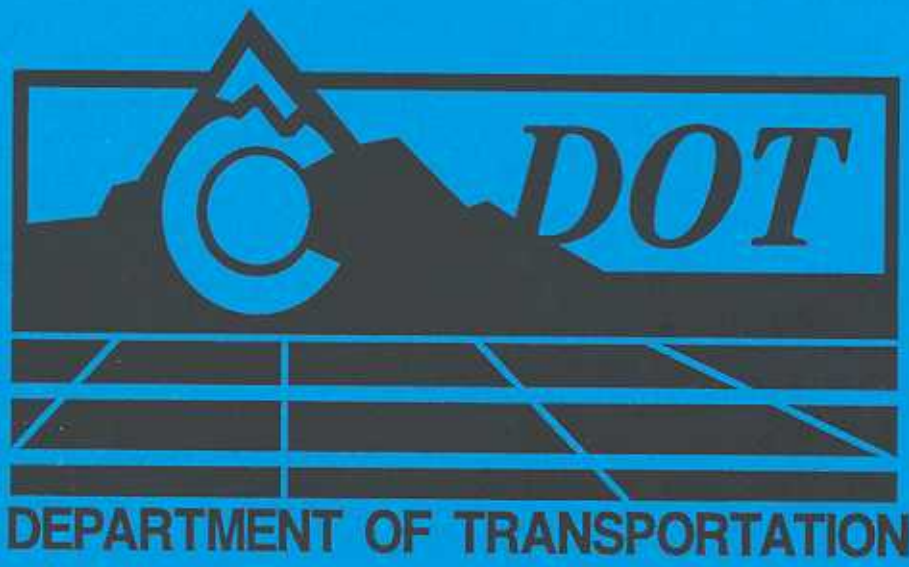
GUIDELINES FOR PAVEMENT SURFACE TREATMENT



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STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION

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DOT

DATE: July 11, 1994

TO: Regional Transportation Directors

FROM: ROBERT L. CLEVENGER

SUBJECT: Guidelines for Pavement Surface Treatment

The attached are Guidelines for Pavement Surface Treatments. These "Guidelines" address crack filling, joint resealing, seal coats, and asphalt overlays. The Guidelines were developed based on "best practice" and are intended to reflect the department's general policy. The Guidelines were written to apply to both construction and maintenance work and will provide statewide uniformity of application; however, using the Guidelines will also require judgement for application. Proper application of surface treatments can improve performance, enhance safety, and extend the service life of pavements.

These "Guidelines" were developed by a task force with representation from within the Department, including maintenance, design, construction, and materials. This task force will continue to meet to provide input on these activities.

I appreciate your cooperation.

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INTRODUCTION

These guidelines address pavement surface treatments which include crack filling, joint resealing, seal coats, and asphalt overlays.

Crack filling for asphalt pavements and **joint resealing** for concrete pavement extend pavement life by reducing the intrusion of water.

A **seal coat** is an application of a thin (usually less than 1 in thick) layer of asphalt, with or without aggregates, to a roadway surface to restore its characteristics, such as skid resistance, ride quality, and waterproofing of the underlying layer.

Thin hot mix **asphalt overlays**, with thicknesses of 1/2 to 1-1/2 inches are also effective and used for similar purposes. Generally, no structural improvement is developed in the pavement through the application of these surface rehabilitation techniques. These should be considered for only those pavements that possess the necessary remaining strength to support the design vehicular loads.

Surface treatment techniques are used for one or more of the following functions:

* Improved pavement **performance** by providing a smooth surface that affects not only the riding comfort but also the road user costs. Smooth surfaces decrease vehicle maintenance costs, fuel costs, and traveling time. Noise is another important functional condition that is affected by the surface quality.

* Enhanced **safety** by providing a skid resistant and/or rut-free surface.

* Extended **service life** by providing a renewed waterproof surface and protection from aging, oxidation, moisture deterioration, and traffic abrasion.

A particular surface treatment technique may not achieve all of the above functions; however, by achieving even a few, a surface technique may significantly extend the service life of the pavement and provide the user more consistent pavement performance. These relatively low cost techniques should be considered for preventive maintenance or surface treatment strategies.

In addition to surface treatments and thin overlays, pavement surface recycling is also considered an increasingly viable surface treatment technique.

CHAPTER 1

CRACK FILLING AND JOINT RESEALING

PURPOSE

These guidelines establish the basis and procedures for both crack filling and joint resealing in conjunction with other surface treatments.

Crack and joint maintenance at the proper time with suitable material and methods will reduce overall maintenance cost and prolong the life of pavements. Crack filling and joint resealing is high priority routine maintenance which is both corrective and preventive. Crack filling and joint resealing can correct the problem of moisture intrusion and help prevent or slow the development of more serious problems thereby extending the life of the pavement.

PRIORITY

Crack filling and joint resealing operations are to be performed as part of a comprehensive maintenance program. This will take time to accomplish and a greater dedication of resources to crack filling and joint resealing until we achieve the goal of making these operations a routine maintenance function throughout the State. Each region will develop an implementation plan as funds are budgeted on a yearly basis for crack filling and joint resealing.

ASPHALT PAVEMENTS

Criteria for Crack Filling

Crack filling on newer pavements should be considered a high priority item and cracks should be filled as soon as possible after detection, preferably in the first fall crack filling period after they initially appear.

Priority for crack filling on older pavements should be based on the condition of the pavement and on the condition of the cracks. The potential for moisture related pavement damage must be evaluated in order to establish both the need and urgency for resealing.

The factors that should be considered in establishing the priority for crack filling on older pavements include:

(1) Climate
(2) General pavement condition
(3) Subgrade type, characteristics (permeable, impermeable)
(4) Type and condition of crack

Chip and slurry seals may be used in conjunction with crack filling; however, cracking may be so severe or of such a nature that crack filling is not appropriate and other repair methods such as blade or full depth patching must be considered.

When

When the air temperature is below freezing, or when excessive moisture is present in the pavement crack filling is difficult to perform correctly and is not considered appropriate. For these reasons crack filling operations should take place in the fall or spring of the year during periods when the pavement is dry and air temperatures are above 35°F. Fall crack filling is preferred over spring because work done in the fall will help keep water out of the pavement during winter snows and especially during spring thaws.

The extent of the crack opening produced by thermal expansion or contraction is an important factor in crack filling. Operations conducted during the appropriate time of year (fall or spring), will provide approximately average openings. Therefore, neither winter or summer is the right time for crack filling. When cracks are poured in the summer, the crack is narrow and it is difficult for the sealant to penetrate down through the crack. Cracks in winter are open their widest resulting in too much sealant being poured.

Crack filling is not totally dependent upon the crack opening and thus crack filling can be done, if necessary, in at any time of the year. The critical factor is moisture.

To minimize the problem of moisture in the crack, a commercial heating unit (heat lance) can be used. Heat lances capable of producing approximately 3,000 °F air with operating velocities of approximately 3,000 fps at the nozzle orifice have produced good results. Direct flame dryers are not to be used. Too many seconds at 2500 °F to 3000 °F on the side wall of a crack (to burn out a weed for example) will oxidize the AC exposed on the side wall; therefore, the heat lance must be continually moved along the crack.

Material

To obtain a good seal, it is important to use a quality product. For cracks 1/4" or less, an ASTM D 1190 or an CDOT approved cold pour sealant should be used. Rubberized high-float emulsion with

a dilution rate in excess of 30% are not to be used. Application should be made under pressure using a 1/8" to 3/16" nozzle. The use of pour pots is discouraged because very little material gets into the crack and a lot is wasted on the surface.

For cracks greater than 1/4" use either an ASTM D 1190, D 3405 or D 5078 rubber asphalt material. Cracks in excess of 1" wide can be filled with 1/2" minus road mix or suitable patching material. Asphalt with crumb rubber has been shown to work satisfactorily on cracks over 1" wide and up to 1-1/2", but caution must be used. With rubber asphalt products it is very important to follow the manufacture's recommended specification for handling and placing the sealants.

Procedure

Before crack filling, a pavement evaluation should be made to determine the type and scope of work. This evaluation is made to determine if crack filling will be cost-effective.

Crack filling can only be effective as long as the sealant prevents the intrusion of water. It cannot be effective when the pavement integrity has failed due to very extensive cracking. The pavement analysis may indicate that a chip seal, slurry seal, or an overlay may be needed with badly deteriorated areas being appropriately patched. Even with chip seals or slurry seals crack filling of cracks 3/8" and greater prior to surface sealing operations will prevent further moisture intrusion into the subgrade.

Clean and dry are important factors when crack filling. Using compressed air is a good method for removing moisture, dirt and sand, and will usually provide a clean face for bonding. A heat lance may be used to dry cracks when excessive moisture is a problem. In addition to drying the crack, the asphalt surface is heated and the asphalt binder softened which helps bond the sealant. A heat lance is to be used with caution as to not burn the exposed AC in the side walls.

Routing of cracks is not recommended because of cost and lack of effectiveness. The pounding produced by routing causes a fracture or weakening of the sidewall and a subsequent sealant failure. Irregular crack patterns are difficult to follow and if the router misses the crack the result is a second crack which also must be filled.

General

Crack filling should be performed well in advance and independent of any type of overlay operation in order to allow sufficient cure time for the sealant. This is particularly important on overlays of two (2) inches or less in thickness where tearing, shoving, and/or washboarding can occur during rolling due to the influence of crack filler material expanding up into the fresh hot asphalt pavement.

When traffic picks up or pulls out filler material, sand should be used for blotting. In general this situation should be avoided by using squeegees on the freshly filled cracks and confining any excess to within a 4" band over the crack. Use of filler materials that continue to bleed or track should be discontinued and the material checked. This may indicate that the materials being used have been diluted too much or there are other material property problems.

Filling cracks 1/2" wide and less can be easily accomplished with maintenance forces. Cracks wider than 1/2" which require higher quality type materials lend themselves to contract methods or maintenance sections with the appropriate equipment. Sealant placement equipment shall be double jacketed using hot circulating heat transfer oil to melt the sealant. No direct fired kettles (tar pots) shall be used.

Filling cracks in conjunction with resurfacing projects can be done if the project provisions allow for the early filling of cracks in the fall or spring well in advance of paving. Regions must keep this in mind when advertising paving projects and are encouraged to either advertise projects early to accommodate proper crack filling or by separate contract when crack filling has not been accomplished by routine maintenance.

CONCRETE PAVEMENT

Criteria for Joint Resealing

Serious distress in concrete pavement can be caused by water and incompressibles which have entered through unsealed joints. Proper resealing of joints removes incompressibles from joints and reduces water infiltration into the joint.

To increase the pavement life all potential sources of water infiltration through the pavement surface should be sealed. These include:

(1) Transverse joints
(2) Longitudinal joint between lane and shoulder joint
(3) Longitudinal joint between traffic lanes
(4) Random cracks

How well the sealant performs will depend on the movement of the joint, the shape of the sealant reservoir, the bond between the sealant and the concrete, and the properties of the sealant material. Many of the same principles which apply to new construction also apply in joint resealing work.

Joint resealing operations on concrete pavements is as important as crack filling is to asphalt pavements. Resealing operations will be based on actual needs determined from field inspections. Initial inspections should be made within five (5) years from construction and every year there after.

When

Cool concrete and air temperatures will hinder the development of bond with the hot applied sealant and will retard the curing rate. The manufacture of the sealant material will normally specify a minimum temperature allowable for sealing. A general recommendation is an air temperature of 50°F. and preferably rising. If the joint walls are too cold they will chill the hot sealant preventing the sealant from developing a good bond with the concrete.

Material

The sealing material should be installed in accordance with the manufacturer's recommendations. Field poured liquid sealants specified for the original joint sealing are also used for resealing operations. These include ASTM D 1190 and ASTM D 3405.

Procedure

Joint Preparation

Previously sealed joints require more work to seal than new joints. The normal procedure necessary for resealing old joints that are debonded is:

(1) Remove old sealant
(2) Reface the joint
(3) Rebuild defective joints
(4) Clean the joints
(5) Apply backup material

The depth of sealant to be removed is approximately twice the final width of the joint. Normally this depth ranges from 3/4 to 1 inch.

Sealant is often removed with a joint plow attachment. Care must be exercised in using the joint plow. If the tools are of the proper size, it will not be necessary to exert extra force to remove the old sealant. If a seal is difficult to remove, a smaller size tool should be used. The tools must not be V-shaped as these will spall the concrete without removing the sealant deep in the joint. All sealant debris should be removed from the joint with compressed air.

An optional removal procedure is high-pressure water blasting. This will remove all sealant and backup material in the joint. The old sealant may extend deeper than the amount to be removed to get the proper shape factor. If so, water blasting would blow out too much material and other equipment may be better suited for only partial depth removal. Water blasting on older pavements may cause spalling of the pavement and should be discontinued if spalling occurs.

In some cases the joint may have to be widened and deepened to provide the required shape factor. A diamond blade saw is the best tool for widening and refacing joints. Most other tools will spall the joint.

Once the old sealant has been removed and the joints have been refaced or rebuilt, the joints are ready for cleaning. Sandblasting is the most common method for cleaning joints; however, high pressure water blasting is another option. (Water used in the sawing operation must be allowed to evaporate before sandblasting.)

The joints should be cleared of any remaining debris just before the joint is sealed using compressed air.
After blowing out the joint a backer rod should be installed. The purpose of the backer rod is to:

(1) support the sealant until it cures
(2) provide a means to control the depth of the sealant section
(3) provide a surface to which the sealant will not bond

Generally, the size of the backer rod material is 1/8 inch diameter greater than the joint width.

Sealing Operation

When the joints have been properly prepared, the actual sealing can begin. The joint preparation and sealing operation are a continuous process and unsealed joints should not be left open. Final preparation must not be completed on more joints than can be sealed during the working day. This helps prevent unnecessary intrusion of moisture, incompressibles and dust. The joints must be completely dry when they are sealed.

As in new construction, the sealant should be applied in the joint from the bottom up under pressure to prevent trapping air bubbles in the sealant. The sealant being applied must not be allowed to overfill the joint. The sealant should come up to within 1/4 inch below the surface of the pavement at the joint .

Excess sealant that gets onto the pavement should be removed. Heated blades will remove hot poured sealant. Cold applied sealant can be merely scraped off before it has a chance to cure.

Random Cracks

Sealing of random cracks should only be considered for cracks that are open wide enough to allow the sealant material to enter the crack. Widening a tightly closed crack is difficult and can result in a maintenance problem where none previously existed. Tightly closed cracks are often nonstructural cracks which occurred soon after construction. These cracks should be monitored and sealed only if they open up or show shown signs of spalling.

Wide cracks should be cleaned with water blasting or compressed air before sealing. As with joint sealing, the crack must be dry and completely free of dirt, dust or any other material that might prevent bonding of the sealant.

The same procedures and sealant materials (ASTM D 1190 and ASTM D 3405) are suitable for filling random cracks. Care should be used when filling random cracks as excess material will need to be removed from the surface.

The depth of random crack filling can be difficult to control and overfilling results in the wasting of material. When cracks are greater than 3/4 inch wide a backer rod should be used to control the depth of material.

Crack filling operations is not to be used in place of proper repair techniques. Where random cracking has resulted in untied and moving pieces of concrete pavement, the appropriate patching methods must be used to repair the pavement.

CHAPTER 2

SEAL COATS

FOG SEAL

Fog seals are the application of diluted asphalt emulsion without an aggregate cover.

Purpose: The purpose is to seal the surface and provide some enrichment of oxidized asphalt cement (AC) surfaces that become dry and brittle with age, and to prevent raveling of chip seals and pavements laid in the late fall. Some fog seals are also used to rejuvenate the AC surface. Their primary use on high-volume roads has been to prevent raveling of open graded surfaces.

Application: Generally, anionic or cationic slow or medium setting type emulsions are used for fog seals because they can be applied in a coverage that flows easily into fine cracks and small voids.

The emulsion is often diluted with equal parts water for better control of the application rate which is usually kept low, (0.1 to 0.15 gal/yd^2) to prevent splashing and a decrease in skid resistance. These seals are used only where the existing surface is sufficiently porous to absorb a substantial portion of the emulsion. The fog seal should be applied when surface temperature is above (60^{0}F) with no threat of rain.

Limitations: Fog seals are not effective for long term crack sealing. In addition, pavement friction may be reduced until traffic wears away some of the asphalt from the surface.

SAND SEAL

Sand seal is an application of asphalt followed by a sand cover aggregate.

Purpose: This seal serves the same function as a fog seal, but provides better friction and minor crack filling.

Application: Usually rapid setting (anionic or cationic) or medium setting (anionic or cationic) emulsions are used. The rate of emulsion application varies from (0.15 to 0.25 gal/yd^2) depending on pavement texture, local conditions, and traffic. The emulsion spray is followed by about (18 to 25 lb/yd^2) of sand or stone screenings. The sand should be 1/4 inch sieve size or smaller. For maximum adhesion, the sand can be applied immediately or for better texture, can be applied after the emulsion has started to break on the top of the rocks in the pavement. Pneumatic tire rolling is desirable.

Limitations: This seal has the same limitations as a fog seal except that a sand seal may not provide the distinct delineation that a fog seal does, depending on aggregate color.

SQUEEGEE SEAL

Squeegee seals are similar to sand seals. The exception is they use a surface drag to spread the emulsion to seal cracks.

SLURRY SEAL

A slurry seal is a mixture of well-graded, fine (sand size) aggregate, mineral filler (in most cases), and a diluted asphalt emulsion. A single course is usually applied in thicknesses of 1/8 to 1/4 inch.

Purpose: Slurry seals are effective in areas where the primary problem is excessive oxidation and hardening of the existing asphalt. They are used for sealing minor surface cracks and voids, retarding surface raveling; delineating different pavement surface areas; and, with proper aggregate, improving surface friction characteristics.

Application: Aggregate, water, emulsion (slow or quick setting), and additives are proportionately mixed together in a slurry machine on the job site and immediately applied to the paved surface with a squeegee device. Additives such as portland cement, hydrated lime, or aluminum sulphate liquids are often used in small quantities as stabilizers or chemical modifiers to aid in setting the slurry.

Limitations: Slurry seals generally do not perform as well as traditional chip seals if the underlying pavement surface is cracked and moves under traffic. In addition, slurry seals require a longer curing time than chip seals. CDOT's usage of slurry seals is very limited.

MICRO-SURFACING

Micro-surfacing is a polymer-modified, cold paving slurry seal system. This system was developed in Germany in 1976, and since then has been used in Europe to fill wheel ruts and resurface major highways.

Purpose: Its most common usage is rut filling, minor leveling, and restoration of skid resistant wearing surfaces. The polymer-modified slurry cures and develops strength faster; therefore, it can be placed in greater thicknesses.

Application: Micro-surfacing consists of a mixture of polymer-modified emulsified asphalt, mineral aggregate, mineral filler, water, and additives.

Limitations: Micro-surfacing requires special paving equipment

with a more powerful and faster mixer than used for slurry seals. An experienced contractor is also desirable. Fast setting characteristics of these materials may hinder construction of acceptable transverse and longitudinal joints. Micro-surfacing mixes are also more aggregate-specific than a normal slurry seal because of chemically triggered, quick reactions.

CHIP SEAL

A chip seal is an application of asphalt followed with an aggregate cover.

Purpose: On low volume roads, chip seals can be used as a wearing course or as the only surface course. Recently, this treatment has also been used on higher volume roads (volume greater than 5,000 vehicles/lane/day) because of its ability to waterproof the surface, provide low severity crack sealing, and improved surface friction. The possibility of loose chips and traffic disruptions have limited the application of chip seals on high volume facilities.

Application: Application usually consists of a spray of polymer modified rapid setting type emulsion (or asphalt cement, cutback) at a relatively high rate, followed immediately by an application of aggregates. Emulsions are preferred over asphalt cements and cutbacks as these can be used with damp aggregates and meet environmental requirements. An asphalt application rate is required to achieve embedment of 75 percent. One size aggregates are preferred because they develop better interlocking and provide maximum contact between the tire and the surface. The cover aggregate is rolled immediately after spreading with a minimum 10 ton pneumatic tired roller to ensure maximum embedment. The minimum recommended pavement temperature required prior to asphalt application is $70^{O}F$.

Limitations: The road may be opened to traffic after rolling is completed; however, traffic speed on the newly placed surface should be limited to about 20 mph for a period of 2 hours (1 hour for asphalt cement in cold weather; 3 or more hours for emulsions in humid weather). On high volume roads, slow moving controlled traffic may be required for longer periods or alternatively, additives can be used to decrease the curing time.

CHAPTER 3

ASPHALT OVERLAYS

Asphalt overlays have two purposes. The first being routine which includes leveling, rut filling, and spot locations including distortions. The second purpose is minor which includes functional overlays of 2 inches or less.

Overlays are used to remedy functional or structural deficiencies of existing pavements. It is important to consider the type of deterioration present in determining whether the pavement has a functional or structural deficiency, so that an appropriate overlay type and design may be developed.

Structural deficiency is defined as any condition that adversely affects the load-carrying capability of the pavement structure. These include inadequate thickness as well as cracking, distortion, and disintegration. It should be noted that several types of distress (e.g., distress was caused by poor construction techniques, low-temperature cracking) are not initially caused by traffic loads, but do become more severe under traffic, to the point that they also detract from the load-carrying capability of the pavement.

Functional deficiency is defined as any condition that adversely affects the highway user. These include poor surface friction and texture, hydroplaning and splash from wheel path rutting, and excess surface distortion.

Maintenance overlays and surface treatments are considered functional overlays and are placed to slow the rate of deterioration of pavements showing initial cracking, but which do not exhibit any immediate structural deficiency. This type of overlay includes thin AC (asphaltic concrete) and various surface treatments to help keep out moisture.

An AC overlay is a feasible rehabilitation alternative for an AC pavement except when the condition of the existing pavement dictates substantial removal and replacement. Conditions under which an AC overlay **would not be feasible** include:

(1) The amount of high-severity alligator cracking is so great that complete removal and replacement of the existing surface is dictated.

(2) Excessive surface rutting indicates that the existing materials lack sufficient stability to prevent recurrence of severe rutting.

(3) An existing stabilized base shows signs of serious

deterioration requiring an inordinate amount of repair to provide uniform support for the overlay.

(4) An existing granular base must be removed and replaced due to infiltration and contamination by a soft subgrade.

(5) Stripping in the existing AC surface dictates that it should be removed and replaced.

It is important that an evaluation of the existing pavement be conducted to identify any functional and structural deficiencies, and to select the appropriate pre-overlay repairs and overlay designs to correct these deficiencies.

CHAPTER 4

CHIP SEALS
GUIDELINES FOR PROJECT SELECTION AND DESIGN

The following guidelines have been identified as the minimum items needed in the selection and design of a chip seal project. Both maintenance and designers need to review the following guidelines when developing a chip seal project.

General - Projects being considered for chip sealing should include an assessment as to how project will fit into the overall region's pavement management program, i.e. how does this process fit into the long range resurfacing plans. A cost comparison of alternative treatments should be made to assess if the chip sealing option is the most cost effective.

Roadway Condition - A survey of the existing roadway condition will need to be made to determine if the roadway is suitable for a chip seal. Prep work to correct profile, cross slope, fill ruts and cracks needs to be identified and included in the overall scope of work.

Construction Considerations - Project location, plus elevation, temperature limits and chip sealing dates needs to be determined. Lane configuration needs to be evaluated to determine the location of joints to avoid placement in wheel paths.

Traffic Control - Determination of ADT is needed to identify traffic control requirements including flagging and pilot car requirements. Additional items to be included in the overall project traffic control plan are handling of traffic through cross roads, etc.

A detailed schedule for both temporary and permanent traffic marking items should be made. It is Department policy to provide short-term pavement markings for construction and maintenance operations in accordance with the requirements of the MUTCD. Short-term pavement markings (raised markers) may be used until the earliest date when it is practical and possible to install the final pavement markings. Normally, it should not be necessary to leave short-term markings in place for more than two weeks (14 calendar days). No Passing zone restrictions will be identified by signs including but not limited to R4-1 and R4-2. Raised markers are to be placed at 40 to 80 foot intervals.

Material Selection - Aggregate selection needs to be based on such items as volume and should include both gradation and type of chip(standard chip vs lightweight). The selection of chip type should consider availability of material/cost.

One size aggregates are preferred because they develop better interlocking and provide maximum contact between the tire and the surface. Lightweight/manmade ceramic aggregates may be a good choice if high volume, high speed traffic is expected.

Emulsions - The weather conditions during the anticipated time of construction can have a great affect on the curing time of an emulsion. Night applications will require a longer time period for curing of the emulsion and hence a longer period of traffic control. Does the project site lend itself to longer traffic control? If not, does a different emulsion than the standard need to be specified? In mountainous areas weather conditions are often cool and medium set emulsions work well, but again longer periods of curing are needed; plan for them in advance.

Are the emulsion and aggregate compatible? They should always be tested. By working with the emulsion supplier, this type of problem can usually be worked out. Most suppliers will want to have samples of aggregates so that they can be sure that aggregate and emulsion are compatible; they do not want failures any more than you do. Staff Materials Bituminous Unit can also conduct compatibility tests.

Polymer modified emulsions perform better than unmodified binders, and they should always be specified.

CHAPTER 5

CHIP SEALS
INSPECTORS CHECK LIST

BEFORE WORK STARTS:

* Know weather limitations. Temperature rising, low humidity.
* Know the type and grade of bituminous material and type of cover material to be used and the recommended rates of application.
* Check traffic control to insure that it has been adequately addressed. To include correct installation of temporary pavement markings.
* Check the prepared surface for trueness, cleanliness and dry condition.
* Utilities on the roadway surface, such as manholes, drop inlets, and valve boxes, should be covered with a light coating of dirt or paper to keep bituminous material from sticking.
* Test area, of approximately 100' in length, is required each day or as needed during the day to determine the rate of bituminous application for retainage of the aggregate cover coat material. Approximately 75% embedment is recommended.
* Cover coat material should be moistened with water to reduce dust coating of aggregate thus enhancing the bond between the bitumen and the aggregate.
* Construction paper should be laid down at the start and the stop of each pass to create square ends.
* Determine whether butt or lap seams are to be used.
* Procedure of application should be determined as not to allow seams in any wheel paths.
* Application procedure should be determined to keep all turning movements on the freshly laid surface to a minimum.

APPLYING BITUMINOUS MATERIALS:

* Check each haul truck for proper temperature and initial quality.
* Watch for application in a uniform, designated and continuous manner and within temperature range required.
* Check the asphalt distributor bar for proper elevation and correct skew of the nozzles to reduce the possibility of streaking and drilling (corn rows).
* The end nozzles should be turned at 90 degrees to the highway to help reduce over spray onto curbs and gutters, and to help reduce the chance for a false seam. Spare, clean, nozzles should be available.
* Skipped or deficient areas shall be corrected and junctions of spreads carefully made.

* Length of bituminous spread not to be in excess for immediate coverage by cover coat material. Keep the chipper and distributor close.
* Be sure that bituminous material is not allowed to chill, set up or otherwise impair cover coat retention.
* Be sure that adequate bituminous material is being applied to the seam line, not just over spray.
* Distributor operator should adjust application rates slightly to compensate for oxidized, open graded, and flushed areas.

APPLYING COVER COAT MATERIAL:

* Cover coat material shall be spread immediately after bituminous spread, according to plan.
* Be sure there is not an excess of aggregate being applied.
* Be sure that the aggregate is properly embedded.
* No tires are to contact the uncovered bituminous material.
* Check to make sure aggregate spreader, roller, and truck tires are not picking up chips in excess.
* Haul trucks are to be staggered (not allowed to back in the same path) thus helping to roll the surface.
* Deficient areas must be covered by additional aggregate.
* Excess piles of aggregate on the roadway surface caused by leaking trucks and aggregate spreader shall be shoveled off prior to rolling.
* Rolling, with an approved (10 ton or more) pneumatic-tired roller, must begin immediately. Three complete coverages must be made. All rolling must be completed prior to the setting of the asphalt.
* Rapid start and stop movements on the surface should not be allowed.
* Light brooming is to be done where specified by the Project Engineer.
* All brooming is to be performed as to prevent embedded aggregate from being loosened.
* Final brooming to remove remaining loose chips is to be done after the seal coat has sufficiently cured.
* Fine, clean, blotting sand should be available nearby in case of excess bleeding or other unforeseen problems.