

Pavement Management Toolbox:

(In order of invasiveness)

1. **Crack Sealing** - Crack sealing is the placement of a sealant material into cracks of an existing pavement surface to prevent excess water and moisture from penetrating the asphalt. This is a preventative measure to keep the road from deteriorating further. Crack Sealing can be done as a standalone treatment or in conjunction with other treatments listed below.

Determining Factors: Crack sealing is done when moderate cracking is beginning to show on the roadways' surface. Crack sealing can be used for cracks wider than $\frac{1}{8}$ of an inch, including block, edge, longitudinal, reflective, thermal or transverse cracking. Pavement experiencing alligator cracking may not be a candidate for crack sealing, as the alligator cracks indicate failures requiring repair beyond crack sealing. Potholes and cracks wider than $1\frac{1}{2}$ inches also should not be crack sealed. If the pavement is a candidate for crack sealing, that treatment should be performed in the spring or fall when cracks are neither completely open (as they are in winter) nor closed (as they are in summer). Most manufacturers recommend a minimum pavement temperature of 40 degrees Fahrenheit.

2. **Fog Seal** - A fog seal is a thin liquid layer applied to the surface of a paved road in relatively good condition. The intent of this treatment is to seal the pavement, rejuvenate, restore the wearing surface and provide resistance to deterioration due to the weather and sun. Subsequent to a Fog Seal the cracks are sealed with a liquid asphalt sealer. This treatment will extend the life of the pavement. This is classified as preventive maintenance.

Determining Factors: As asphalt pavement is subjected to traffic loads and ages; it oxidizes and cracks develop in the surface due in part to the pavement becoming more brittle. Oxidation is one of the reasons asphalt concrete pavement fades in color from the deep, rich black color everyone remembers from when the road was constructed or last resurfaced. Fog seal applications serve to seal narrow cracks, slightly restore lost flexibility to the pavement surface, provide a deep, rich black pavement surface color, and most importantly help preserve the underlying pavement structure. On existing asphalt pavement, fog seals are typically applied on either an intermittent or cyclical basis. Location, weather, traffic loading, and pavement conditions are factors used to determine if a fog seal application is appropriate. Roadways selected for fog seal treatment are commonly those which have minor cracking, faded color, and where a fog seal would help extend the pavement life until resurfacing becomes necessary. Roadways chosen for cyclical fog seal applications would typically be treated every three to five years.

3. **Chip Seal** – Chip sealing is a two-step process which includes first an application of asphalt emulsion and then a layer of crushed rock to an existing asphalt pavement surface. A chip seal gets its name from the “chips” or small crushed rock placed on the surface. Asphalt emulsions used in chip seal applications contain globules of paving asphalt, water, an “emulsifying agent” or surfactant, polymer, and sometimes a “rejuvenator.” Soap is a common form of a surfactant. In washing clothes or dishes, the surfactant helps remove the dirt and suspend the dirt particles in the wash water. Similarly, in asphalt emulsions, the surfactant keeps the paving asphalt globules in suspension until it is applied to the pavement surface when the water in the asphalt emulsion starts to evaporate. The chips (small crushed rocks) are immediately applied after the asphalt emulsion is applied to the pavement surface. The polymer in the asphalt emulsion is a “hardener” which serves to improve the adhesion to the crushed rock and to the

pavement surface. A “rejuvenator” is an asphalt or additive which when applied to the existing pavement will slightly soften the pavement it is applied to creating a better bond.

Determining Factors: Chip seals are placed under one of three scenarios, as a “wearing course” meaning vehicles drive directly upon it; as part of a “cape seal” meaning a chip seal is first placed, then covered by slurry seal or microsurfacing; or as an “interlayer” meaning a layer between underlying asphalt pavement and a new asphalt or rubberized asphalt surface.

As asphalt pavement is subjected to traffic loads and as it ages, it oxidizes, becomes more brittle and cracking develops in the pavement structure. A chip seal serves to seal the narrow cracks, help bind together cracked pavement, provide a wearing (driving) surface, and protect the underlying pavement structure. Chip seals used as interlayers serve to retard reflective cracking which develops from the bottom of the pavement structure towards the top. Chip seals are typically applied on an intermittent or one-time basis. Location, weather, traffic loading, and pavement conditions are factors used to determine if a chip seal application is appropriate. Roadways selected for chip seal treatments are commonly those which have moderate block (or “alligator”) cracking which is not spalling (or “popping out”), no rutting, an acceptable ride quality, and in which a chip seal would help extend the pavement life until resurfacing or rehabilitation can be performed. Roadways chosen for cyclical chip seal applications would typically be treated every seven to ten years.

4. **Microsurfacing** - A Microsurface is a thin layer (3/8”) preventative maintenance treatment applied to an existing paved surface in either one or two layers. This treatment adds a tough wearing coat that will seal and protect the existing pavement and give it a new friction course. Crack sealing is applied to the pavement prior to Microsurfacing. For the work some of the cast iron structures in the street will be adjusted to final grade prior to application if deemed necessary. Minor pothole patching and other pavement repairs are done prior to installation of this treatment. This treatment is done in two applications. The second application will usually occur the day after the first application.

Determining Factors: surfacing is applied in order to help preserve and protect the underlying pavement structure and provide a new driving surface. Roads chosen for microsurfacing application generally have low to moderate distress and narrow crack width. Microsurfacing is typically applied on an intermittent, project-specific basis. Location, weather, traffic loading, and pavement conditions are factors used to determine if a microsurfacing application is appropriate. Roadways selected for microsurfacing treatment are commonly those which have slight to moderate distress, no rutting, and generally narrow crack widths, and in which a microsurfacing treatment would help extend the pavement life until resurfacing becomes necessary. Roadways chosen for cyclical microsurfacing applications would typically be treated every five to seven years.

5. **Cape Seal** - A complete Cape seal application is done in several steps. After roads are leveled with a thin coat of asphalt (if necessary) a full width coating of rubberized chip seal material is applied. The chip seal has a surface that can be driven on for a short time and it is rougher than standard asphalt. It has some loose chips. About a week after chip seal, the roads will receive a Microsurface coating. The finished micro surfaced road will be very similar to a standard paved surface. The “Cape seal” term describes the complete multi-layer treatment.

Determining Factors: Cape seal serves to seal and bond the cracks in the existing pavement. The slurry seal or microsurfacing serves to improve the chip retention and smoothness of the driving surface. Cape seals are typically applied on an intermittent, project-specific basis. Location,

weather, traffic loading, and pavement conditions are factors used to determine if a cape seal application is appropriate. Roadways selected for cape seal treatments are commonly those which have moderate distress, limited or no rutting, moderate crack widths, and in which a cape seal treatment would help extend the pavement life until rehabilitation or reconstruction can be performed. Typically, cape seals are applied in residential streets where a chip seal would create a rougher surface.

6. **Overlay** - The intent of this treatment is to leave the existing pavement structure intact. All of the cast iron structures (manholes, catch basins water and gas gates) will be reset to meet the new pavement elevation. A bonding agent is sprayed on the pavement and approximately 1.5 to 2 inches of new pavement installed. Minor pothole patching and other pavement repairs are done prior to installation of this treatment. This treatment adds strength to the road surface.

Determining Factors: Asphalt overlay, also known as resurfacing, is a feasible and cost-efficient option for repairing minor surface damages to your pavement such as small cracks, rutting, depressions caused by large vehicles, some water damage, potholes, and so on. The basic concept of the asphalt overlay process involves simply placing a new layer of asphalt aggregate on top of the existing asphalt that's showing signs of disrepair. In some cases, the existing asphalt might require some milling prior to installing the new layer, especially if there's been water damage or water drainage issues that result in standing water. Before applying the new layer of asphalt, you need to ensure that all excess water has been properly removed or drained. Otherwise, you'll have to deal with potentially more significant and costly water damage and internal asphalt erosion in the future at which point complete asphalt removal and replacement might be necessary. Lifespan of 7 to 10 years.

7. **Mill and Overlay** - The existing pavement has 0.5 to 2 inches of the surface ground off. This treatment removes the existing deteriorated wearing surface and leaves the substructure intact. Then the installation of new pavement follows the Overlay description above. It is not uncommon for two layers to be installed after milling of the pavement.

Determining Factors: A road is an ideal candidate for Mill and Overlay typically when the pavement may be exhibiting minor to moderate surface distress (cracking, bleeding, raveling, oxidation). Surface leveling should be completed as needed. Full depth patching may be required in areas of advanced deterioration. Structure adjustments may be considered to damaged structures. Studies by local professional organization, Bay State Roads (UMASS College of Engineering) show that changes in asphalt chemical composition now suggests 7-10 years lifespan.

8. **Cold-In-Place Recycling** - Cold-in-place recycling is a preservation technique for reusing the existing road material to create a new roadway surface. The old road is ground up, mixed with some additives, and immediately placed back down on the road. Additives are based off a specific mix design created in a lab, and typically no new asphalt mix is required for this treatment. After one week a wearing surface will be put on top of the new road, typically a microsurface treatment and it will look very similar to a typical paved surface. All structures (catch basins, manholes, and water and gas gates) will have to be reset for this treatment.

Determining Factors: Cold-In-Place Recycling is useful in treating a wide range of distresses and failures such as: raveling, potholes, bleeding, skid resistance, rutting, corrugation, shoving, fatigue, edge, and block cracking. It can improve the ride quality caused by bumps, swells, sags,

and depressions. CIR can be performed relatively quickly which reduces user delay. Brittleness of aged existing pavement is enhanced, and it can provide improved rutting resistance in the pavement life. Extensive laboratory research has shown that CIR is effective in improving performance of the pavement while also reducing overall cost. CIR is limited to applications where underlying soil structures are adequate. It addresses issues restores old pavements to a like new condition while also being environmentally friendly. Rebuilds road base, can last up to 25 years depending on final surfaces treatments used.

9. **Full-Depth Reclamation** - This treatment is intended for a roadway that has outlived its useful life. It is considered to be the most aggressive resurfacing treatment. The entire pavement structure is completely pulverized to depth of 14" to 20". Most of the pulverized material is reused as a subbase for the asphalt paving. Additional material may be required to be blended in the subbase to meet specifications. After the subbase is installed a minimum of 4" of asphalt is installed in multiple layers.

Determining Factors: The advantages of a full-depth reclamation are considerable compared to remove and replace reconstruction. It provides the benefit of being equal or better in performance while also minimizing the consumption of fuel and natural resources. FDR treats all types of failures to the highest severity. It eliminates ruts, rough areas, and potholes. It also eliminates alligator, transverse, longitudinal, and reflection cracking. In addition, FDR restores the grade contours to allow for better surface drainage. FDR can be performed in place of traditional remove and replace reconstruction. FDR takes cold in-place recycling to the next level by grinding up the old pavement and using it as a stronger foundation for the new roadway. This is beneficial in cases where reconstruction is necessary in order to increase the structural capacity of the roadway due to increased vehicle traffic. Base should last 15-30 years, if constructed properly; the road surface will depend on the surface treatment used.