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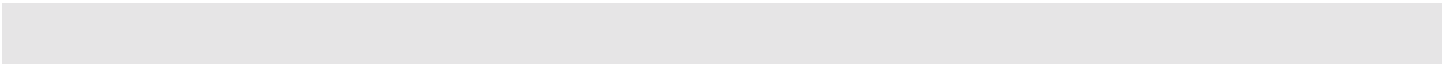


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Pavement Condition Evaluation Manual

*Pavement Evaluations for use with the
DRM™ System.*

DATE 01/10/01



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Pavement Condition Evaluation Manual

*Pavement Evaluations for use with the
DRM™ System.*

Forward

This document is designed as a tool to evaluate pavements, determine a pavement's condition and as a guideline for use of the DRM™ System. The document describes various distresses for rigid, flexible, and composite pavements and sets a standard for establishing severity and extent. For each distress, three levels of severity (Low, Medium, and High) and three levels of extent (Occasional, Frequent, and Extensive) are defined. From this description, a pavement condition rating can be developed. This rating will allow an objective determination of where the DRM™ system can be effectively used. Pavements covered include:

Flexible: Asphalt pavements

Composite: Rigid base (typically concrete) with a flexible surface

Jointed Concrete:

CRCP: Continuously Reinforced Concrete Pavements

This manual identifies various types of pavement distress for the pavement types listed. Provided with each distress overview is a recommended acceptable level of pavement condition that DRM is suitable for. The rating method used is based upon visual inspection of pavement. Although the relationship between pavement distress and performance is not well defined, there is general agreement that the ability of a pavement to sustain traffic loads in a safe and smooth manner is adversely affected by the occurrence of observable distress. The rating method provides a procedure for uniformly identifying and describing, in terms of severity and extent, pavement distress. The mathematical expression for Pavement Condition Rating (PCR) provides an index reflecting the composite effects of varying distress types, severity, and extent on the overall condition of the pavement.

The method used to compute PCR is based upon the summation of deduct points for each type of observable distress. Deduct values are a function of distress type, severity, and extent. Deduction for each distress type is calculated by multiplying distress weight times the weights for severity and extent of the distress. Distress weight is the maximum number of deductible points for each different distress type. The mathematical expression for PCR is as follows:

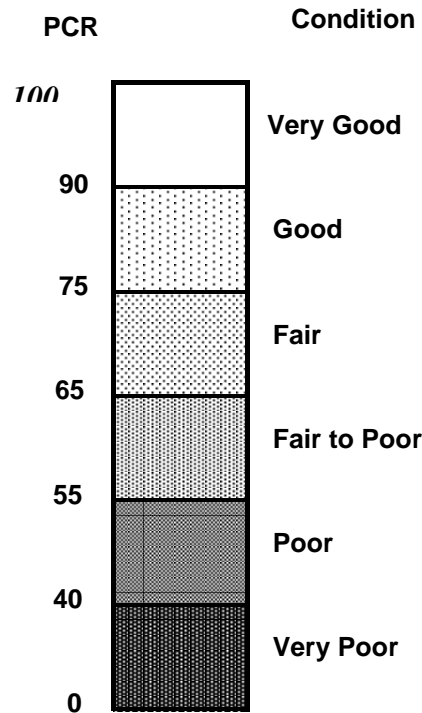
$$PR = 100 - \sum_{I=1}^n \text{Deduct}$$

Where:

n = number of observable distresses, and

Deduct = (Weight for distress) (Weight for severity) (Weight for extent)

A PCR scale has been developed to describe the pavement condition using the PCR numbers calculated from the above equation. The scale has a range from 0 to 100; a PCR of 100 representing a perfect pavement with no observable distress and a PCR of 0 representing a pavement with all distress present at their “High” levels of severity and “Extensive” levels of extent. Use of the DRM™ process as a Surface Treatment would usually begin with a PCR rating of 60 or higher, a range lower than that would typically require DRM™ Interlayer in a minor or major rehabilitation of the pavement.



Before reviewing the types of pavement distress, a note on using this manual.

For each pavement distress a description is provided that gives acceptable conditions for DRM™ Surface Treatment and DRM™ Interlayer. Each distress condition includes a description discussing the best practice and use of the DRM™. While some pavements may only exhibit a single distress, in many cases the pavement will exhibit several distresses. Treatment selection should be based on the summary of all distress types, severity and extent.

Special notes for use of DRM™:

The DRM™ System is used effectively on composite, rigid and flexible pavements with or without surface milling as an Interlayer Membrane. For finished surface treatments, DRM™ System is effective on composite pavements and flexible asphalt surfaces.

Typically, when used as a surface treatment, the ADT (average daily traffic) should be less than 5,000 per lane. Consideration should be given to heavy commercial traffic when using DRM™ as a surface treatment and should not exceed 500 commercial vehicles per day, per lane.

DRM™ as an interlayer membrane has no traffic restrictions when used with Slurry Seal, Micro Surfacing, and Bituminous Overlays as the final surface. Recommended minimum thickness for typical bituminous overlay mixtures is 1 1/4 inch. Where profiling of the pavement is required, insure that the correct overlay method and thickness is used.

SUMMARY OF PCR DEDUCT VALUES

| <u>Distress Type</u> | Distress Weight | Severity | | | Extent | | | Total |
|--|------------------------|-----------------|----------|----------|--------------------------|----------|----------|--------------|
| | | L | M | H | O | F | E | |
| Raveling (Flexible/Composite) | 10 | .3 | .6 | 1 | .5 | .8 | 1 | _____ |
| Bleeding (Flexible/Composite) | 5 | .8 | .8 | 1 | .6 | .9 | 1 | _____ |
| Corrugations (Flexible) | 5 | .4 | .8 | 1 | .5 | .8 | 1 | _____ |
| Rutting (Flexible/Composite) | 10 | .3 | .7 | 1 | .6 | .8 | 1 | _____ |
| Potholes/Debonding (Flex./Comp.) | 10 | .4 | .7 | 1 | .5 | .8 | 1 | _____ |
| Patching (All Pavement Types) | 5 | .3 | .6 | 1 | .6 | .8 | 1 | _____ |
| Settlement (All Pavement Types) | 10 | .5 | .7 | 1 | .5 | .8 | 1 | _____ |
| Crack Seal Deficiency (Flex./Comp.) | 5 | 1 | 1 | 1 | .5 | .8 | 1 | _____ |
| Wheel Track Cracking (Flexible) | 15 | .4 | .7 | 1 | .5 | .7 | 1 | _____ |
| Longitudinal Joint Cracking (Flex.) | 5 | .4 | .7 | 1 | .5 | .7 | 1 | _____ |
| Longitud. Cracking (Comp./JC/CRC) | 5 | .2 | .6 | 1 | .4 | .8 | 1 | _____ |
| Edge Cracking (Flexible) | 5 | .4 | .7 | 1 | .5 | .7 | 1 | _____ |
| Random Cracking (Flexible) | 5 | .4 | .7 | 1 | .5 | .7 | 1 | _____ |
| Block & Transverse Cracking (Flex.) | 10 | .4 | .7 | 1 | .5 | .7 | 1 | _____ |
| Transverse Crack (Comp./JC/CRC) | 15 | .4 | .7 | 1 | .5 | .8 | 1 | _____ |
| Pumping (Comp./JC/CRC) | 15 | .7 | .7 | 1 | .3 | .7 | 1 | _____ |
| Faulting (Jointed Concrete) | 10 | .4 | .7 | 1 | .5 | .8 | 1 | _____ |
| Surface Deterioration (JC/CRC) | 10 | .4 | .7 | 1 | .6 | .8 | 1 | _____ |
| | | | | | Total Deduct | | | _____ |
| | | | | | 100 - Total Deduct = PCR | | | _____ |

Flex Flexible Pavement
 Comp Composite Pavement
 JC Jointed Reinforced Concrete or Jointed Concrete Pavement
 CRC Continuously Reinforced Concrete Pavement

SUMMARY OF PAVEMENT DISTRESS

| <u>Distress Type</u> | <u>Surface Treatment</u> | <u>Interlayer Membrane</u> |
|--|--------------------------|----------------------------|
| Raveling (Flexible/Composite) | L:O,F,E M:O,F,E | L:O,F,E M:O,F,E H:O |
| Bleeding (Flexible/Composite) | M:O,F,E H:O,F | M:O,F,E H:O |
| Corrugations (Flexible) | L:O,F | L:O,F M:O |
| Rutting (Flexible/Composite) | L:O,F,E M:O | L:O,F,E M:O |
| Potholes/Debonding (Flex./Comp.) | ALL | L:O,F,E M:O,F,E H:O |
| Patching (All Pavement Types) | ALL | ALL |
| Settlement (All Pavement Types) | L:O | L:O,F M:O |
| Crack Seal Deficiency (Flex./Comp.) | O,F,E | O,F,E |
| Wheel Track Cracking (Flexible) | L:O,F,E M:O,F | L:O,F,E M:O,F,E H:O |
| Longitudinal Joint Cracking (Flex.) | L:O,F,E M:O,F | L:O,F,E M:O,F,E H:O |
| Longitud. Cracking (Comp./JC/CRC) | NA - L:O,F,E M:O,F | ALL |
| Edge Cracking (Flexible) | ALL | ALL |
| Random Cracking (Flexible) | ALL | ALL |
| Block & Transverse Cracking (Flex.) | L:O,F,E M:O,F,E H:O | ALL |
| Transverse Crack (Comp./JC/CRC) | L:O,F,E M:O,F,E H:O | ALL L&M H:O,F |
| Pumping (Comp./JC/CRC) | L:O | L:O |
| Faulting (Jointed Concrete) | L:O M:O | L:O,F M:O,F |
| Surface Deterioration (JC/CRC) | L:O M:O | All L&M H:O,F |

Flex Flexible Pavement
 Comp Composite Pavement
 JC Jointed Reinforced Concrete or Jointed Concrete Pavement
 CRC Continuously Reinforced Concrete Pavement

L = LOW O = OCCASIONAL
 M = MEDIUM F = FREQUENT
 H = HIGH E = EXTENSIVE

Types of Pavement Distress

Raveling (Flexible/Composite Pavements)

Raveling is disintegration of the pavement from the surface downward due to the loss of aggregate particles. Raveling may occur as a result of asphalt binder aging, poor mixture quality, segregation, or insufficient compaction.



Severity Level:

Low: Very little coarse aggregate has worn away some loss of fine aggregate, coarse aggregate is exposed.

Medium: Surface has an open texture and is moderately rough with considerable loss of fine aggregate and some coarse aggregate removed.

High: Most of the surface aggregate has worn away or become dislodged. Surface is severely rough and pitted and may be completely removed in places.



Extent Level: Occasional: Less than 20% of the surface area is raveling.

Frequent: Between 20% and 50% of the surface area is raveling.

Extensive: More than 50% of the surface area is raveling.

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F,E

DRM™ sealant will fill the raveled voids and allow the emulsion to provide a uniform sealed wearing surface.

INTERLAYER: L:O,F,E M:O,F,E H:O

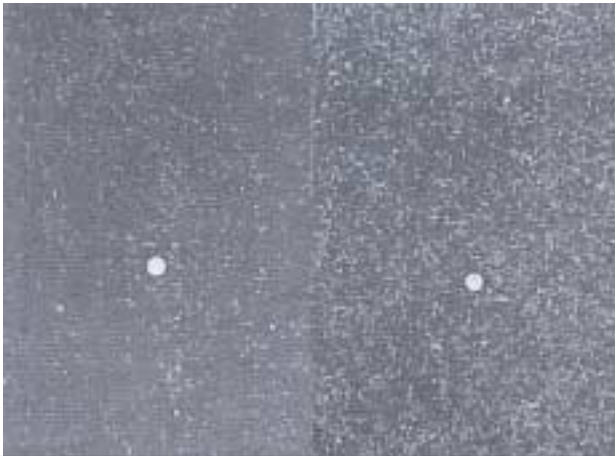
DRM™ sealant will fill the raveled voids and allow the emulsion to provide a uniform flexible membrane. Where High Severity (Frequent and Extensive) conditions exist, surface milling should be performed then the DRM™ Interlayer used prior to a bituminous overlay.

Bleeding (Flexible/Composite Pavements)

Bleeding or flushing is the presence of free asphalt binder on the pavement surface. Bleeding is caused by an excess amount of bituminous binder in the mixture and/or low air void content.

Severity Level: **Medium:** Both coarse aggregate and free bitumen are noticeable at the pavement surface.

High: Surface appears black with very little aggregate noticeable.



Close-up view of Bleeding, High and Medium Severity

High severity on left shows most aggregates covered with asphalt and Medium Severity on right shows less aggregates covered with asphalt.



High Severity Bleeding

Extent:

Occasional: Less than 10% of the length exhibits bleeding.

Frequent: Between 10% and 30% of the length is bleeding.

Extensive: Bleeding occurs in more than 30% of the length.

DRM™ Usage:

SURFACE TREATMENT: M:O,F,E H:O,F

DRM™ sealant usage will be minimized in the areas with bleeding and allow the emulsion to provide a uniform sealed wearing surface. This treatment may slow or reduce future bleeding. A larger aggregate is desirable for this treatment giving greater bridging ability above the bleeding surface.

INTERLAYER: M:O,F,E H:O

DRM™ Interlayer is suitable for use with Medium severity; where bleeding is High and Extensive, use of the DRM™ may only add more asphalt to an already rich asphalt environment. The use of DRM™ Interlayer prior to an overlay on this condition may not provide a cost benefit. Note: Where bleeding is isolated to wheel tracks only the Interlayer will provide a uniform consistent surface to place the overlay. This treatment may slow or reduce future bleeding. A larger aggregate is desirable for this treatment giving greater bridging ability above the bleeding surface.

Corrugations (Flexible Pavements)

Corrugations are a series of transverse ridges and valleys (or ripples) occurring at regular intervals along the pavement. Unstable bituminous mixture or poor base quality are associated with this distress.



Severity Level:

- Low:** Noticeable effect on ride, but no significant reduction in comfort.
- Medium:** Moderate ride discomfort is noticeable, driver able to maintain vehicle control easily.
- High:** Vehicle vibration is severe, speed reduction is necessary for comfort and to maintain vehicle control.

Extent:

- Occasional:** Less than 10% of the section length is affected by this distress.
- Frequent:** Between 10% and 30% of the section length is affected by this distress.
- Extensive:** Greater than 30% of the section length is affected by this distress.

DRM™ Usage:

SURFACE TREATMENT: L:O,F

Use of DRM™ on this condition should be limited based on poor ride quality and the poor stability of the underlying mixture.

INTERLAYER: L:O,F M:O

Use of DRM™ on this condition should be limited based on poor ride quality and the poor stability of the underlying mixture. Where Medium and High Severity (Frequent and Extensive) conditions exist, surface milling should be performed to remove the unstable mixture then the DRM™ Interlayer used prior to a bituminous overlay.

Rutting (Flexible/Composite Pavements)

Ruts are vertical deformations in the pavement surface along the wheel tracks. In severe cases pavement uplift may occur along the sides of the rut, but in most instances only a depression is noticeable. Rutting is caused by consolidation or lateral movement of any or all pavement layers, including subgrade, under traffic.



Severity Level: Rutting severity is based upon rut depth, as approximated visually.

Low: Barely noticeable, depth less than 6 mm (1/4 inch).

Medium: Readily noticeable, depth more than 6 mm (1/4 inch), less than 25 mm (1 inch).

High: Definite effect upon vehicle control, depth greater than 25 mm (1 inch).



Extent: **Occasional:** Less than 20% of the section length is rutted.

Frequent: Between 20% & 50% of the section length is rutted.

Extensive: More than 50% of the section length is rutted.

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O

Use of DRM™ on the more severely rutted conditions should be limited based on poor pavement profile and the poor stability of the underlying mixture.

Note: Medium rutted areas may be corrected by rut filling with Micro Surfacing or bituminous leveling prior to the DRM™ surface treatment.

INTERLAYER: L:O,F,E M:O

Use of DRM™ on this condition should be limited based on poor pavement profile and the poor stability of the underlying mixture. Where Medium and High Severity (Frequent and Extensive) conditions exist, surface milling should be performed to remove the rutted unstable mixture then the DRM™ Interlayer may be used prior to a bituminous overlay.

Note: Where the rutting is caused by a weak structure and wheel track cracking exists, the Interlayer will keep water from penetrating the pavement surface and entering the base improving the structural capacity of the pavement.

Potholes/Debonding

(Flexible /Composite Pavements)

Potholes are bowl-shaped voids or depressions in the pavement surface. Potholes are localized failure areas which are usually caused by weak base or subgrade layers.



Medium Severity Pothole

Loss of surface by de-bonding is the removal of the asphaltic surface layer from the underlying layer. The problem is most common with thin asphalt surface layers [less than 50 mm (2 inches)] and is caused by freeze-thaw action or poor bonding of the two layers during construction.



Composite Pavement De-bonding Medium



Medium Severity

Severity Level: Use the following table to determine the severity levels:

| Depth of De-bonded Area | De-bonded Area <0.8 m ² (1 sq. yd.) | De-bonded Area >0.8 m ² (1 sq. yd.) |
|-------------------------|--|--|
| < 25 mm (1") | Low | Medium |
| > 25 mm (1") | Medium | High |

Regardless of depth, potholes less than 150 mm (6 inches) in diameter shall be considered to be of low severity.

Extent:

- Occasional: < 5 potholes /1.6 km (per mile)
- Frequent: 5 – 10 potholes/1.6 km (per mile)
- Extensive: > 10 potholes/1.6 km (per mile)

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F,E H:O,F,E

DRM™ surface treatment will effectively fill all cracks and ravels and provide a uniform sealed wearing surface. ALL POTHoles REQUIRE REPAIR PRIOR TO DRM

INTERLAYER: L:O,F,E M:O,F,E H:O

DRM™ Interlayer will effectively fill all cracks, ravels and shallow voids and provide a uniform flexible membrane. All potholes greater than ½ inch depth shall be filled prior to DRM. Where High Severity (Frequent and Extensive) conditions exist or severe be-bonding is occurring, surface milling should be performed to remove the potholes then the DRM™ Interlayer used prior to a bituminous overlay.

Patching (All Pavement Types)



Flexible Pavement High Severity Patching



Flexible Pavement High Severity Patching

Patching is either the placing of asphalt concrete (or other additional material) on the surface of the existing pavement or the replacement of the existing pavement in small isolated areas.

Deductions shall be made for all patches present in the pavement which are the result of deterioration and/or maintenance since the last construction project. For concrete pavements (JRC/JC or CRCP) deductions shall also be made for patches made with asphalt concrete material.

On flexible and composite pavements, large patches [greater than 12.5 m² (15 sq. yd.)] such as spot overlays or wedge courses, shall be rated for condition as part of the existing pavement rather than as patches.



Composite Pavement Medium Severity



Jointed Concrete Pavement Low Severity

For concrete pavements (CRC/JC or CRCP), no deductions shall be made for existing patches which consist of sound concrete. Where deterioration exists with a concrete repair, the deterioration shall be rated as part of the pavement. Also, where multiple patches are found along a transverse joint or crack which do not interconnect they shall be added together to represent the size of one patch. Multiple patches found along a longitudinal joint or crack which do not interconnect, but are within the same slab, shall be added together to represent the size one patch.

Severity Level:

- Low:** Patch size <0.1 m² (1 sq. ft.).
- Medium:** Patch size <0.8 m² (1 sq. yd.).
- High:** Patch size >0.8 m² (1 sq. yd.).

Extent:

- Occasional:** < 10 patches/1.6 km (per mile)
- Frequent:** 10 – 20 patches/1.6 km (per mile)
- Extensive:** > 20 patches/1.6 km (per mile)



Jointed Concrete Pavement High Severity



CRC Pavement Low Severity



CRC Pavement High Severity

DRM™ Usage: DRM™ is suitable for use as an interlayer or surface treatment with all levels of patching, as long as the patches have been repaired or do not exhibit a severity level that will prevent effective use of the process. Review the patched areas for other distress levels discussed in this manual.

Settlement (All Pavement Types)

Settlement is a dip or depression in the longitudinal profile of the pavement surface. Settlement shall be considered a distress when it causes a noticeable effect upon riding quality. Settlement should not be confused with corrugation, which is another type of surface profile deficiency specific to flexible pavements.

Flexible Pavement Low Severity



Composite Pavement Medium Severity



Jointed Concrete, Medium Severity



In CRC pavements, where short transverse crack spacing is prevalent, short waves or undulation may develop as a result of poor support conditions, frost heave, or permanent deformation of the subgrade.

Severity Level: Severity is based upon the effect of the settlement on vehicle control when traveling along the roadway at 60 km/hour (40 MPH).

Low: Noticeable effect upon ride, driver able to maintain vehicle control easily.

Medium: Some discomfort to passengers, driver able to maintain control with slight corrective action.

High: Definite effect upon ride quality. Noticeable profile dips in settlement areas greater than 150 mm (6 inches). Poor ride corrective action needed.

Extent:

| | |
|--------------------|---|
| Occasional: | Less than 2 settlements/1.6 km (per mile) of roadway. |
| Frequent: | 2 to 4 settlements/1.6 km (per mile) of roadway. |
| Extensive: | More than 4 settlements/1.6 km (per mile) of roadway. |

DRM™ Usage: L:O,F M:O

DRM™ is suitable for use based on ride quality on low/occasional conditions. For usage beyond low/occasional, the pavement will require some type of repair (reconstruction, leveling, etc.) to eliminate the settlement.

Crack Sealing Deficiency (Flexible/Composite Pavements)

Crack Sealing deficiency is crack sealing which is no longer effective in preventing intrusion of water or cracks which have never been sealed.

Severity Level: Severity levels are not considered.

Extent: Occasional: Less than 20% of the cracks along the pavement section are not effectively sealed.

Frequent: Between 20% and 50% of the cracks along the pavement section are not effectively sealed.

Extensive: More than 50% of the cracks along the pavement section are not effectively sealed.



DRM™ Usage:

SURFACE TREATMENT: O, F, E

DRM™ surface treatment will effectively fill all cracks and provide a uniform sealed wearing surface. CRACKS WIDER THAN 2 INCHS REQUIRE REPAIR PRIOR TO DRM

INTERLAYER: O, F, E

DRM™ Interlayer will effectively fill all cracks and provide a uniform flexible membrane.

Wheel Track Cracking (Flexible Pavement)

Cracks located within or near the wheel tracks. For evaluation purposes each wheel track shall be considered 1 m (3 feet) in width. Wheel track cracking usually starts as intermittent, single longitudinal cracks progressing to multiple longitudinal cracking, and eventually interconnected or alligator cracking. Wheel track cracking usually results from fatigue failure of the asphaltic layer.

Severity Level: Severity is based upon both crack width and multiplicity of the cracking. Both criteria must be satisfied when assigning the severity level.

Low: Single or intermittent multiple cracking with average crack width less than 6 mm (1/4 inch).

Medium: Single or multiple cracking (may also include regions of intermittent alligator cracking) with average crack width greater than 6 mm (1/4 inch) with little spalling or loose pieces.

High: Multiple cracking with extensive alligator cracking. Raveling is fairly common with average crack width greater than 6 mm (1/4 inch), and some alligator blocks are easily removed.

Extent: Extent is based upon percentage of the wheel track length within the section which exhibits cracking.

Occasional: Less than 20%. **Frequent:** Between 20% and 50%. **Extensive:** More than 50%.



DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F

DRM™ sealant will effectively fill the cracks and raveled areas and allow the emulsion to provide a uniform sealed wearing surface.

INTERLAYER: L:O,F,E M:O,F,E H:O

DRM™ sealant will fill the raveled voids and allow the emulsion to provide a uniform flexible membrane. Where High Severity (Frequent and Extensive) conditions exist, surface milling should be performed then the DRM™ Interlayer used prior to a bituminous overlay.

Longitudinal Joint Cracking (Flexible Pavements)

Deterioration or cracking of the longitudinal joints formed by separate passes of an asphalt paver, including shoulders and widening. Poor compaction along the longitudinal joint often results in the disintegration of material along the joint and may be accompanied by single or multiple cracking.

| | | |
|------------------------|----------------|---|
| Severity Level: | Low: | Deterioration <25 mm (1 inch) wide at the surface, or single crack < 6 mm (1/4 inch) and no raveling. |
| | Medium: | Deterioration 25 mm – 50 mm (1 inch – 2 inch) wide at the Surface and may extend down to the intermediate course, or single or multiple cracking 6 mm – 25 mm (1/4 inch - 1 inch) with some raveling. |
| | High: | Deterioration > 50 mm (2 inches) wide at the surface and likely extending down to the intermediate course or lower, or multiple cracking > 25 mm (1 inch) wide with much raveling. |



Extent: Based on the average linear feet of longitudinal cracking per 30 m (per station of 100 feet length).

Occasional: Less than 15 m/30 m (50 feet per station).

Frequent: Between 15 and 45 m/30 m (50 and 150 feet per station).

Extensive: More than 45 m/30 m (150 feet per station). Complete Longitudinal joint cracking along the pavement centerline and edge [60 linear m/30 m (200 linear feet per station)] is termed extensive.

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F

DRM™ sealant will effectively fill the longitudinal joint and raveled areas and allow the emulsion to provide a uniform sealed wearing surface.

INTERLAYER: L:O,F,E M:O,F,E H:O

DRM™ sealant will fill the longitudinal joint and raveled voids and allow the emulsion to provide a uniform flexible membrane. Where High Severity (Frequent and Extensive) conditions exist, the joint should be repaired or surface milling should be performed, then the DRM™ Interlayer used prior to a bituminous overlay.

Longitudinal Cracking (Composite/Jointed Concrete/CRC Pavements)

A crack or break approximately parallel to the pavement centerline. This type of cracking is usually associated with subgrade settlement or insufficient bearing support.

In a composite pavement, longitudinal joints and pavement edges of the underlying rigid base usually reflect through the asphalt surface as a result of thermal movement in the underlying slab. Poor paving lane joint construction can also result in a longitudinal crack (see longitudinal cracking for flexible pavements for description and images).

Severity Level: **Low:** Crack width less than 6 mm (1/4 inch) with no spalling or distortion along crack edges.

Medium: Crack opened or spalled to a width between 6 mm and 25 mm (1/4 and 1 inch) over at least one half its length.

High: Crack opened or spalled to a width greater than 25 mm (1 inch) over at least one half its length.

Extent (Composite): Based upon the average linear feet of longitudinal cracking per 30 m (per station of 100 feet length).

Occasional: Less than 15 m/30 m (50 feet per station).

Frequent: Between 15 and 45 m/30 m (50 and 150 feet per station).

Extensive: More than 45 m/30 m (150 feet per station). Complete Longitudinal joint cracking along the pavement centerline and edge [60 linear m/30 m (200 linear feet per station)] is termed extensive.

Extent (Jointed/CRC): Extent is based upon percentage of slabs or sections which exhibit longitudinal cracking.

Occasional: Less than 5% of the slabs or section length have longitudinal cracking.

Frequent: Between 5% and 20% of the slabs or section length has longitudinal cracking.

Extensive: More than 20% of the slabs or section length have longitudinal cracking.

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F

DRM™ surface treatment is not typically recommended for concrete pavement surfaces.

INTERLAYER: L:O,F,E M:O,F,E H:O,F,E

DRM™ sealant will fill the longitudinal joint and spalled areas and allow the emulsion to provide a uniform flexible membrane. Longitudinal joints wider than 2 inches should be repaired, then the DRM™ Interlayer used prior to a bituminous overlay.

Edge Cracking (Flexible Pavement)

Edge cracks are longitudinal or crescent shaped cracks usually within 0.3 m (1 foot) of the pavement edge line.

| | | |
|------------------------|----------------|--|
| Severity Level: | Low: | Tight cracks, width less than 6 mm (1/4 inch) with no break up or raveling. |
| | Medium: | Crack width greater than 6 mm (1/4 inch) with some raveling. |
| | High: | Multiple cracking with moderate raveling and average crack width greater than 6 mm (1/4 inch). |



| | | |
|----------------|--------------------|--|
| Extent: | Occasional: | Cracking occurs along less than 20% of the pavement edge within the section. |
| | Frequent: | Cracking occurs along 20% to 50% of the pavement edge within the section. |
| | Extensive: | Cracking occurs along more than 50% of the pavement edge within the section. |

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F,E H:O,F,E

DRM™ sealant will effectively fill the cracks and raveled areas and allow the emulsion to provide a uniform sealed wearing surface.

INTERLAYER: L:O,F,E M:O,F,E H:O,F,E

DRM™ sealant will fill the cracks and raveled areas and allow the emulsion to provide a uniform flexible membrane.

High severity levels typically indicate a weak structure, repairs may be warranted prior to use of the DRM™ process.

Random Cracking (Flexible Pavement)

Random cracks are those cracks which are not categorized as wheel track, block, transverse, longitudinal joint, or edge.



- Severity Level:**
- Low:** Tight cracks, width less than 6 mm (1/4 inch) with no break up or raveling.
 - Medium:** Crack width greater than 6 mm (1/4 inch) with some raveling.
 - High:** Multiple cracking with moderate raveling and average crack width greater than 6 mm (1/4 inch).
- Extent:**
- Occasional:** Cracking occurs in less than 20% of the pavement section.
 - Frequent:** Cracking occurs in 20% to 50% of the pavement section.
 - Extensive:** Cracking occurs in more than 50% of the pavement section.

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F,E H:O,F,E

DRM™ sealant will effectively fill the cracks and raveled areas and allow the emulsion to provide a uniform sealed wearing surface.

INTERLAYER: L:O,F,E M:O,F,E H:O,F,E

DRM™ sealant will fill the cracks and raveled areas and allow the emulsion to provide a uniform flexible membrane.

High severity levels may indicate a problem with the surface mixture or structure and may require removal prior to use of the DRM™ Interlayer.

Block and Transverse Cracking (Flexible Pavement)

Block cracks are interconnected cracks which divide the pavement into large rectangular pieces or blocks. Block size may range from 1 m by 1 m (3 ft. by 3 ft.) upwards to 3 m by 3 m (10 ft. by 10 ft.).

Transverse cracking is cracks at approximately right angles to the pavement centerline. The occurrence of both block and or transverse cracking is usually related to thermal shrinkage of the asphalt binder. Binder age hardening is also related to formation of these crack types.



Severity Level:

- Low:** Average crack width less than 6 mm (1/4 inch) with no raveling or distortion along crack edges.
- Medium:** Average crack opened or raveled to a width between 6 mm to 25 mm (1/4 to 1 inch) along at least half its length.
- High:** Average crack opened or raveled to a width greater than 25 mm (1 inch) along at least half its length.

- Extent:** Occasional: Less than 20% of the section length is affected by this distress.
Frequent: Between 20% and 50% of this section length is affected by this distress.
Extensive: More than 50% of this section length is affected by this distress.

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F,E H:O

DRM™ sealant will effectively fill the cracks and raveled areas and allow the emulsion to provide a uniform sealed wearing surface.

INTERLAYER: L:O,F,E M:O,F,E H:O,F,E

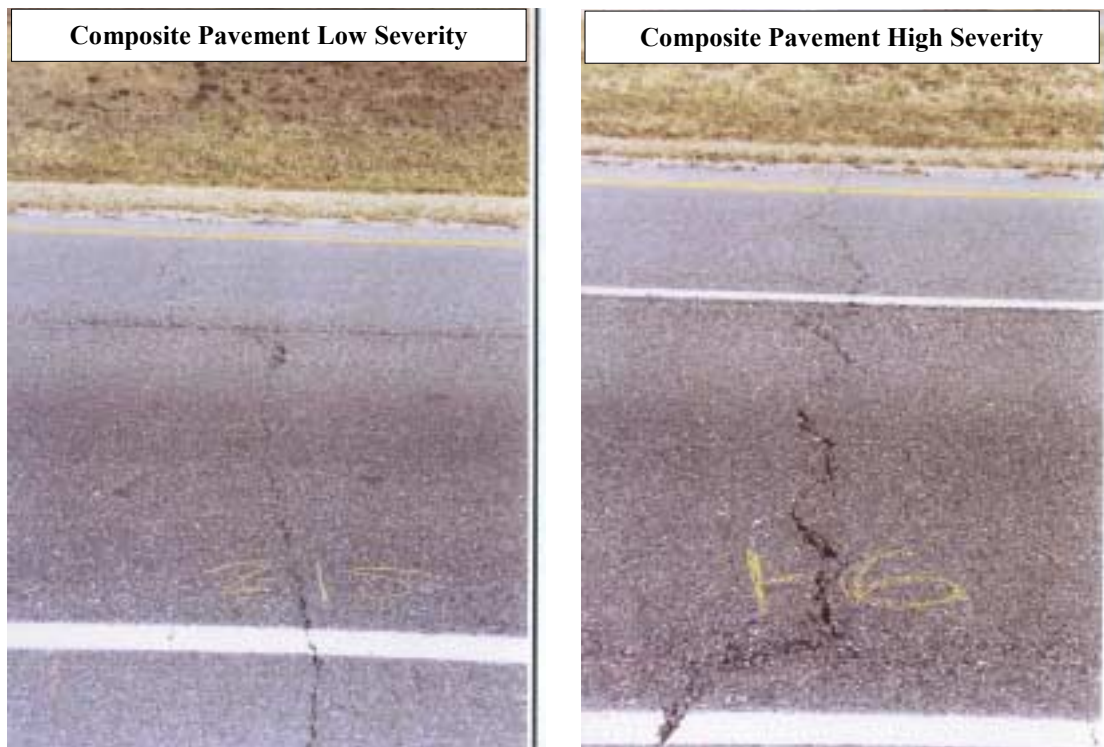
DRM™ sealant will fill the cracks and raveled areas and allow the emulsion to provide a uniform flexible membrane.

High severity levels may indicate a problem with the surface mixture or structure and may require removal prior to use of the DRM™ Interlayer.

Transverse Cracking (Composite/Jointed Concrete/CRC Pavements)

A crack or break at approximately right angles to the pavement centerline. This section includes descriptions of composite pavements as well as Jointed Concrete/CRC pavements that may be the underlying layer in a composite pavement or the surface layer of a pavement.

| | | |
|------------------------|----------------|--|
| Severity Level: | Low: | Average crack width less than 6 mm (1/4 inch) with no raveling or distortion along crack edges. |
| | Medium: | Average crack opened or raveled to a width between 6 mm to 25 mm (1/4 to 1 inch) along at least half its length. |
| | High: | Average crack opened or raveled to a width greater than 25 mm (1 inch) along at least half its length. |



Composite: Where the rigid base layer does not have transverse joints, all transverse cracking is evaluated regardless of location. For jointed bases, a separate evaluation is made of reflective cracks at 1) the joints; and 2) other (non-joint) transverse cracking. Usually all underlying base cracks and joints are eventually reflected through the flexible surface. Additional transverse surface cracking may result from thermal shrinkage and age hardening of the asphaltic layer.

Extent: For Composite pavements or jointed concrete pavements.

The extent level is based upon average crack spacing (CS) as given by the following formula:

$$CS = L/(Z+1)$$

Where:

CS = Average crack spacing in m (ft).

Z = Average number of transverse cracks per panel

L = Transverse joint spacing in m (ft)

Occasional: Average transverse crack spacing greater than 4.5m (15 ft)

Frequent: Average spacing 3 to 4.5 m (10 to 15 ft).

Extensive: Average crack spacing less than 3 m (10 ft)



Jointed Concrete: Some transverse cracks (hairline shrinkage cracks) are expected in reinforced concrete pavements that have large transverse joint spacing. Repeated heavy traffic loading, thermal and moisture gradients and subgrade settlement or consolidation could cause additional transverse cracking. Deterioration of the sealant in a joint is also considered to be a transverse crack in this analysis.

Extent: For composite pavements with joint reflection cracks or CRC pavements.

Occasional: Less than 20%.

Frequent: Between 20% and 50%.

Extensive: More than 50%.



CRC: Transverse cracking in CRC pavements is normal. The cracking is detrimental if the spacing is less than or greater than optimum spacing of about 1.5 m to 2.4 m (5 to 8 ft.).

DRM™ Usage:

SURFACE TREATMENT: L:O,F,E M:O,F,E H:O

DRM™ surface treatment is typically not recommended for concrete pavement surfaces.

INTERLAYER: L:O,F,E M:O,F,E H:O,F

DRM™ sealant will fill the cracks and raveled areas and allow the emulsion to provide a uniform flexible membrane. Heavier interlayer, $\frac{3}{4}$ - $\frac{7}{8}$ inch thickness is recommended for slowing the reflection of working joints in rigid pavements.

High severity levels may indicate a problem with the structure and may require repair prior to use of the DRM™ Interlayer.

Pumping (Composite/Jointed Concrete/CRC Pavements)

Pumping is the ejection of fine soil particles through pavement cracks, joints, or along pavement edges. Pumping can be identified by the presence of surface staining and base or subgrade material near joints or cracks. Shoulder disintegration at the pavement edge is often an indicator of pumping beneath the slab.

Composite Pavement Medium Severity



Composite Pavement High Severity



Jointed & CRC Pavement Low Severity



Jointed & CRC Pavement High Severity



Severity Level:

Low: Some staining of the surface around cracks or joints is noted.

Medium: Same as Low.

High: Clear evidence that pumping exists. Excessive staining, medium severity or greater, faulting, corner breaks or punchouts.

Extent: Occasional: Less than 10 of the joints and cracks exhibit pumping.

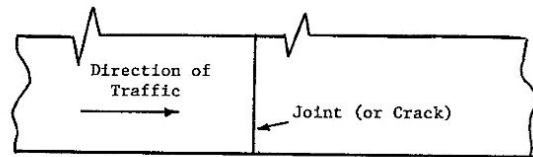
Frequent: 10% to 25% of the joints and cracks exhibit pumping.

Extensive: More than 25% of the joints and cracks exhibit pumping.

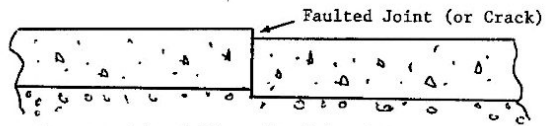
DRM™ Usage: As a surface treatment and interlayer, the DRM™ process is suitable for use on low severity levels, and occasional levels of pumping. Other severity & extent levels of pumping would require repair of the pavement substructure prior to use of the DRM™ process.

Faulting (Jointed Concrete Pavements)

Faulting is the difference in elevation between abutting slabs at transverse joints or cracks. Faulting is usually caused by a pumping action of underlying fine grained materials, settlement of soft subgrade, or from curling or warping of slabs due to temperature and moisture gradients.



PLAN View of a Jointed Concrete Pavement



Cross-sectional View of a Jointed Conc. Pav.

Severity Level: Low: Less than 6 mm (1/4 inch) fault).

Medium: 6 mm to 13 mm (1/4 to 1/2 inch) fault.

High: Greater than 13 mm (1/2 inch) fault.

Extent: Occasional: Faulting occurs along less than 20% of the joints and cracks.

Frequent: Faulting occurs along 20% to 50% of the joints and cracks.

Extensive: More than 50% of the joints and cracks are faulted.

DRM™ Usage:

SURFACE TREATMENT: L:O M:O

DRM™ surface treatment is typically not recommended for concrete pavement surfaces.

INTERLAYER: L:O,F M:O,F

DRM™ sealant will fill the joints and cracks and allow the emulsion to provide a uniform flexible membrane. Heavier interlayer, 3/4 - 7/8 inch thickness is recommended for slowing the reflection of working joints in rigid pavements.



High severity and extent levels indicate a problem with the structure and will require repair prior to use of the DRM™ Interlayer. The use of an interlayer on faulting pavements will have limited affect on slowing the reflection of those joints or cracks. Joints with vertical movement should be stabilized prior to an interlayer and overlay.

Surface Deterioration (Jointed Concrete/ CRC Pavements)

Disintegration or loss of concrete from the surface of the pavement. Includes scaling and abrasion. Scaling is the flaking away of the concrete surface. Abrasion is usually a result of weathering and traffic wear and is normally confined to the wheel track area.



Severity Level:

- Low: Aggregate visible
Medium: Surface has an open texture and is moderately rough with considerable loss of fine aggregate and some coarse aggregate removed.
High: Surface rough or pitted

Extent:

- Occasional: Less than 20 percent of the surface area
Frequent: 20 to 50 percent of the surface area
Extensive: More than 50 percent of the surface area. This level includes continuous distress in both wheel tracks.

DRM™ Usage:

SURFACE TREATMENT: L:O M:O

DRM™ surface treatment is typically not recommended for concrete pavement surfaces.

INTERLAYER: L:O,F,E M:O,F,E H:O,F

DRM™ sealant will fill the joints, voids and cracks and allow the emulsion to provide a uniform flexible membrane. Heavier interlayer, 3/4 - 7/8 inch thickness is recommended for slowing the reflection of working joints in rigid pavements.