based on road surface and climate conditions.

For More Information

For further information or for applications not covered in this Road Surface Guide, contact 3M Traffic Control Materials Division, 1-800-553-1380. Follow instructions to reach Technical Service for Pavement Markings. In Canada call 1-519-452-6201.

Acknowledgment:

This guide was modeled after the Pavement Distress Manuals, Flexible and Rigid, which were developed by the Minnesota Department of Transportation (Mn/DOT) and the Local Road Research Board (LRRB). Photos and copy were taken directly from those manuals with permission of the LRRB and Mn/DOT.
<table>
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<th>Season</th>
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<tr>
<td>Not Recommended</td>
<td>Application Window</td>
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**Road Surface Guide**

**Product Family**

**Climate Guide**
How to use this guide

This guide is divided into two main sections: Asphalt Cement Concrete and Portland Cement Concrete. The first page in each of these sections describes common surface treatments and gives application recommendations for them. The remaining pages describe distresses of aging surfaces with photographic examples. The last two pages of the Introduction address application over existing markings, and over oil drip zones.

1. Find the heading that best describes the condition of the surface you are considering for application of Stamark tape.

2. Use the photos and the descriptions to determine the level of distress or the condition of the surface.

3. Follow the Application Recommendations.

The distress pages are formatted as follows:

**Name of Distress** — The name or names by which the distress is commonly referred.

**Description** — A physical description of the distresses, what they look like and how they can be identified.

**Severity Levels** — A description of three severity levels of each of the distresses: low, medium and high.

**Application Recommendations** — Recommendations for application of Stamark Pavement Marking Tapes. The recommendations refer explicitly to the portion of the road which is affected by the distress. However, consideration should be given to the rate at which the distress is spreading when assessing whether a durable marking is appropriate. The following symbols are used:

- [Acceptable Application]
- [Unacceptable Application]
Existing Markings

If markings exist on the roadway, remove them from the surface by sandblasting or grinding. A minimum of 80% of the road surface beneath the existing markings must be exposed prior to long line tape application. A minimum of 90% of the road surface beneath the existing markings must be exposed prior to transverse and symbol & legend tape applications. However, Stamark tape may be applied over existing Stamark tapes that are well worn and tightly adhered to the road surface. To determine if the marking is tightly adhered, pry upward in several spots on the tape with a utility knife. The marking should not lift from the pavement surface.

Photo 1 shows a non-Stamark marking that is well worn and must be removed prior to tape application.

Photo 2 shows the marking that has been ground off to 50–75% and is unacceptable for Stamark tape application.

Photo 3 shows a road surface that has had 90% of the marking removed and is an acceptable surface for Stamark tape application.
Do not apply markings over heavy oil drip zones which have developed on any ACC surface. The accumulation of oil on the pavement will not allow the tape to bond to the road surface. It is not possible to remove heavy oil accumulation from any ACC surface. The oil penetrates down and into the asphalt cement making removal impossible. Oil drip zones on PCC surfaces may be removed by grinding or sandblasting the area clean. The picture above shows a typical heavy oil drip area.
Asphalt cement concrete (ACC) roads vary greatly in composition from one location to the next. This is due, in part, to the fact that aggregate and binder materials are derived from local sources. In addition, asphalt mixes are designed for specific traffic, climate and sub-soil conditions.

Aggregates come directly from pits, are processed by crushing, or are byproducts of other industries (e.g. steel slag, coal ash). Nearly the full range of rock types are used in road making. Aggregate is generally a mixture of gravel (coarse, ¼ inch and larger) and sand (fine, .003 to ¼ inch). The size distribution of aggregate is varied to give the desired mechanical and water drainage properties.

Asphalt cement is a byproduct of crude oil refining. It must be heated to facilitate coating of the aggregate during mixing, and flow of the mix during layer formation. Sometimes additives are included to enhance the properties of the mix (e.g. rubberized asphalt, polymer modified asphalt).

Old ACC is sometimes removed from the road, blended with new materials, and reapplied (recycled asphalt).

One common mix design called “open” or “gap” grade is made with only larger sized gravel (½–¾ inch) so that it is less dense than standard mixes. Because its open structure allows water to pass through more freely, it is most often used for the friction course (the upper most layer of the road).

Another mix design referred to as stone matrix asphalt (SMA) is gaining acceptance because of its improved stability. These mixes incorporate stone as large as 1.5 inches and have particular specifications for lay down and compaction.

3M pavement marking tapes have been tested on a wide range of ACC roads and adhesion has been found to be largely independent of type.
ACC Surface Treatments

Treatments for road surface improvement and maintenance need to be considered prior to the application of Stamark tape. Existing Stamark tape can be protected from being covered by the emulsion from road surface treatments by masking the tape with 3M™ SCPS-2 Pre-Masking Tape prior to emulsion application. After the chip is applied and the excess chip cleared away, remove the SCPS-2 to expose the existing tape. Refer to Tech Memo on masking.

**Fog Seal**
A fog seal is a coating of diluted asphalt emulsion applied to new or aging asphalt to reduce raveling or loss of aggregate. Stamark tape can be overlaid after the emulsion has been fully cured. Contact the emulsion manufacturer to determine the time required for the emulsion to fully cure.

**Chip Seal**
A chip seal is a coating of asphalt emulsion applied onto an existing surface and then covered with a ¼ inch (6.350mm) to ⅜ inch (9.525mm) aggregate. Excess aggregate is removed after exposure to traffic. Stamark tapes can be overlaid after the loose aggregate is removed and the emulsion has fully cured. Contact the manufacturer to determine the time required to fully cure the emulsion.

**Slurry Seal**
A slurry seal is a mixture of specially graded fine aggregates and asphalt emulsion squeegeed in-place. It is generally used on city streets and airports where loose aggregates can not be tolerated. Micro-surfacing is a specialized slurry seal. Slurry seal may also be applied to new ACC surfaces to increase longevity. Stamark tape can be overlaid after the emulsion has been fully cured. Contact the manufacturer to determine the time required to fully cure the emulsion.

**Thin Overlay**
A thin overlay is a single application of hot-mix asphalt. It is generally used to provide a smoother riding surface. Because the layer is thin, the ability to achieve an inlay of the tape may depend on the size of the aggregate. Stamark tape can be overlaid following the same guidelines used for new asphalt surfaces (Refer to Information Folder 5.7).
Pavement Seams

Photo 1 shows a successful application of Stamark tape that has been placed along side the ACC seam.

Photo 2 shows the application of Stamark tape that has been placed on top of the ACC seam.

Application Recommendations

Apply the tape a minimum of 4 inches from the asphalt seam to the outside edge of the tape.
See written recommendations.
Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt concrete under repeated traffic loading. Alligator cracking occurs only in areas subject to repeated loading, such as wheelpaths. Therefore, it would not occur over the entire paved area unless the entire area were subject to the traffic loading. (Pattern-type cracking, which occurs over an area that is not subject to loading, is called block cracking. See “Block Cracking” in this report.)

Severity Levels

Low severity: Fine longitudinal cracks running parallel to each other with no or only a few interconnecting cracks. The cracks are not spalled. (See “Spalling” in this report.) Initially there may be only a single crack in the wheelpath.

Medium severity: Further development of light alligator cracks into a pattern or network of cracks that may be lightly spalled.

High severity: Network or pattern cracking has progressed so that the pieces are well defined and spalled at the edges. Some of the pieces may rock under traffic. Pieces may begin to disintegrate forming potholes.

Application Recommendations

Application at low and medium severity levels is acceptable if markings can be placed a minimum of 2 in. (5 cm) from the crack. Many cracks are not straight enough to apply a straight line next to. Do Not apply Stamark tape if the tape must continually cross over the crack unless crack is low in severity and filled. The filler must be in satisfactory condition. If applying transverse markings over the crack, the marking must be cut a minimum of 1 in. (2.5 cm) back from each side of the crack. At high severity levels, the road surface should not be marked with Stamark tape.
Block Cracking

Description

Block cracks are interconnected cracks that divide the pavement into blocks that range in size from approximately 1 by 1 ft. to 12 by 12 ft. in size depending on the asphalt mix properties and surface thickness. Block cracking is not load-associated and usually indicates a hard or brittle asphalt. Block cracking normally occurs over a large portion of pavement area, but sometimes will occur only in non-traffic areas. This type of distress differs from alligator cracking in that alligator cracks usually form smaller, many-sided pieces with sharp angles. Also, unlike block cracks, alligator cracks are caused by repeated traffic loadings, and therefore, found only in traffic areas (i.e. wheelpaths).

Severity Levels

**Low severity:** Blocks are defined by low severity cracks. (See definition of longitudinal and transverse cracking of this report).

**Medium severity:** Blocks are defined by medium severity cracks. (See definition of longitudinal and transverse cracking of this report).

**High severity:** Blocks are defined by high severity cracks. (See definition of longitudinal and transverse cracking of this report).

Application Recommendations

Application at low and medium severity levels is acceptable if markings can be placed a minimum of 2 in. (5 cm) from the crack. Many cracks are not straight enough to apply a straight line next to. Do Not apply Stamark tape if the tape must continually cross over the crack unless crack is low in severity and filled. The filler must be in satisfactory condition. If applying transverse markings over the crack, the marking must be cut a minimum of 1 in. (2.5 cm) back from each side of the crack. At high severity levels, the road surface should not be marked with Stamark tape.
**Name of Distress**

<table>
<thead>
<tr>
<th>Description</th>
<th>Corrugation</th>
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<tr>
<td>Description</td>
<td>Corrugation (also known as washboarding) is a series of closely spaced transverse undulations consisting of alternate valleys and crests (ripples) occurring at fairly regular intervals, usually less than 10 feet along the surface of the pavement. The ridges are perpendicular to the traffic direction. If bumps occur in a series less than 10 feet, due to any cause, the distress is considered corrugation.</td>
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**Severity Levels**

**Low severity:** Corrugation produces low severity ride quality. (Noticeable but not annoying)

**Medium severity:** Corrugation produces medium severity ride quality. (Beginning to be annoying)

**High severity:** Corrugation produces high severity ride quality. (Becomes a safety hazard or causes traffic to slow down)

**Application Recommendations**

Application at any severity levels is acceptable. Corrugation is a surface distress which will not adversely affect adhesion of Stamark tapes. If the Corrugation develops into a transverse crack or other distress, then look for the tab(s) that best describes that distress and follow the application recommendations.
Medium Severity Corrugation
Depression

Depressions are localized areas of pavement with elevations slightly lower than those of the surrounding pavement. In many instances, light depressions are not noticeable until after rain, when ponding water creates “birdbath” areas. On dry pavement, depressions can be spotted by looking for stains caused by ponding water. Depressions cause some roughness, and when filled with water of sufficient depth, can cause hydroplaning.

**Severity Levels**

- **Low severity**: Maximum depth of depression is $\frac{1}{2}$ to 1 inch.
- **Medium severity**: Maximum depth of depression is 1 to 2 inches.
- **High severity**: Maximum depth of depression is more than 2 inches.

**Application Recommendations**

Application at any severity levels is acceptable. Dirt and water tend to accumulate in the depressions which may adversely affect adhesion to the road surface. Extra caution must be taken to insure that the surface is clean and dry prior to tape application.
Low Severity Depression

See written recommendations.

High Severity Depression

See written recommendations.
Edge Cracking

Edge cracks are parallel to and usually within 1 to 2 feet of the outer edge of the pavement or may be a scalloped or alligator type of cracking along the edge of the pavement. This distress is accelerated by traffic loading and can be caused by frost-weakened base or subgrade near the edge of the pavement or differential frost heave along the edge. The area between the crack and pavement edge is classified as raveled if it breaks up (sometimes to the extent that pieces are removed).

**Severity Levels**
- **Low severity**: Low or medium cracking with no breakup or raveling.
- **Medium severity**: Medium cracks with some breakup and raveling.
- **High severity**: Considerable breakup or raveling along the edge.

**Application Recommendations**
Application at low severity levels is acceptable if the marking can be applied a minimum of 2 inches (5 cm) from the crack. At medium and high severity levels, the road surface should not be marked with Stamark tape.
Low Severity Edge Cracking

See written recommendations.

Medium Severity Edge Cracking

High Severity Edge Cracking
Flushing is a film of bituminous material on the pavement surface which creates a shiny, reflecting surface that usually becomes quite sticky when hot. Flushing is the result of free asphalt migrating upward to the pavement surface. It occurs most often in the wheel-paths, especially during hot weather. Since the flushing process is not reversible during cold weather, asphalt will accumulate on the surface. Flushing results in low frictional characteristics when the pavement is wet and is, therefore, a safety hazard.

**Severity Levels**

**Low severity:** Flushing has only occurred to a very slight degree and it is noticeable only during a few days of the year. Asphalt does not stick to shoes or vehicles.

**Medium severity:** Flushing has occurred to the extent that asphalt sticks to shoes and vehicles during only a few weeks of the year.

**High severity:** Flushing has occurred extensively and considerable asphalt sticks to shoes and vehicles during several weeks of the year.

**Application Recommendations**

Application at low and medium severity levels is acceptable. The markings may turn temporarily dark when the flushing is at its peak. At high severity levels, the road surface should not be marked with Stamark tape. High severity levels of flushing will result in the markings turning permanently dark in color as asphalt tracks onto the tape. High severity levels of flushing may also adversely effect adhesion in high shear areas.
Longitudinal Cracking

Longitudinal cracks generally follow a course approximately parallel to the pavement’s centerline or lay-down direction. There are two types of longitudinal cracks, load related (located within the wheel-paths) and non-loaded cracks that meander in and out of the wheel-path or longitudinal cold joint. The load related crack is defined to be fatigue cracking and is covered under alligator cracking. The first type of longitudinal crack is the type covered under this definition.

Severity Levels

Low severity: One of the following conditions exist:
- Non-filled crack width is less than ¼ inch
- Filled crack of any width (filler in satisfactory condition)

Medium severity: One of the following conditions exist:
- Non-filled crack width is ¼ to ½ inches
- Non-filled crack width up to ½ inches surrounded by light and random cracking
- Filled crack of any width surrounded by light random cracking

High severity: One of the following conditions exist:
- Any crack filled or non-filled surrounded by medium or high severity random cracking
- Non-filled crack over ½ inches
- A crack width where a few inches of pavement around the crack is severely broken

Application Recommendations
Application is acceptable if markings can be placed a minimum of 2 inches (5 cm) from the crack. Many cracks are not straight enough to apply a straight line next to. Do not apply Stamark tape if the tape must continually cross over the crack unless the crack is low in severity and filled. The filler must be in satisfactory condition. If applying transverse markings over the crack, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the crack. Long line applications should also be cut 1 inch (2.5 cm) back from each side of the crack at high severity levels.
Low Severity Longitudinal Cracking

See written recommendations.

Medium Severity Longitudinal Cracking

See written recommendations.
A patch is an area of pavement that has been replaced or covered with new material. It can be identified by its color and texture. It can have an irregular shape when a pothole is filled or a rectangular shape such as a utility patch. A patch can range in size from less than 1 square foot to several thousand square feet.

There are several types of patches. A few types are identified as follows:

**Temporary patch:** The so called “Throw and Go” patch such as a pothole that was filled with hot or cold mix.

**Skin patch:** A thin blade laid or paver laid overlay that occurs in a small area.

**Permanent patch:** Utility cut or permanent repair. These patches are normally rectangular patches where the original pavement material was removed and new material was placed. The surface of these patches is normally flush with the adjoining original pavement and they have straight edges.

**Overlay patch:** An overlay patch may also be considered a permanent repair. It is cut into the original materials and you will not be able to tell if there has been any removal of the original material. These are typically larger in size and found more often in rural sections.

**Application Recommendations**

Patches are repairs of some type of distress. Patches are usually temporary and will eventually display the original distress characteristics over time. Find the cause for the patching and follow the application recommendations for that type of distress.
Low Severity Patches

Medium Severity Patches

High Severity Patches

See written recommendations.
Polished Aggregate

Description

This distress is caused by repeated traffic applications. When the aggregate at the surface becomes smooth to the touch, adhesion with vehicle tires is considerably reduced. When the portion of the aggregate extending above the surface is small, the pavement texture does not significantly contribute to reducing vehicle speed. Polished aggregate should be counted when close examinations reveal the surface aggregate is smooth to the touch. This type of distress is indicated when the number on a skid resistant test is low or has dropped significantly from previous ratings.

Severity Levels

No degrees of severity are defined.

Application Recommendations

Application is acceptable at all levels; however, at medium and high severity levels, the road pavement should be textured by grinding, sandblasting, or rotopeening to provide a better bonding surface.
Medium Severity Polished Aggregate

See written recommendations.
Potholes (Chuckholes)

Description
Potholes are small (usually less than 3 feet in diameter), bowl-shaped holes in the pavement surface. They generally have sharp edges and vertical sides near the top of the hole. Their growth is accelerated by free moisture collection inside the hole. Potholes are produced when traffic abrades small pieces of a pavement surface that has weakened. The pavement then continues to disintegrate because of poor surface mixtures, weak spots in the base or subgrade, or because it has reached a condition of high severity alligator cracking. Potholes are generally structurally related distresses and should not be confused with raveling and weathering.

Severity Levels
Examples of different severity levels are pictured above.

Application Recommendations
Application of transverse markings should be avoided in areas where potholes exist. Application of long line markings is acceptable at low severity levels if the potholes are not concentrated near to where the markings will be placed. At medium and high severity levels the road surface should not be marked with Stamark tape.
Low Severity Potholes

Medium Severity Potholes

High Severity Potholes
Raveling and weathering are progressive disintegrations of the pavement material from the surface caused by the loss of asphalt binder and dislodged aggregate particles. These distresses indicate that either the asphalt binder has hardened appreciably, or that a poor quality mixture is present. In addition, raveling may be caused by the abrasive action of sand and tires, especially at intersections. Softening of the surface and dislodging of the aggregates due to oil or fuel spillage is also included under raveling.

Severity Levels

Low severity: The fine aggregate or binder has started to wear away. The large aggregate particles are exposed at the top. In some areas, the surface is starting to pit. In cases with oil or fuel spillage, the stain can be seen, but the surface is hard and cannot be penetrated with a coin.

Medium severity: The fine aggregate and/or binder has worn away. At least one-third of the diameter of the large aggregates is exposed. The surface texture is moderately rough and pitted. In cases with oil or fuel spillage, the surface is soft and can be penetrated with a coin.

High severity: The fine aggregate and/or binder has been considerably worn away and large aggregate is coming off. The surface texture is very rough and severely pitted. In case of oil or fuel spillage, the asphalt binder has lost its binding effect and the aggregate has become loose.

Application Recommendations

Application at low severity levels is acceptable for long lines primed with Stamark SP-44T Surface Preparation Adhesive only. At medium and high severity levels, the road surface should not be marked with Stamark tape. Transverse markings should not be applied to any raveled surface.

Name of Distress

Raveling, Weathering or Abrasion

Description

Raveling and weathering are progressive disintegrations of the pavement material from the surface caused by the loss of asphalt binder and dislodged aggregate particles. These distresses indicate that either the asphalt binder has hardened appreciably, or that a poor quality mixture is present. In addition, raveling may be caused by the abrasive action of sand and tires, especially at intersections. Softening of the surface and dislodging of the aggregates due to oil or fuel spillage is also included under raveling.

Severity Levels

Low severity: The fine aggregate or binder has started to wear away. The large aggregate particles are exposed at the top. In some areas, the surface is starting to pit. In cases with oil or fuel spillage, the stain can be seen, but the surface is hard and cannot be penetrated with a coin.

Medium severity: The fine aggregate and/or binder has worn away. At least one-third of the diameter of the large aggregates is exposed. The surface texture is moderately rough and pitted. In cases with oil or fuel spillage, the surface is soft and can be penetrated with a coin.

High severity: The fine aggregate and/or binder has been considerably worn away and large aggregate is coming off. The surface texture is very rough and severely pitted. In case of oil or fuel spillage, the asphalt binder has lost its binding effect and the aggregate has become loose.

Application Recommendations

Application at low severity levels is acceptable for long lines primed with Stamark SP-44T Surface Preparation Adhesive only. At medium and high severity levels, the road surface should not be marked with Stamark tape. Transverse markings should not be applied to any raveled surface.
Low Severity Raveling

See written recommendations.

Medium Severity Raveling

High Severity Raveling
Rutting (Channeling, Wheeltracking)

A rut is a longitudinal surface depression in a wheelpath. Pavement uplift may also occur along the sides of the rut. In many instances, ruts are more noticeable after a rainfall, when filled with water.

**Severity Levels**

**Low severity:** 0 to < ½ inch

**Medium severity:** > ½ to 1 inch

**High severity:** 1 inch or when hydroplaning can occur

**Application Recommendations**

Application at any severity level is acceptable. Dirt and water tend to accumulate in the rutted area which may adversely affect adhesion to the road surface. Longitudinal markings will usually be out of the rutting area, however transverse markings will cross through the rutted area. If application of transverse markings is necessary, extra caution must be taken to insure that the surface is clean and dry prior to application.
Low Severity Rutting

See written recommendations.

Medium Severity Rutting

See written recommendations.

High Severity Rutting

See written recommendations.
Shoving is a permanent, longitudinal displacement of a localized area of the pavement surface caused by traffic loading. Shoving is a transverse undulation in the pavement surface consisting of closely spaced alternate valleys and crests. When traffic pushes against the pavement, it produces a short, abrupt wave in the pavement surface (also see corrugation). This distress is more likely to occur in unstable liquid asphalt mix (cutback or emulsion) pavements.

Severity Levels

Low severity: Shove causes low severity ride quality. (Noticeable but not annoying)

Medium severity: Shove causes medium severity ride quality. (Beginning to be annoying)

High severity: Shove causes high severity ride quality. (Becomes a safety hazard or causes traffic to slow down)

Application Recommendations

Application is unacceptable at any severity level. The road surface should not be marked with Stamark tape.
Low Severity Shoving

High Severity Shoving
There are two types of slippage cracks: traffic related and non-traffic related.

Traffic Related: Slippage cracks are crescent or half-moon shaped cracks. They are produced when breaking or turning wheels cause the pavement surface to slide or deform. This distress usually occurs when there is low strength surface mix or a poor bond between the asphalt layers.

Non-Traffic Related: These are cracks which outline the edge of a fill settlement or slope failure and generally take the form of a large crescent. The pavement in the enclosed (inside) side of the crescent is depressed, or may have been filled with surfacing material.

Severity Levels
Low severity: Average crack width is less than \(\frac{1}{4}\) inch.

Medium severity: One of the following conditions exist:
- Average crack width is between \(\frac{1}{4}\) and \(\frac{1}{2}\) inch.
- The area around the crack is broken into tight-fitting pieces.

High severity: One of the following conditions exist:
- The average crack width is greater than \(\frac{1}{2}\) inch.
- The area around the crack is broken into easily removed pieces.

Application Recommendations
Application is unacceptable at any severity level. The road surface should not be marked with Stamark tape.
Low Severity Slippage Cracking

Medium Severity Slippage Cracking

High Severity Slippage Cracking
Transverse Cracking (Temperature Cracking)

Description
Transverse cracks extend across the pavement at approximately right angles to the pavement centerline. These types of cracks are not usually load-associated.

Severity Levels
Low severity: One of the following conditions exist:
- Non-filled crack width is less than ¼ inch.
- Filled crack of any width (filler in satisfactory condition).

Medium severity: One of the following conditions exist:
- Non-filled crack width is ¼ to ½ inch.
- Non-filled crack of any width up to ½ inch surrounded by light and random cracking.
- Filled crack of any width surrounded by light random cracking.

High severity: One of the following conditions exist:
- Any crack filled or non-filled surrounded by medium or high severity random cracking.
- Non-filled crack over ½ inch.
- A crack of any width where a few inches of pavement around the crack is severely broken.

Application Recommendations
Application at all levels of severity is acceptable; however, transverse markings should not be applied over the crack, if possible. Do Not apply Stamark tape if the tape must continually cross over the crack unless crack is low in severity and filled. The filler must be in satisfactory condition. If applying transverse markings over a transverse crack, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the crack. Long line applications should also be cut 1 inch (2.5 cm) back from each side of the crack at high severity levels.
Low Severity Transverse Cracking
See written recommendations.

Medium Severity Transverse Cracking
See written recommendations.

High Severity Transverse Cracking
See written recommendations.
Curing Compounds

Curing compound is a wax emulsion compound for curing fresh moist plain concrete. Curing compound forms a flexible film which prevents concrete from drying out. It increases strength, abrasion resistance and durability while it reduces cracking and dusting. It is recommended for all types of external PCC paving and road pavements, for applications where damp curing is impracticable.

For new concrete open to traffic less than 90 days, remove the curing compound prior to tape application by sandblasting, shot-blasting or hydro-blasting. If removed by hydro-blasting, the surface must be allowed to dry for a minimum of 24 hours prior to Stamark tape application.

Waterproofing Membranes for Bridge Decks

Waterproofing membranes are designed to repel water from PCC bridge decks. After proper curing, Stamark tapes may be applied to the membrane using the proper surface preparation adhesive.

Surface Textures

Tined PCC: During construction, the new surface is often brushed or grooved (tined). After proper curing, Stamark tapes may be applied to the any tined PCC surface using the proper surface preparation adhesive.

Grooved PCC: Prior to tape application a groove is cut into the pavement surface. Grooving the pavement surface allows preformed pavement marking tape to be embedded into existing pavement surfaces. Grooving enhances adhesion by creating a fresh surface and produces a lower-profile marking that helps protect from snowplow damage.
**Corner Break**

A corner break is a crack that intersects the joints at a distance less than or equal to one-half the slab length on both sides, measured from the corner of the slab. A corner break differs from a corner spall in that the crack extends vertically through the entire slab thickness, while a corner spall intersects the joint at an angle.

**Severity Levels**

**Low severity:** Break is defined by a low severity crack and the area between the break and the joint is not cracked or may be lightly cracked. See “Linear Cracking” for definition of low severity cracks.

**Medium severity:** Break is defined by medium severity crack and/or the area between the break and the joint is moderately cracked. See “Linear Cracking” for definitions of medium severity cracks.

**High severity:** Break is defined by a high severity crack and/or the area between the break and the joint is highly cracked. See “Linear Cracking” for definitions of high severity cracks.

**Application Recommendations**

Application at all levels of severity is acceptable; however, transverse markings should not be applied over the break if possible. If applying transverse markings over a corner break, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the break. Long line applications should also be cut 1 inch (2.5 cm) back from each side of the break at high severity levels.
Low Severity Corner Break

See written recommendations.

Medium Severity Corner Break

See written recommendations.

High Severity Corner Break

See written recommendations.
Durability (D) Cracking

Description

This distress usually appears as a pattern of cracks running parallel and close to a joint or linear crack. A series of fine, hairline crescent-shaped cracks in the concrete surface are usually curving across the slab corners. If the concrete becomes saturated near joints and cracks, a dark-colored deposit can usually be found around fine “D” cracks. This type of distress can eventually lead to disintegration of the entire slab.

Severity Levels

Low severity: “D” cracks cover less than 15 percent of the slab area. Most of the cracks are tight, but a few pieces may have popped out.

Medium severity: One of the following conditions exist:
1. “D” cracks cover less than 15 percent of the area and most of the pieces have popped out or can be easily removed.
2. “D” cracks cover more than 15 percent of the area. Most of the cracks are tight, but a few pieces may have popped out or can be easily removed.

High severity: “D” cracks cover more than 15 percent of the area and most of the pieces have popped out or can be easily removed.

Application Recommendations

Application at low levels of severity is acceptable; however, transverse markings should not be applied over the crack or joint, if possible. If applying transverse markings over a crack, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the crack. At medium and high levels, the road surface should not be marked with Stamark tape.
Low Severity Durability Cracking

See written recommendations.

Medium Severity Durability Cracking

High Severity Durability Cracking
Faulting is the differential vertical displacement of abutting slabs at joints or cracks creating a “step” deformation in the pavement.

Severity Levels
Severity levels are defined by the difference in elevation across the crack or joint.

<table>
<thead>
<tr>
<th>Severity level</th>
<th>Difference in Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0 to ½ inch</td>
</tr>
<tr>
<td>Medium</td>
<td>greater than ½ inch to less than 1 inch</td>
</tr>
<tr>
<td>High</td>
<td>greater than 1 inch</td>
</tr>
</tbody>
</table>

Application Recommendations
Application at low and medium severity levels is acceptable if markings can be placed a minimum of 2 in. (5 cm) from the crack. If applying transverse markings over the crack, the marking must be cut a minimum of 1 in. (2.5 cm) back from each side of the crack. At high severity levels the road surface should not be marked with Stamark tape.
Low Severity Faulting

See written recommendations.

High Severity Faulting
Joint Seal Damage

Joint seal damage is any condition which enables incompressible material such as sand or rocks to accumulate in the joints plus allows significant water infiltration. Accumulation of incompressible materials prevents the slabs from expanding and may result in buckling, shattering or spalling. A pliable joint filler bonded to the edges of the slabs protects the joints from material accumulation and prevents water from seeping down and softening the foundation supporting the slab.

Severity Levels

Low severity: Joint sealant is in generally good condition throughout the section. Sealant is performing well, with only minor damage.

Medium severity: Joint sealant is in generally fair condition over the entire section, with one or more of the above types of damage occurring to a moderate degree. Sealant needs replacement within 2 years.

High severity: Joint sealant is in generally poor condition over the entire section, with one or more of the above types of damage occurring to a severe degree. Sealant needs immediate replacement.

Application Recommendations

Application at any level of severity is acceptable; however, transverse markings should not be applied over the crack or joint, if possible. If applying transverse markings over a joint, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the joint. Application of long line markings over a joint with a high severity of distress should be cut a minimum of 1 inch (2.5 cm) back from each side of the joint.
Low Severity Joint Seal Damage

See written recommendations.

Medium Severity Joint Seal Damage

See written recommendations.

High Severity Joint Seal Damage

See written recommendations.
Linear Cracking (Longitudinal, Transverse and Diagonal Cracks)

These cracks, which divide the slab into two or three pieces, are usually caused by a combination of repeated traffic loading, thermal gradient curling and repeated moisture loading and/or differential heave or settlement of the subgrade. (Slabs divided into four or more pieces are counted as Divided Slabs.) Low severity cracks are usually related to warp or friction and are not considered major structural distresses. Medium or high severity cracks are usually working cracks and are considered major structural distresses. Hairline cracks that are only a few feet long and do not extend across the entire slab are counted as shrinkage cracks.

Severity Levels

**Low severity**: Non-filled cracks less than or equal to \( \frac{1}{4} \) inch or filled cracks of any width with the filler in satisfactory condition. No faulting exists.

**Medium severity**: One of the following conditions exists:
1. Non-filled crack with a width between \( \frac{1}{4} \) and \( \frac{1}{2} \) inch.
2. Non-filled crack of any width up to \( \frac{1}{2} \) inches with faulting of less than \( \frac{1}{2} \) inch.
3. Filled crack of any width with faulting less than \( \frac{1}{2} \) inch.

**High severity**: One of the following conditions exists:
1. Non-filled crack with a width greater than \( \frac{1}{2} \) inch.
2. Filled or non-filled crack of any width with faulting greater than \( \frac{1}{2} \) inch.

Application Recommendations

Application at any level of severity is acceptable; however, transverse markings should not be applied over the crack or joint, if possible. If applying transverse markings over a crack, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the crack. At medium and high levels, the road surface should not be marked with Stamark tape.
Low Severity Linear Cracking  
See written recommendations.

Medium Severity Linear Cracking  
See written recommendations.

High Severity Linear Cracking  
See written recommendations.
Polished Aggregate

When the aggregate in the surface becomes smooth to the touch, adhesion with vehicle tires is considerably reduced. When the portion of aggregate extending above the surface is small, the pavement texture does not significantly contribute to reducing vehicle speed. Polished aggregate should be recorded when close examination reveals that the aggregate extending above the concrete is negligible, and the surface aggregate is smooth to the touch. This type of distress is indicated when the number on a skid resistance test is low or has dropped significantly from previous ratings.

Severity Levels
No degrees of severity are defined. However, the degree of polishing should be such that it will become a safety problem in the next couple of years or already is.

Application Recommendations
Application is acceptable at all levels; however, at medium and high severity levels, the road pavement should be textured by grinding, sandblasting, or rotopoeening to provide a better bonding and skid resistant surface.
Low Severity Polished Aggregate

See written recommendations.

High Severity Polished Aggregate

See written recommendations.
Name of Distress  

**Popouts**

Description

A popout is a small piece of pavement that breaks loose from the surface. Popouts usually range in diameter from approximately 1 to 4 inches and in depth from $\frac{1}{2}$ to 2 inches.

Severity Levels

No degrees of severity are defined for popouts. However, popouts must be extensive before they are counted as a distress. Average popout density must exceed approximately three popouts per square yard over the entire slab area.

Application Recommendations

Most PCC surfaces experience some degree of popout over the life of the roadway. The left photo shows a PCC surface where popouts are becoming very evident. The right photo shows severe popout and should not be marked with Stamark tape.
Low Severity Popouts

High Severity Popouts
Name of Distress

Pumping (Bleeding)

Description

Pumping is the ejection of material (water, clay, silt, etc.) from the slab foundation through joints or cracks. Pumping can be identified by surface stains and evidence of base or subgrade material on the pavement or shoulder close to joints or cracks. Pumping can also occur along the slab edge, causing loss of support.

Severity Levels

No degrees of severity are defined. It is sufficient to indicate that pumping exists.

Application Recommendations

Do not apply any Stamark tape over any joint or crack that is demonstrating any degree of pumping until rehabilitation efforts have been completed. Proper joint seal, underseal or increased drainage operations must be successfully completed prior to any tape application. If applying transverse markings over a crack, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the crack.
Low Severity Pumping

Medium Severity Pumping

High Severity Pumping
Scaling / Map Cracking / Crazing

Map cracking or crazing refers to a network of shallow, fine or hairline cracks that extend only through the upper surface of the concrete. The cracks tend to intersect at angles of 120 degrees. Map cracking or crazing may lead to surface scaling, which is the progressive disintegration and loss of the concrete slab wearing surface to a depth of approximately ¼ to ½ inch. The type of scaling defined here is not caused by “D” cracking. If scaling is caused by “D” cracking, it should be counted under that distress only.

Severity Levels
Low severity: Crazing or map cracking exists over most of the slab area; the surface is in good condition, with only minor scaling present.
Medium severity: Slab is scaled, but less than 15 percent of the slab area is affected.
High severity: Slab is scaled over more than 15 percent of its area.

Application Recommendations
Application is unacceptable at any severity level. Scaling demonstrates a loss of the concrete slab wear surface to which the tape adheres. The road should not be marked with Stamark tape.
**Name of Distress**

**Spalling, Corner**

**Description**

Corner spalling is the breakdown of the slab within approximately 2 feet of the corner. A corner spall differs from a corner break in that the spall usually angles downward to intersect the joint, while a break extends vertically through the slab corner. Spalls less than 5 inches from the crack to the corner on both sides should not be counted.

**Severity Levels**

<table>
<thead>
<tr>
<th>Depth of Spall</th>
<th>Dimensions of Sides of Spall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 x 5 inches to Over</td>
</tr>
<tr>
<td></td>
<td>12 x 12 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 inch</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>More than 1 to less than 2 inches</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>More than 2 inches</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

*Corner spalls having an area of less than 10 square inches are not counted.*

**Application Recommendations**

Application at any level of severity is acceptable; however, transverse markings should not be applied over the crack or joint, if possible. If applying transverse markings over a crack, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the crack. Application of long line markings over a joint or crack with a high severity of distress should be cut a minimum of 1 inch (2.5 cm) back from each side of the joint or crack.
Low Severity Corner Spalling

See written recommendations.

Medium Severity Corner Spalling

See written recommendations.

High Severity Corner Spalling

See written recommendations.
Spalling, Joint

Joint spalling is the breakdown or disintegration of the slab edges within 2 feet of the joint. A joint spall usually does not extend vertically through the slab, but intersects the joint at an angle. The breaking or chipping of the pavement joints usually results in fragments with feathered edges.

Severity Levels

<table>
<thead>
<tr>
<th>Spall Pieces</th>
<th>Width of Spall</th>
<th>Length of Spall (% of length)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 4 inches</td>
<td>Low</td>
</tr>
<tr>
<td>TIGHT: Cannot be easily removed (maybe a few pieces missing).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greater than 4 inches</td>
<td>Low</td>
</tr>
<tr>
<td>Loose: Can be removed and some pieces missing. If most or all pieces are missing, spall is shallow, less than 1 inch (25mm).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than 4 inches</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Greater than 4 inches</td>
<td>Low</td>
</tr>
<tr>
<td>Missing: Most or all pieces have been removed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than 4 inches</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Greater than 4 inches</td>
<td>Medium</td>
</tr>
</tbody>
</table>

A frayed joint where the concrete has been worn away along the entire joint is rated as low severity.

Application Recommendations

Application at low and medium levels of severity is acceptable; however, transverse markings should not be applied over the crack or joint, if possible. If applying transverse markings over a crack, the marking must be cut a minimum of 1 inch (2.5 cm) back from each side of the crack. Application of long line markings over a joint with a high severity of distress should be cut a minimum of 1 inch (2.5 cm) back from each side of the joint. At high severity levels, the road surface should not be marked with Stamark tape.
Low Severity Joint Spalling

Medium Severity Joint Spalling

High Severity Joint Spalling

See written recommendations.