THE TEXAS DEPARTMENT OF TRANSPORTATION

Seal Coat Inspection and Applications

Texas Department of Transportation

MNT 702

Document Update Notice

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The following pages or sections of this document are updated in this revision.

Topic revised	*Pages or sections removed from previous version*	*New page or section numbers inserted*
Table of Contents		Revised the TOC to reflect the combined chapters 1 and 2 and renumbered the following chapters.
Course Schedule		Adjusted course schedule to account for newly combined chapters 1 and 2.
Chapters 1 and 2		Combined chapters 1 and 2. Removed section 2, “Pavement Preservation Training” from chapter 1. Moved section 1, “Pavement Preservation Concepts” to beginning of new Chapter 1. Renamed Chapter 1 “General Principles of Seal Coats”
Appendix A		Revised appendix to include above course revisions.

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Seal Coat Inspection and Application

Welcome!

Please tell us the extent of your experience in seal coat design, construction and inspection procedures.

☐ None; I have never performed any seal coat design, construction, or inspection.

☐ I have performed some type of seal coat design, construction, or inspection for ___years.

☐ I have performed seal coat design, construction, and inspection in the following projects:

Seal Coat Inspection and Application

This course will provide instruction on the proper inspection methods and equipment used in seal coat construction. Specifically; the course will cover the need for a pavement preservation strategy that is applied consistently across the state in seal coat applications; inspector duties and authority on the job; proper equipment inspection and calibration methods; common terminologies used in seal coat processes; identification of necessary repairs prior to seal coat to extend the life of the seal coat; identify and correct on the job defects in seal coats and surface treatments; prioritize the preparatory phases of a seal coat or surface treatment; and list the sequence of events for full width seal coats, strip/spot seal coats or surface treatments. This course is sponsored by the Texas Department of Transportation.

Schedule
There will be a 10-minute break after each chapter

Morning

Chapter 1 – General Principles of Seal Coats

Chapter 2 – Duties of Inspector or Crew Chief

Chapter 3 – Pre-Seal Coat Activities

Chapter 4 – Equipment Inspection

Lunch

Afternoon

Lab Activity – Binder Application Rate Determination and discussion on TVAR

Chapter 5 – Seal Coat/Surface Treatment Application Process

End of Day

Chapter 1 – General Principles of Seal Coats

When this chapter is over, you will be able to:

- Describe the concept of pavement preservation strategies.
- Recite seal coat terminology.
- Describe the need for and limitations of seal coat applications.
- Discuss the factors which may influence the performance of a seal coat applications.
- Identify defects in seal coats and surface treatments.

Section 1 – Pavement Preservation Concepts

Overview

Pavement preservation is a fairly new concept and, thus, is not well known by most maintenance professionals.

Advocates nationwide are expending a great amount of effort to increase public awareness of pavement preservation. The Asphalt Institute and Transportation Research Board's journals have both released special issues focusing on pavement preservation, and many researchers are working to spread information about this type of pavement management.

Michigan State University recently formed a research center to inform the community about the principle of preserving pavements through preventive and routine maintenance. Similarly, the Texas Pavement Preservation Center has been formed to establish a research facility within the Austin, TX, community.

This chapter will explain what pavement preservation is all about and why it is at the forefront of pavement management research. While understanding specific pavement preservation practices and techniques is useful and important, a firm grasp of the underlying principles must come first.

Definition of Pavement Preservation

Key Terminology

The Federal Highway Administration (FHWA) defines pavement preservation as a program employing a network-level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet motorist expectations. Pavement preservation utilizes a combination of preventive and routine maintenance, with a heavy emphasis on prevention. The basic concept is that maintaining a road in good condition is easier and less costly than repairing one with heavy damage.

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The purpose of pavement preservation practices is to extend pavement life and arrest or retard deterioration and progressive failures. This maintenance strategy offers many benefits to road users as well. By keeping roads in good condition, preventive maintenance improves safety conditions. The ride quality of the road is also increased, making driving a more comfortable and pleasant experience for drivers and their passengers. Finally, preventive maintenance operations usually minimize traffic disruptions, thereby reducing congestion and lost time.

The chart below illustrates the performance of pavements over time. The zero mark on the horizontal scale represents new, excellent pavement condition. Throughout Period I, the pavement remains in good condition. Period II shows a critical period of time in the pavement's service life; the pavement begins to deteriorate and then rapidly drops in condition to a point of serious distress. By the end of Period III, the pavement has failed.

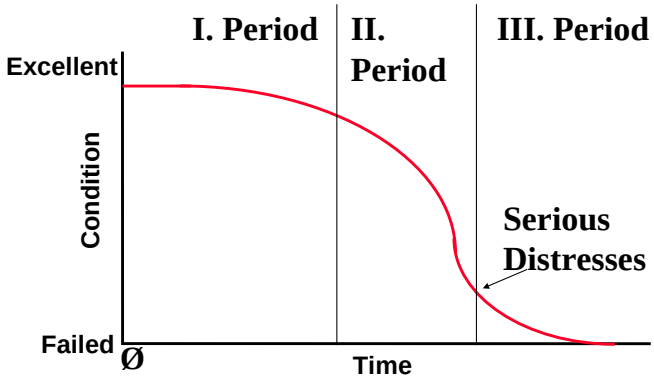

Figure 1-1. The Concept of Preventative Maintenance.

The difference between the effect of preventive and reactive maintenance is significant. Not only is the timing of application different, but the effect (represented by the slopes of the after-treatment performance curves) is also disparate. A pavement that receives preventive maintenance experiences only small fluctuations in pavement condition and generally remains serviceable. The pavement condition drops to an unacceptable level, however, with reactive maintenance, then is temporarily boosted before quickly receding once more.

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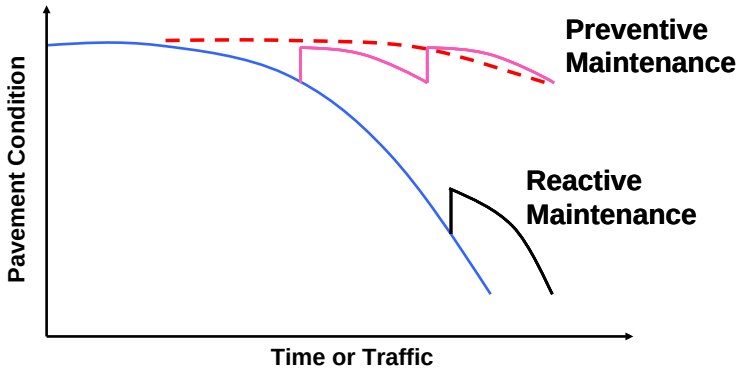

Figure 1-2. Pavement Condition.

Pavement maintenance works in a similar fashion to maintenance performed on a car. The cost of repair is relatively inexpensive (like an oil change or tune up) as the pavement first begins to deteriorate. However, as the progression deteriorates further, the costs increase exponentially (like an engine overhaul). When we consider that keeping the pavement in good condition will most likely cost a quarter or a fifth the amount that will have to be spent to bring the road back from serious distress, the concept of preventive maintenance just makes sense.

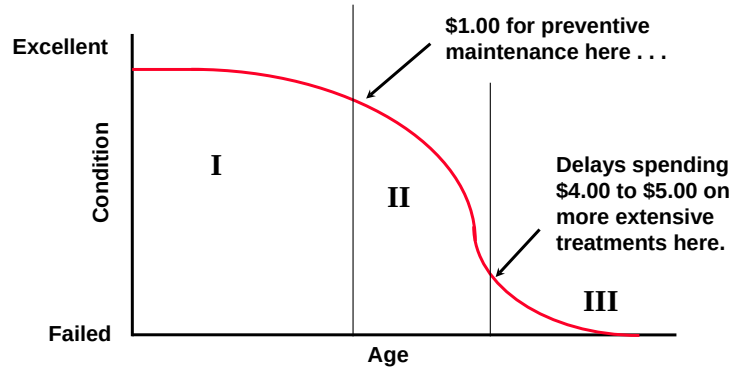

Figure 1-3. The Costs Associated with Preventative Maintenance.

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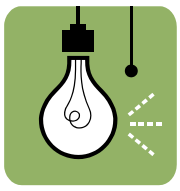
Maintenance Treatments

Key Terminology

Pavement preservation is made up of maintenance treatments. Preventive maintenance treatments constitute a pavement preservation program and include planned maintenance, maintenance that retards future deterioration, and actions that maintain or improve the functional condition of a pavement.

Common preventive maintenance treatments are chip seals, slurry seals, fog seals, crack sealing, joint sealing, and others. Corrective maintenance, however, describes actions that cannot be planned because they are performed in response to unexpected events. Corrective maintenance includes reactive and emergency maintenance and utilizes such treatments as rut level-ups, pothole patching, and slab replacements. Although corrective maintenance is unplanned, many agencies set aside a certain amount of funding for this type of work.

Pavement preservation has many advantages over traditional reactive maintenance programs. Prevention means longer pavement life, better pavement performance, improved pavement condition, and increased safety. Agencies are able to make more informed decisions, and the cost to the public is reduced. Because of the improvements in safety, price, road condition, etc., public satisfaction with the local pavement management system will be heightened.



Although the cost-effectiveness of pavement preservation is often a key point of focus, the number one public priority is safety.

The main function of any department of transportation is to provide the safest roads possible for the traveling public. Preventive maintenance programs are instrumental in achieving optimally safe driving conditions. Prevention provides better pavement surfaces, fewer ruts and raveling, and a reduction in the amount of disruptive repairs due to extensive construction. Improving the safety of public roads is benefit enough to make preservation the pavement maintenance method of choice. The main obstacle to the advancement of pavement preservation concepts is a lack of

education and understanding among road agency personnel, policy makers, and the public in general.

Common preventive treatments range from crack sealing to more complex treatments like hot in-place recycling. Surface treatments including micro-surfacing, slurry seals, chip seals, and thin HMA overlays compose the backbone of pavement preservation practices. This array of different treatments all have unique characteristics that allow a variety of needs to be met. These treatments, though tailored to specific situations or types of distress, all serve the same goal: to improve pavement performance and extend service life.

The main philosophy behind pavement preservation can be summed up as "the right treatment, the right road, and the right time." Preservation requires very careful planning. Often, the best project location and timing are more difficult to identify on roads that are still in good condition than when maintenance actions are reacting to a pavement that obviously needs repair. Placing the treatment too late or too early can reduce the cost effectiveness and overall benefits of a preventive maintenance treatment. Choosing which treatment to use is often no simple task, either. Treatments vary from one another in multiple and subtle ways, and the selected treatment must suit the situation at hand. Type and extent of distress, traffic levels and composition, climatic conditions, seasonal constraints, aesthetic and noise requirements, treatment cost, availability of funding, materials and contractors, and a multitude of other considerations dictate the effectiveness of a treatment.

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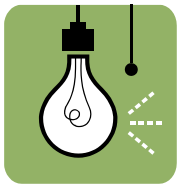
Section 2 – Overview

General

Seal coats, also known as chip seals, are simple, relatively inexpensive pavement surfaces that are highly effective if adequate care is taken in the planning and execution of the work. A seal coat is an application of a layer of asphalt binder covered with a layer of aggregate applied to an existing paved surface. TxDOT spends close to $180 million maintaining 186,600 lane miles of roadway, and seal coats are a very important part of TxDOT's preventive maintenance program. State forces place some seal coats, but the majority are placed by contract as shown below:

Table 1-1. Miles of Seal Coats in Texas per Year.

Year	Contracted Seal Coat, lane-miles	State Force Seal Coat, lane-miles
1999	10,950	3,410
2000	17,740	3,035
2001	17,350	2,850
2002	16,665	2,990



The average life of a seal coat or surface treatment is about six to eight years; however, some have performed successfully for periods of up to 20 years.

Key Terminology

TxDOT specification Item 316, *Surface Treatments,* defines one or more applications of binder and aggregate covered with a single layer of aggregate as a surface treatment. For purposes of this manual, an application of asphalt material covered with a single layer of aggregate when applied to a prepared compacted base is a surface treatment; whereas, a seal coat is applied to a paved surface.

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This manual is intended to provide guidelines for the design, construction, and inspection of seal coats and surface treatments for contract and state force work. Both full-width seal coats/surface treatments as well as strip/spot seal coats are addressed. The manual is directed primarily to office and field engineers, laboratory personnel, and field inspectors.

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Section 3 – Functions of Surface Treatments and Seal Coats

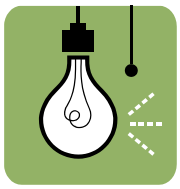
General

A surface treatment is placed on a crushed stone base to provide a roadway with the least expensive permanent type of bituminous surface. It seals and protects the base and provides strength at the road surface so that the base can resist the abrasive and disruptive forces of traffic. It also provides many of the functions that a seal coat provides.

Why Have a Seal Coat?

When applied to a bituminous pavement surface, a seal coat provides a durable all-weather surfacing that:

- seals an existing bituminous surface against the intrusion of air and water,
- enriches an existing dry or raveled surface,
- arrests the deterioration of a surface showing signs of distress,
- provides a skid-resistant surface,
- provides the desired surface texture,
- improves light-reflecting characteristics where these are required (by use of light-colored stone),
- enables paved shoulders or other geometric features to be demarcated by providing a different texture or color, and
- provides a uniform-appearing surface.



The asphalt binder binds the aggregate particles to the underlying surface and provides a waterproof seal. The functions of the aggregate are to resist traffic abrasion, to transmit wheel loads, and to provide skid-resistance and the desired surface texture.

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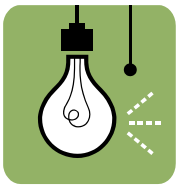
Limitations

- A seal coat or surface treatment has little or no structural strength itself, but it enables the inherent strength of the pavement and the subgrade to be preserved by preventing the ingress of water.
- If a pavement shows evidence of traffic load-associated cracking (alligator, longitudinal, or transverse), a seal coat is only a temporary solution. Areas that show load-associated cracking may require base repair prior to a seal coat or overlay. A thick asphalt concrete overlay or reconstruction is normally required to correct these problems. Seal coats applied to pavements showing signs of non-traffic load-associated longitudinal and transverse cracks have proved somewhat effective. Seal coats usually bridge these cracks in a more satisfactory manner than thin asphalt concrete overlays.
- The application of a seal coat cannot significantly improve the ride quality of a pavement. Overlays of various thickness, spot level-up maintenance patches, or reconstruction are normally required to restore pavement ride quality.
- Pavements demonstrating flushing or bleeding are difficult to repair with seal coats. The binder normally migrates through an added seal coat unless the asphalt quantity applied to the roadway can be altered at these spot locations. Seal coats utilizing a large maximum size aggregate are suggested if seal coats are used on flushed surfaces.



Seal coats have been used successfully on both low- and high-traffic volume roadways but tend to be more successful on low-volume roadways, especially low-volume truck traffic. The use of seal coats in urban areas where accelerating/decelerating traffic and turning movements frequently occur should be approached with caution and is addressed more in Chapter 2.

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Section 4 – Factors Influencing Performance

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General
The performance of seal coats and surface treatments depends on:

- construction techniques used,
- properties of the bituminous binder and the stone,
- amounts of stone and binder used and the uniformity of application,
- development of good adhesion initially which must be maintained throughout the life of the surfacing,
- strength of the underlying base or condition of underlying pavement,
- amount and type of traffic, and
- environmental and drainage conditions.

These factors will be discussed in more detail later in this manual.

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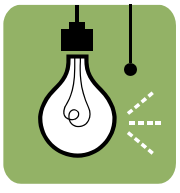
Section 5 – Additional Factors Influencing Performance of Surface Treatments Only

General

Because a surface treatment is placed on a granular base (unlike a seal coat which is placed on an existing paved surface), the materials and construction quality of the base course greatly affects the performance of the surface treatment. Probably the most common failure associated with a surface treatment is delamination of the surface treatment from the base course as shown in Figure 1-4.

Figure 1-4. Construction Traffic Causing Delamination of Surface Treatment from Granular Base Course.

When potholes and small breaks develop in poorly bonded areas such as shown in Figure 1-5, they should be repaired as soon as possible.



Unless attended immediately by maintenance crews when they first appear and are still small, these holes in the surface treatment may quickly become so numerous and so large that it is no longer economical to attempt to restore the surface by simple patching methods.

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Figure 1-5. Potholes Forming Due to Poorly Bonded Surface Treatment.

The performance of a surface treatment greatly depends on:

- ❖ base finishing, and
- ❖ prime coat.

Base Finish

The quality of the base finish is critical to the bonding of the surface treatment to the base. Both the pneumatic and steel wheel roller are used to finish the base. The pneumatic roller is used first, followed by a steel-wheel roller. The kneading action of the pneumatic roller helps the initial rolling to even-out the bladed surface. The steel-wheel roller helps to get an even and less rocky surface before the prime coat is applied.

One type of base finishing known as slush rolling is commonly used and this technique varies depending on the amount of water used. Slush rolling with excessive water can weaken the base, first by trapping water in the base and then by altering the gradation of the base due to the pumping of fines to the top. Slush rolling can build up a layer of fines on the top of the base that will hinder the penetration of the prime coat and the prime can debond from the base easily. Therefore, it is recommended that base finishing be done using a technique that does not involve the use of excessive water.

Types of Base Materials Used

This a list of base materials most commonly used with surface treatments (in the order of decreasing use). Limestone is by far the most common, which is used by 14 districts. Of the stabilized bases, cement and fly ash stabilized bases are most common.

- Limestone
- Caliche
- Iron Ore Gravel
- Gravel
- Fly Ash Stabilized Base
- Cement Treated Base
- Asphalt Stabilized Base

The following four figures show pictures of finished base material surfaces for limestone flexible base, iron ore gravel flex base, cement stabilized base, and emulsion-stabilized base.

Figure 1-6. Finished Limestone Flexible Base.

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Figure 1-7. Finished Iron-Ore Gravel Flexible Base.

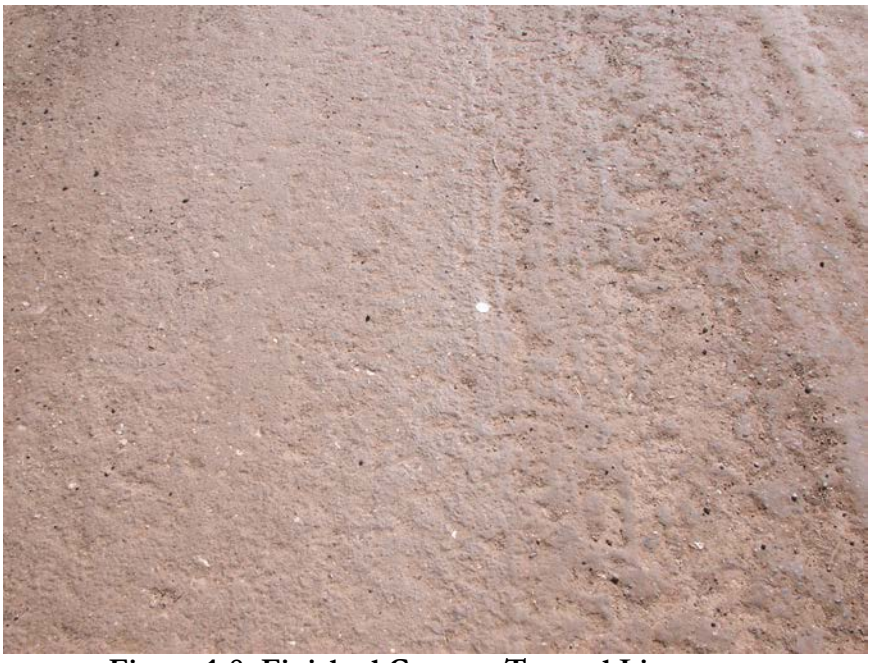

Figure 1-8. Finished Cement-Treated Limestone Base.

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Figure 1-9. Emulsion Stabilized Base.

Both the pneumatic roller and the steel wheel roller are used to finish the base. The pneumatic roller is used first, followed by the steel-wheel roller. The kneading action of the pneumatic roller helps the initial rolling to even-out the bladed surface. The steel-wheel roller helps to get an even and less rocky surface before the prime coat is applied.

District Use of Base Finishing Techniques
TxDOT districts use three base finishing methods.

- Slush rolling
- Blade and roll
- Trimming

Slush rolling is the most common method with 12 districts using it. This base finishing technique varies among districts depending on the amount of water used.

Seven districts use the blade and roll technique.

The trimming technique uses the subgrade trimmer used by districts to finish the base. Excess base is used to compact the base 1-2 inches above the blue-top level, and then, the trimmer is used to cut it down to the required finish level. Then, the trimmed surface is rolled. This eliminates the need to do slush rolling. The excess material is used in other miscellaneous construction operations.

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Figure 1-10. Flexible base surface finished using trimmer and ready for prime coat application.

Prime Coat

Almost all TxDOT districts that use surface treatments typically use a prime coat. The prime coat plays a very important role in pavement structures. Its primary benefit is the facilitation of bond between the surface treatment and the base layer. The binders that are used in the surface treatment courses need to be strong and durable. Such binders do not have the low viscosity needed to penetrate the base layer and grip it, to prevent it from debonding due to shear stresses exerted by traffic and due to other factors. A prime coat which uses a low viscosity binder can act as an intermediary between the surface treatment binder and the base. The gripping effect of the prime coat onto the base also strengthens the base layer by providing more cohesion to the top of the base.

The penetration of the prime coat into the base is very important to get the maximum benefit from the prime coat. The amount of penetration depends on a number of factors including the prime coating method, prime coat binder, base material, base finishing technique and the porosity of the base course. Typical penetration of a sprayed cutback prime could be in the range of 1/8 – 3/8 inches.

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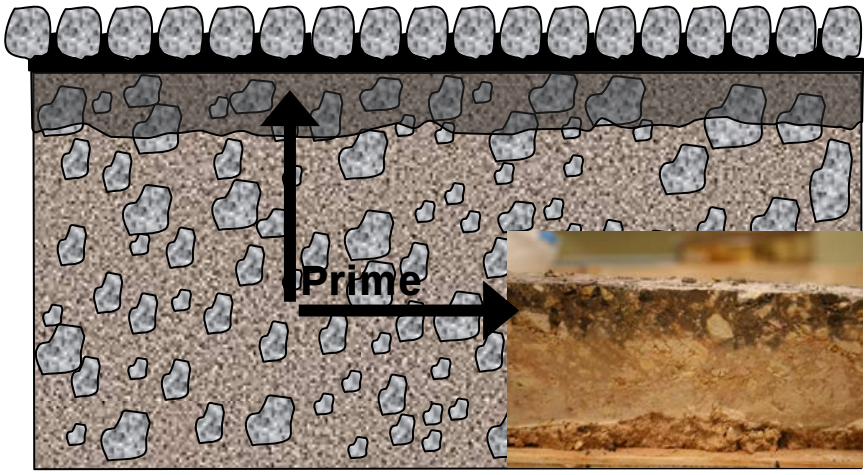

Figure 1-11. Schematic of Prime Coat Penetration into Base.

There is usually a time lag between the completion of the base layer construction and the application of the surface treatment. A well-applied prime coat can protect the base layer from adverse weather conditions and from wear due to construction and regular traffic until the surface treatment is applied. It can also either prevent or slow down the formation of dust on the surface that will have a serious negative impact on the bonding of the binder to the base.

At least four different prime coat types are used by TxDOT districts. These following figures illustrate three of the four types.

Figure 1-12. Spray Prime (MC-30, AE-P).

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Figure 2-9 shows a MC-30 cutback prime coat sprayed using an asphalt distributor. The typical rate of application of the binder is 0.2 gal/sy, which may be adjusted depending on the tightness of base finish and on whether construction traffic has to be allowed on the primed surface. Since this surface treatment project is constructed under traffic, blotting sand was spread using an agricultural fertilizer truck spreader on the MC-30 within minutes after the prime coat binder is sprayed. In this project, the prime coat application rate was reduced to 0.16 gal/sy for constructability purposes.

Figure 1-13. Worked-in (Cut-in) Prime.

Figure 1-13 shows a worked-in prime coat application where diluted emulsified asphalt is sprayed on the finished base, which is then covered with a thin coating of fine base material dust working the windrow with the motor grader. This process is usually repeated 2-3 times to get a total emulsion application rate of 0.2 gal/sy. The emulsions commonly used for this purpose are SS-1, CSS-1h and MS-2. This leaves an asphalt-sand layer on the finished base that is approximately 1/8 in. thick.

Figure 1-14. Covered (Inverted) Prime.

Figure 1-14 shows a covered (or inverted) prime applied on the finished base. This covered prime is similar to a course in the surface treatment where RC-250 cutback is first applied on the finished base, which is covered by spreading Grade 5 rock. This "priming" technique is particularly useful when traffic has to be let on the primed surface before the other half of the roadway is primed. This type of a prime can provide 2-3 months of satisfactory service as a very temporary wearing course under favorable traffic conditions including little or no turning traffic or heavy traffic.

Optimum Conditions in Base for Prime Coat Application
Several conditions may be identified as optimum for a base to have before a prime coat is applied. The base should be:

- reasonably smooth,
- reasonably porous,
- not dusty, and
- structurally strong.

The base should not have standing dust when the prime is applied. Therefore, brooming of the finished base is done to remove the dust. However, brooming has to be done carefully not to disturb the base layer particles.

These optimum conditions for the base may not necessarily be compatible with each other. For example, a reasonably smooth finished base is required to achieve a desirable ride quality in the finished surface treatment. However, an overly smooth base can prevent the prime coat binder from penetrating into the base and achieve a good bond between the base and the prime. Therefore,

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some porosity (fine or small pores) is needed for this bond to be developed. The desirable pore size is determined by the prime coat binder and its wettability of the base material.

In many instances, slush rolling is used to obtain a smooth finished base surface. However, unless care is taken to control the slushing water content, excess water can weaken the base significantly by making its density lower.

Figure 1-15. Curing Flex Base.

Item 247.4 E states that the finished section should be cured until the moisture content is at least two percentage points below optimum or as directed before applying the next successive course of prime coat.

How soon after the Prime is Surface Treatment Binder Applied?

The first decision that an inspector has to make with regard to surface treatment is whether the primed pavement is ready for surface treatment application.

A recent research project asked the districts how long they would wait after the priming before applying the surface treatment. The responses varied from same day to 10 days. This time lag between the prime and the surface treatment depends on the following factors:

- type and grade of binder (i.e. provide time for cutback volatiles to evaporate and for emulsions to cure and penetrate),
- type of base (allow prime to penetrate),
- contractor's construction schedule, and
- work-zone management.

The following general rules appeared from the survey.

- Wait at least 3 days when the prime coat binder is an emulsion.
- Wait at least 7 days if the prime coat binder is a cutback.

Figure 1-16. Prime Coat Peeled During the Brooming Process.

Figure 1-16 shows a prime coat peeled during the brooming process. Generally, a light brooming is done on the primed surface to remove any dust accumulated on it before the surface treatment binder is sprayed. In this case, the peeling of prime may have been due to the following two factors:

- Turning traffic at this location that exert higher shear stresses on the primed base, and
- Shaded area may have contributed to the prime to cure slowly.

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Figure 1-17. Wearing of Prime Coat by Traffic.

Traffic should only be allowed on the prime coated base when it is absolutely necessary. On projects such as the one shown in Figure 1-17, traffic has to be allowed on the primed because it is an existing two-lane roadway. However, opening for traffic for too long, particularly when significant heavy traffic is present can cause the prime coat to wear off and cause problems. In such situations, the surface treatment will not stick well in the area where the prime is worn out and re-priming of the affected area must be done.

Figure 1-18. Failure of Prime Coat Before Surface Treatment is Applied.

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When rainstorms occur on an exposed primed base that is open to traffic, both the prime and the base are likely to get damaged. This is particularly true when drainage paths are not allowed for storm water during construction. Roadside base material windrows can create such situations. The inspector must ensure that when primed (or un-primed) base is opened to traffic, proper drainage channels are provided.

Figure 1-19. Failure of Prime Coat Due to Loose Rock on the Road.

Figure 1-19 illustrates the damage caused to a prime coat because of loose rock on the primed base. In this case, loose bounced-off rock from the chip spreader can be the cause of prime coat damage when traffic on the primed base drives the loose rock into the base. Therefore, it is important to minimize the presence of loose rock on the primed base. One way to achieve this is by shooting the surface treatment binder about 6 inches wide, such that any bounced off-rock from the chip spreader can be retained. Since this extra width of asphalt is to the end of the distributor, it leaves a lighter coating of asphalt, and it can be overlapped when the next lane is shot.

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Figure 1-20. Pick-up of Prime and Surface Treatment by Construction Traffic.

Figure 1-20 shows the pick-up of the newly constructed prime and the first course of surface treatment due to construction traffic. This can be caused by sudden movement of tires in construction vehicles. It can also be caused by poor bonding between the base and the prime or between the prime and the surface treatment. In this case, it appears that the failure occurred between the base and the prime. Failed areas such as this one needs to be quickly repaired by the contractor.

For more information, refer to TxDOT Research Product 0-5169-P2, *Design and Construction Guide for Surface Treatments over Base Courses,* by Sanjaya Senadheera and M. Vignarajah, Center for Multidisciplinary Research in Transportation, Texas Tech University.

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Section 6 – Principal Faults or Defects in Seal Coats or Surface Treatments

General
Some of the most serious defects in seal coats and surface treatments are:

- loss of aggregate,
- streaking, and
- flushing.

Loss of Aggregate
Several major causes for serious loss of cover aggregate from surface treatments and seal coats are shown in Figure 1-21 and Figure 1-22 on the following page:

- A long delay between spraying binder and spreading cover aggregate, causing the hot applied binder to cool and emulsified binder to begin to cure. In both cases, the binder is too viscous (hard) for aggregate to embed properly.
- Sealing too late in the season. Seal coats perform better if they are under traffic a few months prior to winter weather.
- Insufficient binder is provided to cement the cover aggregate into place.
- Selection of an improper binder for prevailing conditions.
- A coating of dust or film of moisture on aggregate particles affects the adhesion to the binder.
- Fast traffic is permitted before adhesion is fully developed.
- A rainstorm occurs prior to development of adhesion.
- Placement of too much aggregate may cause embedded aggregate to dislodge under traffic.

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Figure 1-21. Seal Coat Pavement Surface Exhibiting Aggregate Loss.

Figure 1-22. Seal Coat Pavement Surface Exhibiting Aggregate Loss.

See Appendix A for slides

Poor Adhesion or Bond to Road Surface

The complete loss of a surface treatment or seal coat happens rarely and therefore is not listed as one of the major defects; nevertheless, it can occur. Poor bond between an existing surface and a seal coat placed over it may be due to the following:

- a film or layer of dust,
- moisture in the old surface following wet weather,
- low ambient temperature,
- use of a binder that is too viscous (hard) at the time rock is applied, or
- any combination of these at the time the seal coat was laid.

Streaking

Key Terminology

Streaking results when alternate longitudinal strips of a surface treatment or seal coat contain different quantities of binder, due to lack of uniformity of application of the binder inch by inch across the surface.

An example of streaking as a result of non-uniform binder application is shown in Figure 1-23. The alternating streaks may be representative of areas where there is not enough binder to hold the cover aggregate in place which will result in a loss of aggregate under traffic. Streaking can reduce skid resistance, cause vehicle steering problems, and lead to a serious reduction in the normal life expectancy.

Figure 1-23. An Example of Streaking on a Roadway.

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See Appendix A for slides

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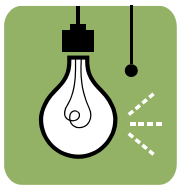
In addition to shortening the service life, streaking can be so pronounced that it interferes with the steering of a car on the road and can cause the vehicle to weave, thereby affecting the safety of traffic.



Some of the more common causes of streaking are mechanical faults, improper or poor adjustment, and careless operation of bituminous distributors. Another frequent cause is applying the bituminous binder at too low a temperature, so that it is not fluid enough to fan out properly from the nozzles on the spray bars.

Other common causes of streaking requiring mechanical correction are:

- operating with a portion of the spray nozzles partially or completely clogged (faulty strainers or absence of strainers is sometimes at least partly responsible for this);
- using spray nozzles of different sizes, different makes, and different rates of discharge in the same spray bar;
- operating when some of the nozzles have not been set vertically and at the proper angle in the spray bar;
- using damaged or badly worn spray nozzles; and
- employing spray bars in which the center-to-center spacing of the nozzles is not uniform.

Flushing

Too much bituminous binder used during the construction of seal coats and surface treatments is one of the most common defects.

Key Terminology

Excess binder exudes upward onto the pavement surface and is the origin of the black and frequently sticky surface condition referred to as flushing, bleeding, or fattening up and which can lead to a loss of skid resistance.

Figure 1-24 on the following page shows an example of a flushed seal coat surface.

See Appendix A for slides

Figure 1-24. A Seal Coat Pavement Surface Exhibiting Flushing in the Wheelpaths.

Every element in the finished highway (width, alignment, and profile) satisfies both engineering and aesthetic demands, and yet the surface is the most obvious part of the structure. A poorly designed and constructed seal coat begins its service life with a blemished appearance and a surface that may have flushed so badly that it will exhibit a loss of skid characteristics. Consequently, the finished surface satisfies neither the appearance nor the basic engineering requirements that the public has a right to expect. This manual will provide guidelines on determining the correct binder application quantities.

The application of insufficient binder leads to a loss of aggregate because not enough binder has been applied to cement the aggregate particles into place. Sometimes the surface on which a seal coat or surface treatment is applied is so open or porous that a large portion of the binder soaks into it. Not enough binder remains on top to hold the aggregate, and traffic can easily dislodge the aggregate.

In general, the use of too little binder occurs less frequently than the application of too much.

Notes:

See Appendix A for slides

Chapter 2 – Duties of Inspector or Crew Chief

When this chapter is over, you will be able to:

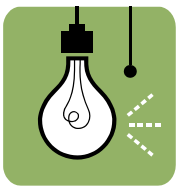
- Describe the authority and duties of an inspector or crew chief.
- Describe the specifications and plans a project must comply with.

Section 1 – Authority of Inspector

General

An inspector serves as a representative of the project engineer. The project engineer has direct responsibility to ensure that all the work is performed in accordance with the contract that includes all plans, specifications, and other documents associated with the project. The engineer's decisions are final with regards to questions of quality or acceptability of materials furnished and work performed; the manner of performance and rate of progress; the interpretations of plans and specifications; and the acceptable fulfillment of the contract. Inspectors have the authority to enforce all the requirements of the contract, and they can shut the job down, if necessary. All the work, materials, and equipment on a project should be inspected. The inspector should thoroughly understand the contract and relevant plans, specifications, special provisions, and the work schedule. The Contract Administration Handbook CCAM and Item 5 of the Standard Specifications provide more detail on the authority of the inspector.

Inspection of Materials and Work



TxDOT must sample, inspect, test, and approve any materials to be used on a seal coat project. Inspection is also required in the preparation or manufacture of materials. Any work in which materials are used without prior testing and approval or written permission of the project engineer may be ordered removed and replaced.

Inspectors are authorized to inspect all work performed on the project. In the case of any dispute arising between the contractor and inspector regarding the work performed or materials furnished, inspectors have the authority to reject materials or suspend work until the issue can be resolved by the engineer.

The inspector is not authorized to revoke, alter, or release the contractor from any requirement of the contract. The inspector cannot approve or accept any portion of the work or issue any instructions contrary to the plans and specifications. The inspector will not act as supervisor, perform other duties for the contractor, nor interfere with the contractor's management of the work.

Notes:

See Appendix A for slides

Section 2 – Duties of the Inspector or Crew Chief

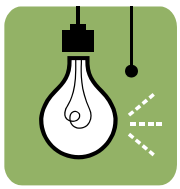
Notes:

See Appendix A for slides

General

Key Terminology

Inspectors are responsible for verifying that all materials, equipment, and work meet the requirements of the specifications, special provisions, and plans. When seal coat work is performed by state forces, the crew chief has the responsibility of both the chief inspector and supervisor.



TxDOT recommends that a seal coat project has a minimum of three people in the inspection team. The chief inspector should be well trained and experienced with all aspects of seal coat work. TxDOT also recommends that the same inspection team be used throughout the district each year to promote consistency and improve seal coat performance.

Inspectors should:

- Be adequately trained;
- Have the freedom to make timely, informed field decisions;
- Develop partnering relationships with contractor and suppliers;
- Understand that plans are only a guide and that each road requires special considerations; and
- Recognize that suppliers are excellent resources for information on their respective products

The duties of the inspection team may be divided as shown below:

- Inspector 1 (Chief Inspector): Inspect the overall job, including traffic control, and determine the asphalt and aggregate application rates.
- Inspector 2: Monitor the binder application and control the rate based on instructions from the chief inspector.
- Inspector 3: Monitor the aggregate application and control the spread rate based on instructions from the chief inspector. Inspect the rolling operation.

Inspectors should report to the project engineer, usually through the chief inspector, concerning the progress of the work and the manner

in which it is being performed. Any deviation from the plans or specifications must be brought to the attention of the chief inspector, engineer, and the contractor.

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Duties

The inspector (or crew chief on state-force work) generally has the following duties:

- ❖ Thoroughly understand the specifications, special provisions, and plans prior to the beginning of the project.
- ❖ Ensure that aggregate stockpiles are adequate and are conveniently located.
- ❖ Ensure that asphalt storage heating facilities are adequate.
- ❖ Inspect all equipment to be used on the job.
- ❖ Sample both aggregate and asphalt materials as required.
- ❖ Monitor the temperature of the pavement surface, air, and asphalt binder.
- ❖ Adjust binder and aggregate application rates.
- ❖ Ensure the amounts of aggregate and asphalt used on the project are accurately recorded.
- ❖ Inspect the quality of the finished project and bring any deficiencies to the attention of the contractor and engineer.
- ❖ Ensure all reasonable precautions are taken to provide for the safety of the traveling public and all personnel involved in the project.
- ❖ Establish and maintain a professional working relationship with the contractor's personnel.
- ❖ Perform other duties as directed by the chief inspector, engineer, or their supervisor.

See Appendix A for slides

Section 3 – Specifications and Plans

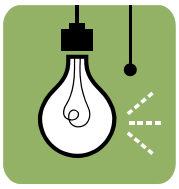
General
All aspects of a seal coat project must comply with the following contract documents:

- TxDOT's Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (referred to in this manual as the Standard Specifications),
- Special Specifications,
- Special Provisions, and
- Plans.

The contract document contains a complete listing of the particular requirements governing a seal coat project.

Standard Specifications
Standard Specifications address the following:

- Quality of the materials and equipment,
- Method and manner of work to be performed, and
- Method of measurement and payment.



The Standard Specifications are revised and updated periodically. It is important to ensure that the correct edition of the Standard Specifications is referenced.

The Standard Specifications are also available online at http://www.dot.state.tx.us/business/specifications.htm.

Special Specifications
Special Specifications are supplemental specifications applicable to the individual project, not covered by the Standard Specifications.

Special Provisions
Special Provisions revise or supplement the Standard Specifications or Special Specifications.

Plans
The Plans (contract drawings) describe in detail the work to be accomplished.

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See Appendix A for slides

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Section 4 – Safety

General
Inspectors and crew chiefs should refer to TxDOT's *Occupational Safety Manual and the Handbook of Safe Practices* to understand and follow all safety procedures applicable to seal coat work.

See Appendix A for slides

Chapter 3 – Pre-Seal Coat Activities

When this chapter is over, you will be able to:

- Describe the preparatory phases for a seal coat project.
- Describe the repairs that may be required prior to a seal coat project.
- Describe the proper methodology of stockpiling aggregate.
- Describe how to effectively plan and conduct a preconstruction meeting.

Section 1 – Overview

General
Seal coat projects take a great deal of planning and careful preparation to ensure that a seal coat job will last for many years. Numerous details must be worked out between the responsible engineer and the contractor. The engineer needs to know the approximate date the contractor plans to start the operation and who will supply the materials. The engineer must also arrange for the preconstruction meeting, which will be explained in detail in Section 4 of this chapter.

The main preparatory stages for a seal coat project include:

- Repairs and patching;
- Selecting application rates;
- Stockpiling, sampling, and testing aggregate;
- Traffic control needs such as certain hours of operation due to schools, businesses, etc.; and
- Preconstruction meeting.

This chapter will discuss these preparatory stages in detail, with the exception of selecting application rates, which are discussed thoroughly in the Chapter 3, Section 7 of the Engineers Course.

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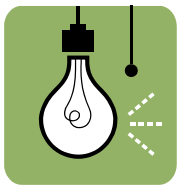
Section 2 – Repairs and Patching

Notes:

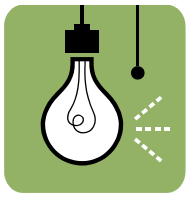
General



Any repair work that the pavement needs should be done well ahead of seal coat work, ideally in the previous summer or fall. Certain repairs may involve a strip/spot seal coat or fog seal, reducing the amount of the future seal coat binder that is absorbed into the repair. TxDOT maintenance forces usually perform these repairs.

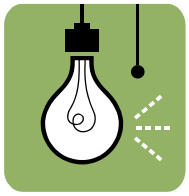
Timing

There is no absolute time frame during which repair work ***must*** be accomplished. It is generally preferred that all repair work be done as far as eight months prior to applying the seal coat. This is particularly true when repairs are performed using cold-laid asphalt mixes. This allows plenty of time for the materials to cure adequately prior to sealing. However, this means doing the repairs during the fall of the previous year. This may be practical in some regions of the state and not others.



If a fog seal is to be placed on a repaired area, the materials in the repaired area should be completely cured before a fog seal is applied. Fog sealing on pavement repairs can be placed anytime after the repair has cured and prior to seal coat work.

The responsible maintenance personnel should coordinate repairs as far in advance as possible. This will enable them to plan schedules and needed materials accordingly.



Always repair the cause, and not just patch over the failure. If the cause of the failure is not addressed, it will always come back.

See Appendix A for slides

Figure 3-1. The Result of an Underlying Failure not being Properly Repaired.

Figure 3-2. Example of a Full Depth Repair.

Types of Repairs

Many different types of repairs may be required as described below.

Milling or Planing. High spots in the existing surface may be planed smooth with either a heater planer or, more commonly, a cold planer. This will help to smooth out a rough riding surface.

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See Appendix A for slides

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See Appendix A for slides

Level-Up. Depressions may require leveling up with either a hot- or cold-laid asphalt mix. The sizes of this type of patch will vary, of course, but may range from the size of a wheel path only a few feet in length to a full two-lanes wide and 50 feet or more in length.

Figure 3-3. Example of a Spot Level-Up.

Pothole Repair. All potholes must be repaired in a permanent manner before the seal coat is applied.

Base Repair. All base failures must be repaired before seal coat work. This may require an in-place repair or removal and replacement with suitable material.

Edge Repair. Raveled edges and edge drop-offs must be repaired. If vegetation and soil has built-up at the pavement edge, it must be removed and the pavement edge restored.

Figure 3-4. Edge in Need of Repair.

Crack Sealing. Large cracks must be sealed with a crack sealant. If they are excessively large, it may be necessary to cut them out and apply a hot or cold mix patch. Cracks this large, however, are not common in Texas, unless there has been a failure or distress in the base or subbase. In this event, maintenance personnel must remove the whole section, including the base or subbase, and completely rebuild it.

Figure 3-5. Example of Edge Cracking Needing Crack Seal.

Additional Seal Coat Preparation Considerations

- Fill Ruts– Be sure the rut is not an underlying pavement failure.

Figure 3-6. Example of Moderate Rutting Suitable for Level-Up.

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See Appendix A for slides

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See Appendix A for slides

❖ Herbicide Edges – Herbicide all edges and shoulders that have grass or weeds growing in them. Leaving vegetation growing in the pavement will cause deterioration.

Figure 3-7. Surface deterioration due to encroaching vegetation.

❖ Cut Off High Edges – Cut off all buildup on the edges to get the water off the road and not down the edge. Preventing the water from standing on the road will help prevent the damage.

Figure 3-8. High Edge Resulting in Pavement Edge Corrision.

- Repair Public Access Intersections – Repair these as you would repair a roadway. It is important to keep these in good repair.

Figure 3-9. Public Access Roadway Intersection Ready for Sealing.

- Fog Seal Fresh Patches and Edges– Fog seal fresh patches to help seal off the surface to prevent loss of rock and bleeding. Insure adequate compaction is being achieved when placing patches.

Figure 3-10. Edge in need of repair and fog seal.

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See Appendix A for slides

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What Not to Do

- Do not seal asphalt repairs that are less than 3 months old.
- Do not edge seal after the seal coat.
- Do not perform level-ups after the seal coat.
- Do not seal dirty gutters in curb and gutter areas.
- Do not wait too late to get started on preparatory work.
- Do not omit tack when laying blade patches.

Figure 3-11. Aggregate Loss Due to Fresh Patches.

Figure 3-12. Shelling Rock from Fresh Patch.

See Appendix A for slides

Figure 3-13. Results of No Tack.

Figure 3-14. Dirty Gutters.

For additional photos of road repairs, please see Appendix B.

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See Appendix A for slides

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Section 3 – Stockpiling Aggregate

General
TxDOT's Standard Specifications allow the contractor to stockpile aggregate to be used on the project at locations approved by the engineer. For the sake of efficiency, most contractors will elect to do this. There are, however, some steps that must be taken before stockpiles are placed on the job site.

Supplier
The supplier provides a tentative agreement that the required materials will be available before the contractor submits a bid on the project. When the contract is awarded, the contractor identifies his supplier to the engineer.

Aggregate Sampling and Testing
The plans, specifications, and special provisions identify the required tests for the aggregate. TxDOT's *Manual of Testing Procedures (2002)* defines the test procedures, which are located at: www.dot.state.tx.us/services/consturction/test_procedures. The sampling and testing locations and frequencies are in TxDOT's "Guide Schedule of Sampling and Testing" located at: ftp://ftp.dot.state.tx.us/pub/txdot-info/cmd/guide_schedule.pdf

Item 6.1 of the Standard Specifications states, "All materials being used are subject to inspection or tests at any time during preparation or use. Any material which has been tested and accepted at the source of supply may be subjected to a check test after delivery, and all materials which, when re-tested, do not meet the requirements of the specifications will be rejected."

The method and location of sampling materials should be consistent and uniform. The AE can retest accepted materials if the material shows visible changes, does not conform to specifications, or if further testing is called for by the specifications or Guide Schedule. Construction Materials and Pavements (CST M&P) *Material Inspection Guide* located at: http://crossroads/org/cst/docs/mig.pdf contains additional material specific information on sampling and testing responsibilities. Note: Only TxDOT personnel will have access to this document.

See Appendix A for slides

Stockpile Locations
Normally, the contractor proposes the stockpile locations to the project engineer for approval. TxDOT Standard Specifications for surface treatments (Item 316) gives broad restrictions on stockpile locations as follows:

- Should be at least 30 feet from roadway,
- Should not obstruct traffic or sight distance,
- Should not interfere with the access from abutting property, and
- Should not interfere with roadway drainage.

Contamination
Stockpiles must be placed so that they are not contaminated. Extreme care must be taken that clay and mud do not pose a problem. Stockpiling should not be situated such that roadway drainage will cause the aggregate to remain excessively wet.

Area Preparation
If necessary, the contractor may be required to prepare a stockpile area before the aggregate is placed on it. He may be required to level it with a dozer or motor grader and to clear it of any debris, such as vegetation, rocks, and sticks. Appropriate storm water pollution prevention devices should be placed as necessary.

Proper Stockpile Techniques
Stockpiles should be placed in a manner that will minimize (or prevent) segregation and degradation.

Segregation. The separation of the different-sized aggregate particles. Segregation would result in one part of the stockpile containing only the coarser particles and another area containing only finer particles. Ideally, any sample taken from any area of the stockpile should contain a representative sampling of the complete range of sizes.

Degradation. The breaking apart of the aggregate particles. This, of course, would result in a finer gradation of aggregate than desired. Degradation occurs most commonly from improper operation of the front loader, rather than improperly constructed stockpiles. Figure 3-15 shows a properly placed stockpile. Note the series of loads that have been placed adjacent to each other. Stockpiles should *not* be placed in one high cone-shaped heap, because segregation is almost certain to occur.

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See Appendix A for slides

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Figure 3-15. Properly Placed Aggregate Stockpiles.

See Appendix A for slides

Section 4 – Preconstruction Meeting

General
When all sampling and testing have been accomplished, and before work begins, it is necessary for the contractor and his representatives to meet with TxDOT's representatives. During this meeting, the participants develop a "game plan" and work out the final details.

Meeting Objectives
Specifically, the preconstruction meeting should meet the following objectives:

Meeting All Personnel Involved. The contractor and his foreman and supervisors meet the project engineer, chief inspector, and the other project inspectors in the preconstruction meeting. This is sometimes the first time these two groups have ever met each other in person.

Establish Working Relationship. The preconstruction meeting provides an opportunity to establish a harmonious, yet professional working relationship between key personnel involved in the project. It is necessary for TxDOT personnel to be able to work in harmony with the contractor's personnel; otherwise, every day of the project can be agony. Yet, as representatives of the taxpayers of Texas, key personnel must maintain a professional image.

Define Responsibilities. All project personnel must be aware of the chain of command or escalation ladder in the event of project-related conflicts.

Define Work Schedule. TxDOT and the contractor should agree on a work schedule that defines the roadways to be seal coated. They should reach a general agreement on the sequence of lanes to be sealed, and any unique features should be discussed.

Review Traffic Control. Traffic control and handling must be discussed. Ensuring the safety of the traveling public during construction projects is critically important. Traffic handling methods, devices, signs, and barricades must be discussed in detail. Emphasis should be placed on the correct flagging procedures.

Identify Work Days and Holidays. By contract, a project must be completed within a specified number of days. The contractor should inform the engineer if he intends to work any weekends or holidays.

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See Appendix A for slides

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Miscellaneous. Discuss any other pertinent information concerning the project at this meeting. Both TxDOT and the contractor's representatives should leave the meeting with a full understanding of the project.

Attendees

There is no specific rule as to who should attend the preconstruction meeting. The project supervisor, foreman, and any other supervisory personnel on the project should represent the contractor. It is highly recommended that the following TxDOT personnel attend (as a minimum):

- Project Engineer,
- Area Engineer(s),
- Maintenance Supervisor(s),
- Director of Maintenance,
- District Laboratory Engineer, and
- Inspectors.

If traffic is expected to be a major factor, sometimes the Department of Public Safety (DPS) will be represented. Occasionally, a representative of the local police department will attend, especially if the project is located in a major metropolitan area. This police inclusion is recommended.

Any other people who have a direct interest or responsibility in the project may be invited to attend. This may include the district public information and safety representatives, Federal Highway Administration personnel, and occasionally, a representative of the asphalt supplier, especially if a special binder is specified.

See Appendix A for slides

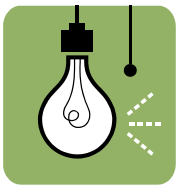
Chapter 4 – Equipment Inspection

When this chapter is over, you will be able to:

- List the typical types of equipment required for a seal coat project.
- Explain the general inspection procedures for seal coat equipment on the job site.

Section 1 – Introduction

General



Inspectors of seal coat work must be knowledgeable of the capabilities and limitations of the equipment. Equipment must be properly calibrated, well maintained, and functioning correctly to have a successful seal coat project.

This chapter will provide basic knowledge and general inspection procedures for the following typical types of equipment:

- Rotary broom,
- Asphalt distributor,
- Aggregate spreader,
- Haul trucks,
- Rollers,
- Front-end loader, and
- Heater and storage unit.

The contractor should provide a manufacturer's manual for each piece of equipment on the project to consult wherever specifications arise.

Provisions for Inspection

The contractor and project engineer typically coordinate the starting date of the project and set a date and time for the equipment to be assembled for inspection. It is advisable to set aside a minimum of half a day for equipment inspection at least one day before seal coat work begins. Do not conduct the initial equipment inspection the first hour or two of the morning the project begins. Even if all the equipment was functioning correctly on the last project, equipment problems can occur during the movement of the equipment. Allow plenty of time to carefully inspect all equipment, and to correct any discrepancies that are found.

Inspecting for Leaks

Visually inspect all equipment used on the project for leakage of any substance that might contaminate the asphalt, aggregate, or prevent adhesion to the pavement surface. These substances include fuel (both diesel and gasoline), hydraulic fluid, engine coolant, crankcase oil, and transmission fluid.

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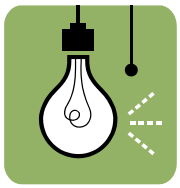

Inspecting for leaks is extremely important, not only before the project begins, but throughout the entire project. If a leak is detected in any piece of equipment, remove the equipment from the roadway until it is repaired.

Safety

Follow the manufacturer's safety procedures for inspection and operation of all equipment.

Additional safety procedures should be followed for any equipment used for transporting, storing, or applying asphalt materials. Heating asphalt binder always constitutes some degree of hazard, with the exception perhaps of emulsions. The most hazardous are cutback asphalts because of the highly flammable solvents used. Extreme care must be taken not to allow open flames to come in contact with the asphalt or the gases from these materials. When working with asphalt cement, the major safety concern is related to the high temperature of the binder. Asphalt cement at 300°F can cause very severe burns. Avoid standing near the asphalt distributor during heating and operation unless necessary. Although the operator should not stand near the asphalt distributor, the operator should not leave the equipment unattended when heating and be prepared with a fire extinguisher. It is recommended that a copy of the Material Safety Data Sheet (MSDS) for the binder being used be kept with the asphalt distributor truck. In addition, refer to TxDOT's Occupational Safety Manual, Chapter 7, Safety Standards and Safe Practices regarding asphalt heaters, distributors, and storage.

See Appendix A for slides

Section 2 – Rotary Broom

General

Adequately broom the pavement before asphalt is applied. This must be performed thoroughly to ensure an adequate bond of the asphalt to the pavement. Also broom a finished seal coat to remove excess aggregate particles. Power rotary brooms are used for these purposes. Figure 4-1 shows an example of a rotary broom. A vacuum sweeper is another type of broom which may also be used to clean the pavement.

Figure 4-1. Rotary Broom.

Rotary brooms for seal coat work should be self-propelled, four-wheeled, and capable of operating in both forward and reverse. Either a gasoline or diesel engine powers the rotary brooms. The bristle brush should be capable of being raised, lowered, and rotated horizontally. Figure 4-2 shows the bristle brush on a rotary broom.

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See Appendix A for slides

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Figure 4-2. Bristle Brush on Rotary Broom.

Identifying Data
As with other pieces of equipment, the manufacturer's name, model number, and serial number may be recorded and entered in the project folder. The inspector should record in the project diary that the equipment was inspected and found acceptable for use on the project.

Safety Markings
The rotary broom, or sweeper as it is often called, operates well ahead of the rest of the equipment. This puts it in a very vulnerable position on many roads, due to its tendency to create dust and the exposure to traffic. Safety markings, lights, and flags must be in place on the broom and checked for the benefit of the traveling public as well as the sweeper operator.

Bristles
The bristles may be nylon or fiber, or some may be a combination of nylon and steel bristles. The bristles on the sweeper should be checked to ensure they are in good condition. The width of the brush should be checked for evenness. If the bristles are worn off unevenly, too much pressure will be exerted in one spot and the bristles may not make contact in another. Replace the bristle assembly if there is visible unevenness.

Rotary and Hydraulic Lift Controls
The brush should be inspected to see that it can be raised and lowered and that it can be rotated horizontally. It should be capable of discharging dirt and debris or aggregate to the left or right. The rotary control should start and stop the rotating promptly.

See Appendix A for slides

Older Model Brooms

Some of the older types of brooms have a separate hydraulic cylinder at each end of the broom, which raises and lowers the brush assembly. These cylinders are operated with separate controls. Sometimes, the two cylinders do not exert even pressure, causing one end of the broom to exert heavy pressure on the pavement while the other end barely contacts the surface. This is not a problem with newer models, since they are now manufactured with single controls. If an older model is being used on the job, take care to watch for uneven pressure at opposite ends of the brush.

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See Appendix A for slides

Section 3 – Asphalt Distributor

Notes:

General

The asphalt distributor is the most complex piece of equipment used in seal coat construction work because it has many components, and all must be operating properly.

Key Terminology

An asphalt distributor is a truck-mounted, insulated tank, with numerous special purpose attachments. Figure 4-3 shows a typical asphalt distributor.

Figure 4-3. Typical Asphalt Distributor.

The major components are:

- Asphalt tank,
- Heating system,
- Circulating and pumping system,
- Filter screens,
- Spray bar and nozzles,
- Hand sprayer, and
- Controls and gauges.

The inspectors should record the serial number and model of the asphalt distributor and enter this information in the project folder.

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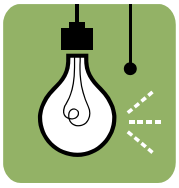
Asphalt Binder Tank

The asphalt distributor tanks vary in size. Those used for most seal coat work hold from 1000 to 2000 gallons of asphalt binder. Some tanks may be larger or smaller, but this range is adequate for most jobs. The tank is insulated to prevent the asphalt from cooling too quickly. Asphalt cement temperatures for seal coat work are commonly well over 300°F. If the tanks were not well insulated, the asphalt would cool quickly near the skin of the tank and could harden to unworkable levels.

The distributor must have a current calibration certificate in accordance with Test Method Tex-922-K, Part I. This means that the distributor has been checked to determine the accuracy of the measuring stick (strap stick) and the capacity of the tank. The calibration certificate is considered valid as long as it is current and there is no evidence or reason to suspect that any major modifications have been made to the distributor tank.

The tank unit should be visually inspected inside before it is filled. It should be clean to prevent contamination or mixing of different types of asphalt.



Use extreme caution to avoid chemical or physical reactions that can occur when different asphalt binders are inadvertently used in the same tank. An example is pumping hot asphalt into a distributor that previously held asphalt emulsion.

The heater unit should be checked for proper starting and operation. Each burner should operate independently to allow either one to be used alone or simultaneously. The burner flames must be adjustable to regulate the amount of heat being directed into the flues. The fuel lines and burners should be free of fuel leaks.

Baffle Plates and Flues. The inside of the tank contains two or three baffle plates to stabilize the load while in motion. This is especially critical where a constant spray pressure is necessary. The tank has either one or two flues or heat ducts running lengthwise in the tank. These flues allow heat to be conducted into the center of the tank. In spite of the insulation in the tank, some heat loss is inevitable. By use of a burner system in combination with recirculation within the tank, the asphalt can be heated uniformly. Always keep material above the flues when heating. Material below

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the flues is subject to igniting. Figure 4-4 shows the baffles and flues running through the asphalt tank.

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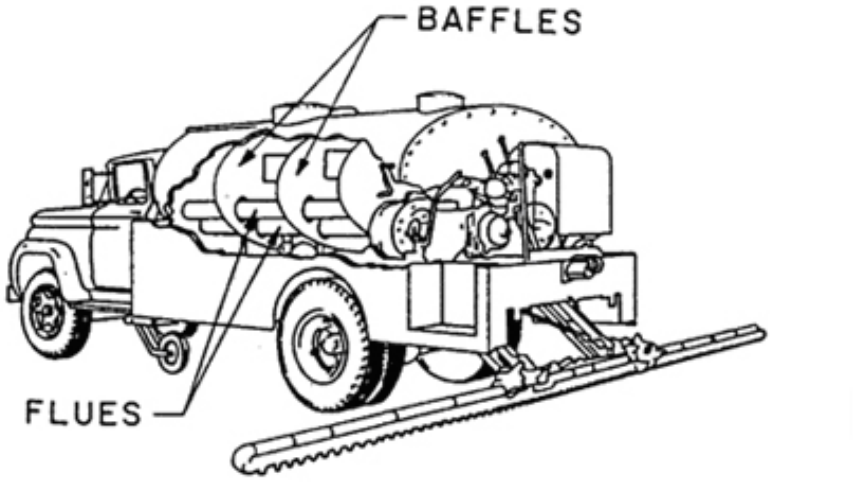

Figure 4-4. Illustration of Baffles and Flues Inside Distributor Tank.

Thermometer. The tank should be equipped with a thermometer. The thermometer should have a range from below 100°F to at least 400°F. Many models have a mercury thermometer mounted in a well in the side of the tank. It should have a chain to prevent it from being dropped and a screw-on cap to keep the well covered. Some models of distributors use a dial-type thermometer mounted outside the tank. These use a thermocouple that is mounted inside the tank. Both types of thermometers are acceptable and should be checked for accuracy. Infrared thermometers can be used to verify asphalt temperature. Another verification technique is to obtain a sample of the asphalt from the distributor and check with a separate thermometer. Figure 4-5 shows the tank thermometer being removed for taking a temperature reading.

Figure 4-5. Thermometer Removed from Distributor Tank.

See Appendix A for slides

Manhole. At the top of the tank is an opening commonly called a manhole. It has a heavy, hinged lid with a fastener. The manhole is used in filling the tank and permits visual inspection of the tank and its contents. The manhole is also opened to measure the amount of asphalt in the tank using a calibrated strap stick. The measuring process is called "strapping the tank" and will be described in detail in Chapter 5. Figure 4-6 shows the manhole cover from the top of the tank.

Vent. All asphalt distributor tanks are equipped with a vent. The location of the vent will vary according to the manufacturer. Take care to ensure that the distributor is always parked where there is adequate crosswind to prevent an accumulation of fumes (from the vent) to come in contact with the burner flame. This is especially true when using cutback asphalts. Distributors have caught fire producing a total loss of the equipment. The cause has usually been associated with operator error by leaving a distributor heating and unattended.

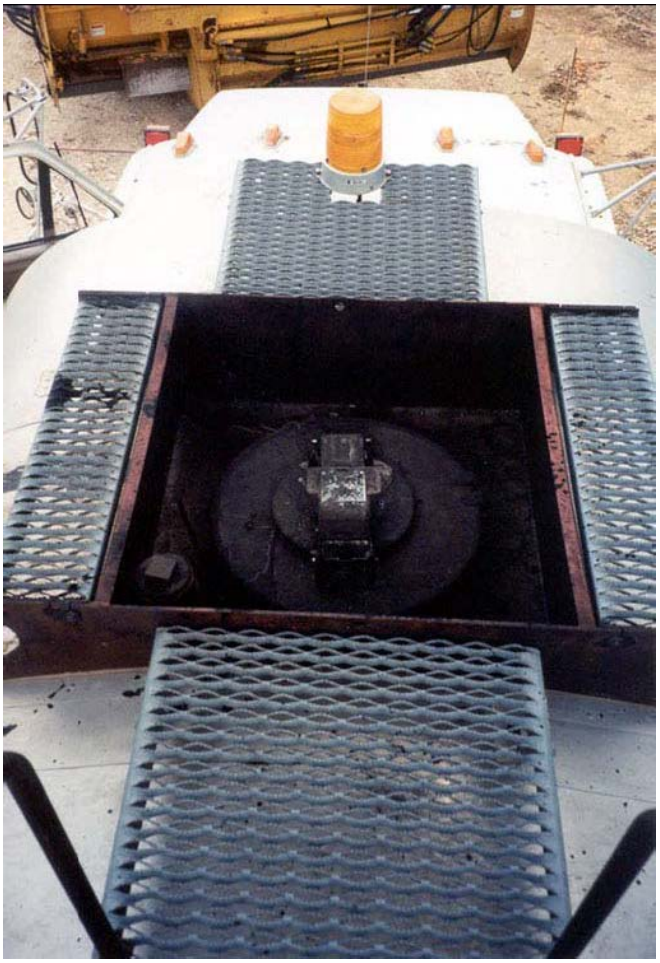

Figure 4-6. Manhole Cover on Top of Distributor Tank.

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Distributor Heating System

Asphalt temperature is a critical factor in the success of a seal coat/surface treatment. To maintain a constant temperature, a proper heating system is necessary.

Burners. Depending on the make and size of the distributor, either one or two propane–or diesel fired–burners are used. The burners are mounted on the platform at the rear of the tank and are positioned so the flame is directed into the flues that pass through the tank. Figure 4-7 shows a typical configuration.

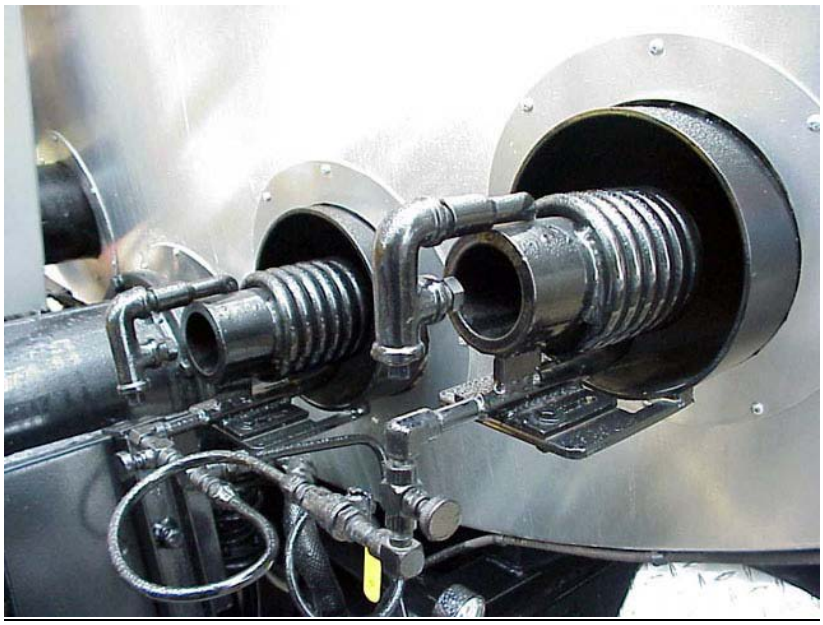

Figure 4-7. Burner Configuration at Rear of Tank.

Heating. The need for heating will depend on the following:

- Type of asphalt binder being used,
- Ambient temperature,
- Length of time the binder is in the distributor before being sprayed on roadway, and
- Whether the distributor is filled directly from heated storage tanks or has been hauled some distance in an insulated transporter.

Most emulsions used for seal coats are applied at 120°F to 160°F. When using asphalt cement, application temperatures may range from 275°F to 375°F. Application temperatures for cutback asphalts may range from 125°F to 275°F. Cutbacks should be shot 25°F to 50°F below their respective flash point. For each binder type, refer to Item 300, *Asphalts, Oils, and Emulsions,* for correct heating and application temperatures.

Distributor Circulation and Pumping System

All asphalt distributors must have a power-driven pump to spray asphalt under pressure onto the roadway. The pumps also serve to provide a circulation system. There are two systems commonly used to supply pressure to the spray circulation system. One system has a separate engine mounted at the rear of the tank. This engine supplies power to the pump only. Power from the truck engine operates the pump on the other system. Figure 4-8 shows a truck-mounted hydrostatic distributor system. Figure 4-9 shows a truck-mounted asphalt distributor and Figure 4-10 shows a trailer-mounted distributor.

Figure 4-8. Hydrostatic Distributor Located at Front of Truck.

Figure 4-9. Truck-Mounted Asphalt Distributor.

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Figure 4-10. Trailer-Mounted Asphalt Distributor.

Function. In addition to providing the power to spray asphalt binder on the road, the pump provides power to perform the following functions:

- Circulate the asphalt throughout the tank. This is necessary to prevent asphalt from burning if it remained next to the flues for an extended period. Also, it will prevent asphalt from remaining near the skin of the tank long enough to cool and harden.
- Circulate asphalt through the spray bar and bring unused asphalt back into the tank. This will prevent asphalt from remaining in the spray bar long enough to cool, harden, and clog the spray nozzles.
- Pump unused asphalt out of the distributor.
- Pump from one storage tank to another. It may be used as an auxiliary pump to transfer asphalt from one tank to another.
- Fill the distributor tank. If a storage tank, heater unit, or transporter unit is not equipped with a pump, the distributor spray pump may be used to fill the distributor tank.

Filter Screens

Most distributors have filter screens in the main piping between the tank and the spray bar. These wire-mesh filters prevent particles of burned asphalt or impurities from entering the spray bar and clogging the spray nozzles.

These screens should be removed and washed with diesel fuel, or particles should be burned off with a torch. This will prevent a

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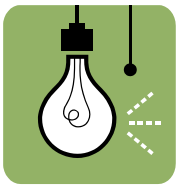
blockage of the flow of asphalt, allowing it to flow under full pressure to the nozzles. On a large project, the filters should be cleaned periodically.

Distributor Spray Bar

The spray bar and spray nozzles regulate the amount of asphalt sprayed on the roadway and regulate the spray pattern. Figure 4-11 shows a typical distributor spray bar.

Figure 4-11. Typical Distributor Spray Bar.



The spray bar on most distributors used on seal coat projects is 12 feet wide – the width of a typical traffic lane. Different bar widths are available. TxDOT recommends ten to 14-foot widths.

A series of evenly spaced (every four inches) spray nozzles along it compose the spray bar. It contains a return line for continuous circulation of asphalt through the bar. Some models are equipped with shut-off valves on each nozzle to allow closing a few spray nozzles for spraying irregular areas. Figure 4-12 shows the nozzles on a typical spray bar.

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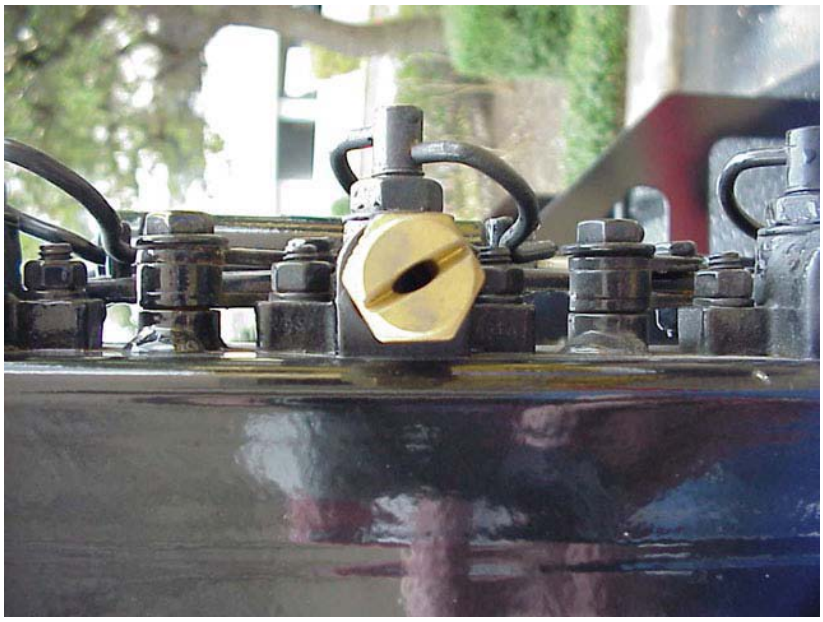

Figure 4-12. Nozzle on Typical Spray Bar.

Hinged Bar. Most spray bars are hinged at each end to allow the end to be folded up when spraying is not in progress. Never drive the distributor in traffic with the ends extended, because they extend beyond the sides of the truck. Some have chains attached at the ends of the bar and to the truck chassis. The chains help to support the ends of the bar when they are in the spray position. Chains may also serve as a safety hitch to hold the ends securely in the upright position. Figure 4-13 shows the spray bar ends folded up.

Figure 4-13. Hinged Spray Bar with Ends Folded Up.

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Spray Nozzles. Nozzles are manufactured with different size openings to permit different application rates of asphalt. Nozzles are designed to spray a fan-shaped pattern, rather than a circular spray. Figure 4-14 shows the spray nozzles viewed from the top. Figure 4-15 shows the spray nozzles viewed from behind the distributor. Some distributors are equipped with a second spray bar, sometimes called a *wheelpath bar*. This second spray bar is used to spray a different application rate in the wheelpath and is controlled with a separate computer.

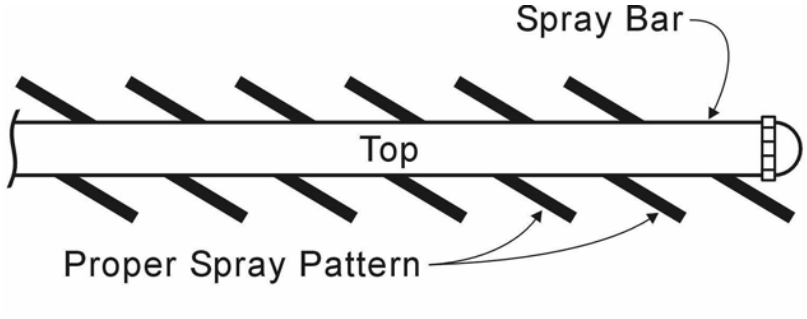

Figure 4-14. View of Distributor Bar as Seen from Top of Distributor.

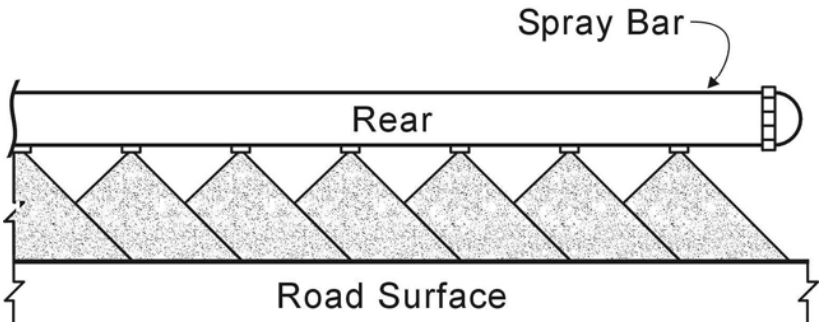

Figure 4-15. View of Distributor Bar as Seen from Rear of Distributor.

Inspecting the Spray Bar. To inspect the spray bar, raise it and, if possible, rotate it outward so the nozzles can be inspected as shown in Figure 4-16. The nozzles are critical to obtain uniform asphalt coverage. They must be in good condition and properly oriented to obtain consistent asphalt coverage across the width of the lane being sealed. Nozzles are typically made of brass and can easily be gouged or otherwise damaged, which will affect spray pattern.

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Figure 4-16. Distributor Spray Bar Rotated Outward.

The following is a list of several items on the spray bar that must be inspected.

- Spray Bar Ends. Check the ends of the bar to see if they can be raised and lowered. There should be some method of securing the ends in the raised position. Most models are equipped with a chain device to secure the ends when raised.
- Bar Position. The bar should be straight when the ends are lowered. Check the position in all directions. Spray patterns will be distorted if the bar is not straight.
- Hoses, Joints and Pipes. There should be no leaks in any of the hoses, joints, and pipes. If asphalt leaks onto the pavement when the distributor is not spraying, a puddle of asphalt will form. This type of spill is difficult to clean up and will usually result in too much asphalt at that location which will bleed through the cover aggregate.
- Spray Bar Width. Check the spray bar to ensure it is the correct width. Ensure that the proper amount of extensions and nozzles have been installed to cover the required width.
- Spray Bar Height. Check the height of the spray bar. The distributor must be parked on a flat, level surface, with the bar in the lowered position. Measure the height from the bottom of the nozzles to the pavement surface. Take measurements at various points across the width of the spray

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bar to ensure that the height is constant. Set the height according to the manufacturer's recommendations. Measure the bar height first with the tank empty and again after the tank is full. If there is more than about one inch difference, take corrective action. This will prevent a change in the overlap of the fan pattern between the beginning and end of a shot.

- Spray Nozzles. A nozzle is mounted every four inches along the width of the spray bar. The correct number of nozzles should be in place for the width being sealed. If a variable spray rate is to be used, check the nozzles to see that they are the proper size and in the correct location. If there are more nozzles than needed, the operator should close off the extra nozzles. To achieve a straight, sharp edge of asphalt coverage, use a deflector nozzle at the ends of the spray bar. Do not allow the end nozzle to be turned perpendicular to the spray bar axis in an attempt to get a sharp edge, because it will cause too much asphalt at the edge and it robs the next nozzle of the overlap normally provided by the end nozzle.

Nozzle Angle. Set the nozzles to the proper angle according to manufacturer's specifications. The angle is usually between 15° and 30°, as shown in Figure 4-17, depending on the manufacturer. All nozzles must be set at the same angle to avoid distortion of the spray pattern. Every distributor should be equipped with a tool used to accurately set the proper angle.

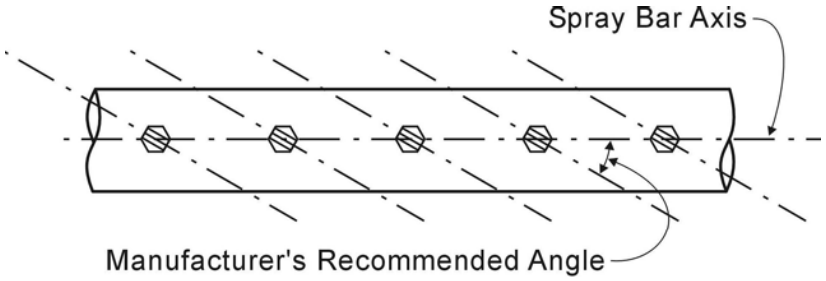

Figure 4-17. Nozzles on Spray Bar Set at Manufacturer's Recommended Angle.

The proper spray pattern depends directly on the exactness of the nozzle angles. If not set correctly, the fan pattern can be distorted as shown in Figure 4-18.

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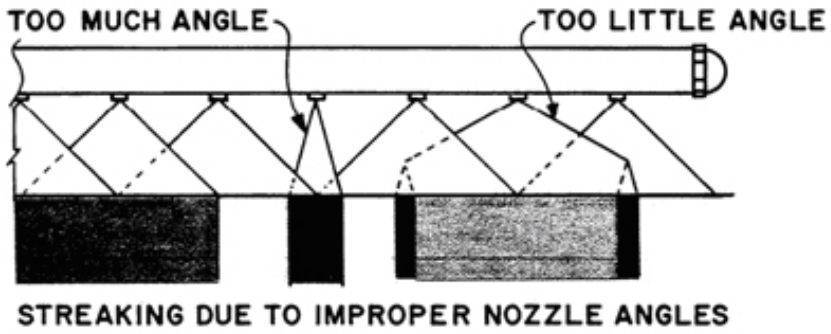

Figure 4-18. Effect of Incorrect Nozzle Angle.

Fan Width. In addition to the nozzle angle, the height of the spray bar is critical to obtaining a correct spray pattern. The height of the bar above the surface of the roadway determines how wide the fan spreads. Triple lap coverage as shown in Figure 4-19 is desirable and is achieved at a spray bar height of 12 inches.

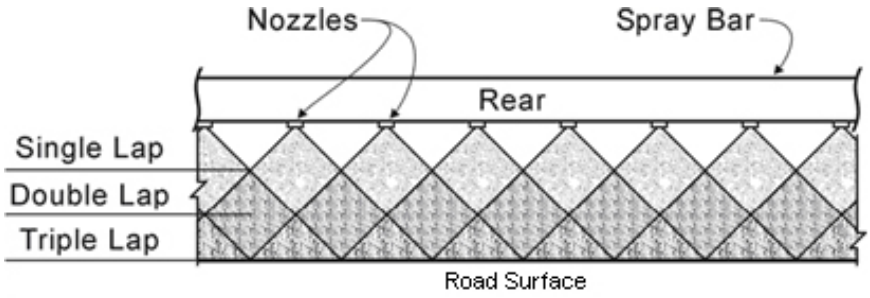

Figure 4-19. Various Asphalt Spray Patterns.

Standard truck springs will compress under a heavy load, and flex back to an arch when the load is removed. If an asphalt distributor had standard springs, the spray bar would be one height when the tank is full. As the asphalt is sprayed and the tank empties, the spray bar would rise with the decreased weight on the springs. Consequently, the beginning of the shot would have triple lap coverage, but the lap would increase as the spray bar height increases. This would cause streaking.

To avoid this inconsistency, most distributors are equipped to either prevent the springs from compressing under a load or to prevent them from arching back with a near-empty tank. Many are stabilized with compressed air. The important point is that the spray bar should remain at a constant height whether the tank is full or empty.

To check the fan width, the operator should back onto a flat area and place one or two layers of brown paper under the spray bar. Have the operator turn the spray on momentarily. Make certain he turns it off as quickly as possible. This will not give an exact representation of

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the fan widths, but it will quickly reveal any problems with the spray pattern. If this is not conclusive, the operator may spray a short test strip (20 to 30 feet). This will usually reveal any nozzle problems.

Nozzle Output. The amount of asphalt being sprayed out of each nozzle will vary. Nozzle output should be tested in accordance with TxDOT Test Method Tex 922-K, Part III (bucket test) to ensure each nozzle is spraying within the correct tolerance.

Buckets for the bucket test must be shaped so they will fit under the nozzles side-by-side. A 4-inch diameter by 8-inch height concrete cylinder mold as shown in Figure 4-20 is commonly used for the bucket test.

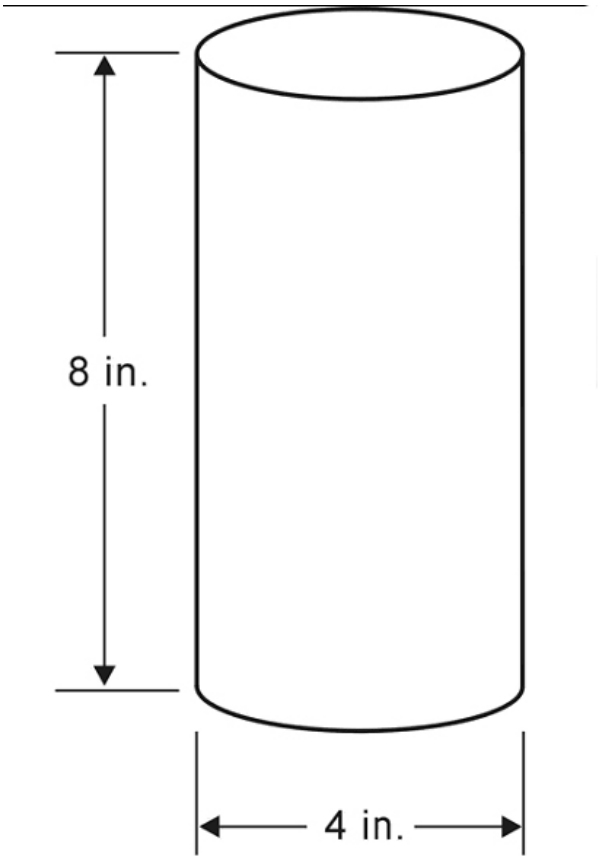

Figure 4-20. Concrete Cylinder Mold Typically Used for Spray Bar Calibration.

If asphalt is used for the test, heat it to the temperature at which it will be applied. Water may also be used for this test. Before the test begins, turn the spray bar on for a short period of time to make certain none of the nozzles are clogged. The distributor should be moved off the test area to *blow out* the nozzles.

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If all nozzles are working, the test can proceed. If any nozzles are clogged, removed and clean them or take them out of service.

Place a container under each nozzle to catch all the flow from that nozzle, as shown in Figure 4-21. Set the pump pressure or speed to match the application rate for the seal coat work. When the containers are all in position, turn the sprayer on briefly to fill the containers to about 3/4 full.

Figure 4-21. Calibration of Asphalt Distributor Spray Bar.

Item 316, *Surface Treatments,* requires that there be no more than a 10 percent variation in the weight of the contents between each bucket. If water is used for this test, all water must be removed from the distributor tank after calibrating the spray bar. Adding hot asphalt will cause water in the tank to be converted to steam resulting in an explosion, which may result in serious injury. At the least the asphalt tank is likely to overflow via the manhole, possibly endangering those nearby.

Transverse Variation. Some seal coat work may require the application of more asphalt binder outside the wheel paths to prevent aggregate shelling. Using different nozzle sizes outside the wheel path versus in the wheel path can achieve the rate variation.

Hand Sprayer

All distributors should be equipped with a hand sprayer for use in narrow, irregular-shaped areas that are inaccessible to the spray bar. Figure 4-22 shows a typical hand sprayer. The handle shown on the right side of Figure 4-23 also serves as the shut-off valve control. To turn the spray on, the operator turns the handle 90°.

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Figure 4-22. Typical Hand Sprayer on Asphalt Distributor.

Figure 4-23. Handle-Control Valve.

Distributor Controls and Gauges

The asphalt distributor must deliver a uniform and precise amount of asphalt onto the roadway. Equally as important is the need for consistency throughout the length of the asphalt shot. Many gauges and controls are necessary to achieve this consistency.

Thermometer. As mentioned earlier, a thermometer is used for monitoring asphalt temperature. Most are located in a well in the side of the tank. Some models have a dial thermometer mounted on the outside of the tank, with a thermocouple inside the tank. This type is more convenient to use and easier to read than the mercury thermometer, which must be removed from the well, but it is subject to malfunctions.

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Volume Gauge. Most tanks are equipped with a volume gauge, as shown in Figure 4-24. These should be used only as a convenience to the operator to know when the tank is getting close to empty. They should never be used as the basis for payment.

Figure 4-24. Volume Gauge on Distributor Tank.

Strap Stick. The manufacturer supplies a measuring stick (strap stick) with the distributor. Some distributors have the gallon levels on the stick itself. Others have a metal scale riveted on the side of the frame as seen in Figure 4-25. The stick or scale must be in accordance with Test Method Tex-922-K, Part I. Chapter 6, Section 12 discusses how the distributor is "strapped."

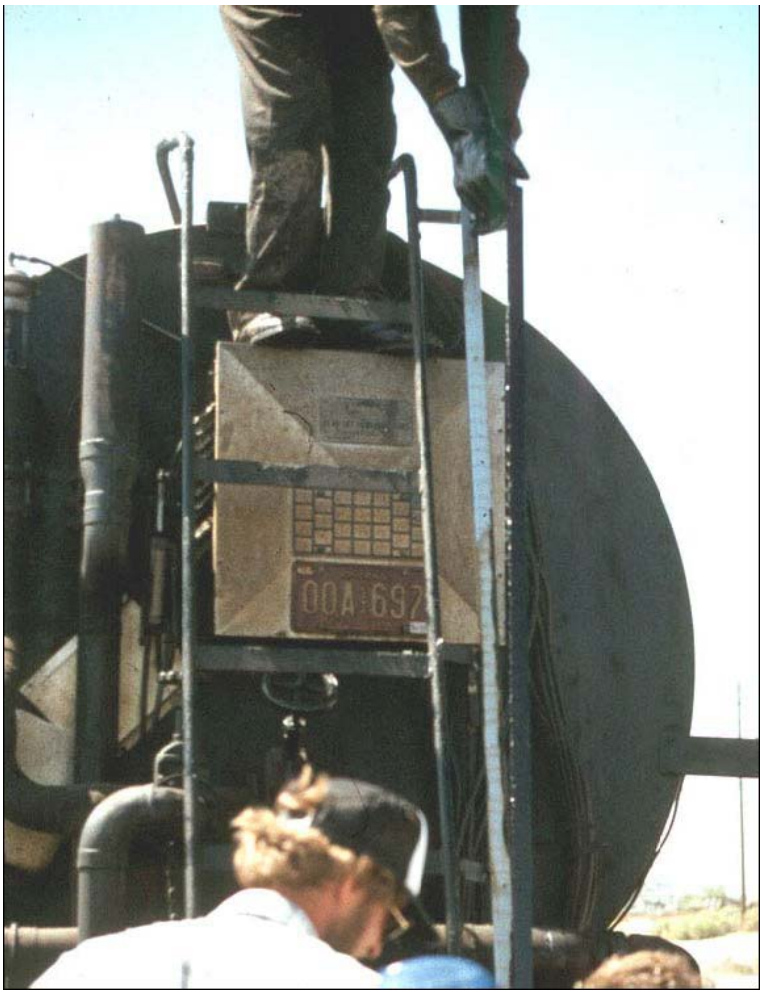

Figure 4-25. Strap Stick Used to Measure Quantity of Asphalt in Distributor Tank.

Pump Pressure or Rate. All asphalt distributors have a power-driven pump to spray asphalt under pressure onto the roadway. The pumps also provide a circulation system. Some distributors measure the pump pressure in pounds per square inch (psi) in the lines. This type of distributor is equipped with a conversion chart supplied by the manufacturer. The chart converts the amount of psi into gallons per minute (gpm) dispensed at the spray bar. The pump rate is measured in gallons per minute increments on another type of distributor.

The gauge is a very important device because the pressure under which asphalt is being sprayed will greatly influence the quality of the job. If the pressure is too low, the asphalt will streak and the pattern will be uneven. If the pressure is too high, the asphalt may atomize and the pattern may be distorted. High wind magnifies these ill effects.

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The pump should be operated at the highest pressure possible without atomizing the asphalt. Field tests are the way to determine the ideal pressure or pump rate. Once the ideal pressure is determined from the test, the pump should be operated at that rate or pressure.

Most distributors are computerized so that the desired binder application rate is set by the distributor operator who then must operate the vehicle at a specific engine RPM.

Digital-Measuring Instrument (DMI). Specifications require that a vehicle be furnished with a calibrated digital-measuring instrument, accurate to plus or minus six feet per mile. The inspector should verify that no modifications have been made that might affect the accuracy of the measuring instrument since calibration.

Valve Control. The valve control turns the spray on and off. A distributor operator must be able to turn all spray nozzles on and off simultaneously and instantaneously. This is a simple task in a computerized distributor and can be accomplished from inside the cab with a switch on the control panel, as shown in Figure 4-26.

At the beginning and end of a shot, the distributor passes over paper, which masks the pavement to form a straight, sharp line. The distributor must pass over the masking paper on both ends at spraying speed. The operator must be able to turn all nozzles on in the split second that the distributor passes over the masking paper.

Figure 4-26. Computerized Asphalt Distributor Controls.

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A *computerized* distributor may be operated by one person, but a *manually* operated distributor requires two people. On manually operated distributors, the driver lines up the machine and keeps it on line at the correct speed while the spray operator works the valve control and, on some models, sets the pump motor speed and monitors pump pressure. These two people must work as a team.

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Section 4 – Aggregate Spreader

General

Key Terminology

The aggregate spreader, sometimes called the "spreader box" distributes aggregate evenly over the film of asphalt sprayed by the asphalt distributor.

The specifications require aggregate spreaders to be self-propelled and have a continuous feed feature. Figure 4-27 shows the spreader most commonly seen on a seal coat project.

Figure 4-27. Aggregate Spreader or Spreader Box.

The spreader receives aggregate from a haul truck that dumps the aggregate into a receiving hopper at the rear of the spreader. A conveyor system transports the aggregate to another bin at the front of the vehicle. Gravity spreads the aggregate evenly across adjustable gates, which allow precise amounts of aggregate to pass through.

The major components of the aggregate spreader are as follows:

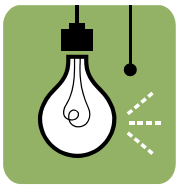
- Truck hitch,
- Receiving hopper,
- Belt conveyors,
- Spreading hopper,
- Discharge gates, and

- Discharge roller.

The spreader must distribute cover aggregate at a uniform rate over the entire width and length of the area being sealed. Not only must it be uniformly spread, it must also be the correct quantity of aggregate. For a clear understanding of how this is done, this section further describes each component of the spreader. Part of the visual inspection of the aggregate spreader should be directed at the overall condition of the power train, primarily detecting evidence of leaks in the engine and transmissions.

Record the manufacturer's name, spreader model number, and serial number.

Truck Hitch



To be operated properly, the haul truck backs up to the spreader; a coupling on the spreader engages on the rear of the truck; the coupling locks securely together; and the spreader box *pulls* the truck (in neutral gear position) behind it. The truck should not push the spreader box. This is very important because the amount of aggregate covering the asphalt depends partially on the traveling speed of the spreader. Thus, to maintain a constant speed and ensure a uniform aggregate application rate, the spreader must regulate its own speed.

The spreader coupling must be able to lock securely with the truck hitch, and the spreader box operator must be able to release the hitch easily and quickly. Figure 4-28 is a photo of a typical spreader box truck hitch arrangement.

Visually check the truck hitch for anything broken or bent. Ensure the locking mechanism is working properly by having a truck hook up to the spreader box. Have the operator manipulate the release to be sure it will disengage the truck effectively.

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Figure 4-28. Aggregate Spreader Truck Hitch.

Receiving Hopper

After the truck has engaged the hitch on the spreader, the operator raises the truck bed and dumps aggregate into the receiving hopper. Figure 4-29 shows the receiving hopper. Its only function is to receive the aggregate from the truck. At the bottom of the receiving hopper, there are openings through which the belt conveyors must pass in a continuous loop. A rubber shield prevents aggregate from piling up on the belt, being carried ahead of the receiving hopper and being spilled onto the ground. This shield should not be torn or missing so that it can function properly.

Figure 4-29. Receiving Hopper of Aggregate Spreader.

Visually check the receiving hopper for overall condition. There should be no holes or large gaps that would allow aggregate to fall through to the road surface. The conveyor belt system should have

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rubber, neoprene, or fabric cowling (or flaps) around it to prevent aggregate loss. There should also be a flap on top of the receiving hopper to ensure a tight fit against haul trucks as the aggregate is being dumped into the receiving hopper.

Belt Conveyors
Two belt conveyors transport the aggregate. These can be seen on each side of the photo in Figure 4-30. These belts must be in good condition and not frayed enough to allow aggregate to spill over the sides onto the roadway.

The operator should start the conveyors and demonstrate the speed control. Vary the speed to ensure that the supply of aggregate reaching the front hopper can be increased or decreased as needed.

There should not be an excessive amount of slack in the belts since this will cause sagging and loss of aggregate off the sides. If there is too much slack, tighten the belts.

Figure 4-30. Belt Conveyors on Aggregate Spreader.

Discharge Hopper
The discharge hopper receives the aggregate from the belt conveyors and distributes it laterally in the hopper. The aggregate falls over two angular devices at the top of the discharge hopper, as seen in Figure 4-31. This photo also shows a scalping device. This can consist of either a series of bars or a coarse mesh to separate any large rocks, dirt clods, or weeds from the aggregate.

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See Appendix A for slides

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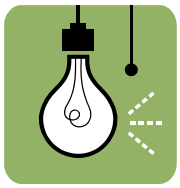
Check the hopper to ensure that it is clean and does not contain any aggregate particles from a previous project. Check the scalping grate to ensure that it covers the entire top of the hopper. This grate performs the very important function of keeping large clay balls and other foreign matter out of the fresh asphalt binder. Also, there should be no holes or cracks in the hopper where aggregate can fall through and cause a ridge or row of excess aggregate.



Check the exterior of the discharge hopper for damage. Occasionally, the operator drives a spreader over a large rock or other object damaging the lower front corners. Damage of this sort may be critical because the roller bearings are held in a casing in this section of the hopper. Damage can cause the roller to wobble resulting in an uneven flow of aggregate.

Figure 4-31. Discharge Hopper of Aggregate Spreader.

Discharge Gates

On the bottom of the discharge hopper are a series of discharge gates, as shown in Figure 4-32, that can be opened by operator control to discharge the aggregate. A switch located at the top and in the front of the discharge hopper can open or close each gate individually.

Check to see that they are correctly adjusted to close the gates fully. You will not be able to judge whether the adjustment is correct when the gates are open until the spreader is actually dispensing aggregate.

See Appendix A for slides

Figure 4-32. Discharge Gates on Aggregate Spreader.

Discharge Roller

Some aggregate spreaders have a roller at the bottom of the discharge gates which spins to assure an even flow of aggregate onto the asphalt. This roller (Figure 4-33) ensures that an even amount of aggregate is spread laterally across the pavement. The roller must be straight, not warped, for the aggregate to be distributed evenly.

Visually examine the discharge roller to ensure there is no mud or other debris caked on its surface. Stretch a string line from end to end of the roller to be certain it is not warped. To check the end bearings of the roller for excessive wear, turn on the spreader and observe for wobble in the roller or noise coming from the bearings as they turn.

Figure 4-33. Discharge Roller on Aggregate Spreader.

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See Appendix A for slides

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See Appendix A for slides

Wheels and Tires

With the spreader in motion, observe the wheels for any indication of wheel wobble or excessive *toe-in* or *toe-out*. Any of these conditions will tend to cause the tires to scuff the aggregate. The spreader box is the first vehicle to drive over the freshly placed aggregate, and when the spreader's tires pass over the aggregate, the aggregate particles will still be in unarranged positions. Any scuffing by the spreader's tires may shove the aggregate sideways rather than straight downward. Scuffing will appear as a dark, ragged-looking strip causing asphalt to be picked up on the tires of the pneumatic rollers.

Check the tires to detect any gouges that might adversely affect the aggregate arrangement. Gouges that may weaken the sidewall could lead to a tire blowout. Change this type of faulty tire before the project starts.

Brakes and Clutch

The operator should stop and start the spreader a few times so the operation of the clutch and brakes can be checked.

Tailgate Aggregate Spreader

The tailgate of a haul truck is sometimes used as an aggregate spreader by state maintenance forces in spot sealing. Some TxDOT districts have installed air-operated tailgate spreaders. Figures 4-34-A through D show how modifications can be made to the typical truck so that an employee is no longer needed to ride on the tailgate spreader. This will reduce the number of employees needed in the crew and improve safety in the operation.

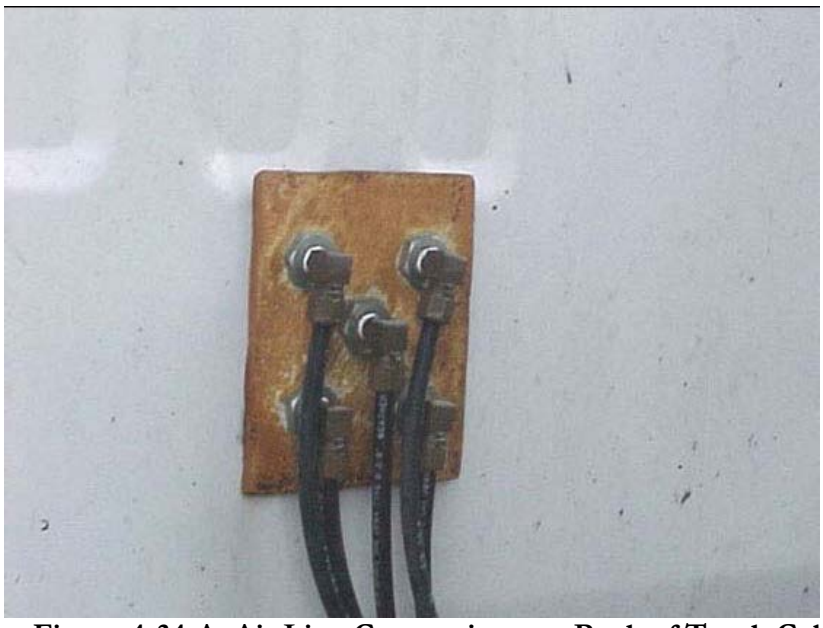

Figure 4-34-A. Air Line Connections on Back of Truck Cab.

Figure 4-34-B. Control Valve in Truck Cab.

Figure 4-34-C. Mirror to View Rock in Truck and Rock Flow.

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See Appendix A for slides

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Figure 4-34-D. Air Cylinder to Open/Close Spreader.

Chip Spreader Calibration

- Adjust gates.
- Repeat test until all gates place same amount of aggregate ± 1 lb/sy.
- Then adjust main feed until correct quantity is placed.
- Can be done offsite the day before.

Figure 4-35. Chip Spreader Calibration.

See Appendix A for slides

Section 5 – Haul Trucks

General
The cover aggregate is stockpiled before the start of the seal coat project. The stockpiles are placed alongside the roadway in the immediate vicinity of the project so that the aggregate does not have to be hauled a long distance when seal coat work begins.

Key Terminology

The trucks used to transport the aggregate and dump it into the spreader box are usually of the end-dump variety. They are normally either tandem-axle or single axle trucks like the one shown in Figure 4-36.

Figure 4-36. End-Dump, Single-Axle Aggregate Haul Truck.

Size
The size of the truck bed is an important factor and is expressed in cubic yards. The single-axle trucks normally carry six cubic yards of aggregate.

The bed capacity for tandem-axle trucks is usually 12 or 14 cubic yards. The capacity may be increased by adding boards at the top of the sides.

Condition
All trucks used on a seal coat project should be in reasonably good mechanical condition. They should be free from leaking fuel,

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See Appendix A for slides

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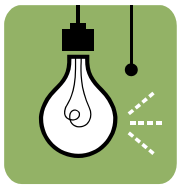
crankcase or transmission oil, engine coolant, and hydraulic fluid. Any of these fluids leaking onto a fresh seal coat usually prevent proper bonding of the asphalt and aggregate. All trucks must be legally registered to operate on the public highway and have appropriate safety equipment.

Hoist

All trucks must have a hoist mechanism to enable the bed to be raised in order to dump the load into the receiving hopper of the spreader unit. The truck operator should raise and lower the bed, so the operation of the hoist can be checked. The hoist mechanism should operate properly and be free of hydraulic leaks.

Tailgate

The tailgate should be hinged at the top and have the capability of being latched closed at the bottom as shown in Figure 4-37. This prevents the aggregate from spilling out until the tailgate is unlatched. As the bed is raised, check the locking mechanism on the tailgate. It should lock securely when the bed is in the down position and unlock smoothly as the bed begins to rise.



Hitch

Every truck should be equipped with a hitch that is compatible with the one on the spreader box. This is very important, since the spreader box *tows* the truck as the load is being emptied. In most cases, this is a bar-type hitch as shown in Figure 4-38.

Figure 4-37. Latch on Tailgate of Haul Truck.

See Appendix A for slides

Figure 4-38. Truck Hitch to Connect to Aggregate Spreader.

Identifying Numbers

TxDOT requires that each truck used on a seal coat contract have a unique identifying number attached similar to that shown in Figure 4-39. The number must be securely attached and clearly legible throughout the project.

Figure 4-39. Haul Truck with Identification Number Affixed.

This number enables the inspector to identify each truck on the project at a glance. Every truck must be inspected before the project begins, and the bed of each truck must be measured. It would be possible to substitute an unauthorized truck on the job if numbers were not plainly and immediately identifiable. Record the

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See Appendix A for slides

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identification number, the truck bed measurements, and cubic yard capacity.

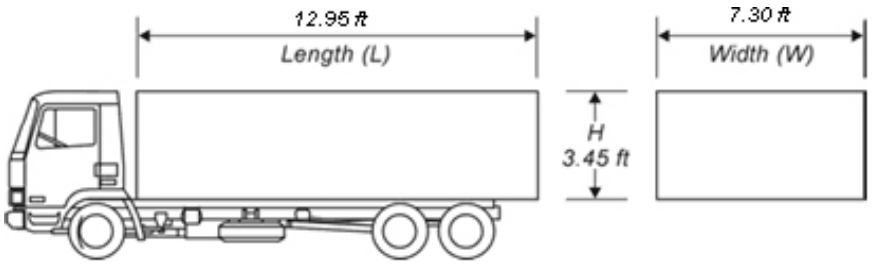
Bed Measurements

The volume of each truck bed must be obtained because aggregate is typically paid by the number of cubic yards placed on the roadway. Each truck is measured, and the number of full loads placed on the roadway is counted to arrive at the pay quantity of aggregate.

Ideally, all trucks used on the project should have the same capacity to easily compute the volume of aggregate placed on the roadway. No particular truck size is best.

Measure the length (L), width (W), and height (H) of the inside of the truck bed to the nearest 0.05 feet as shown in the example below. Multiply these three measurements to obtain the volume in cubic feet. Then convert this product to cubic yards by dividing by 27 as shown in the following example.

Example: Volume of Truck Bed (V):



$$V = \frac{L \times W \times H}{27}$$

$$V = \frac{12.95 \times 7.30 \times 3.45}{27}$$

V = 12.08 CY, round to 12 CY

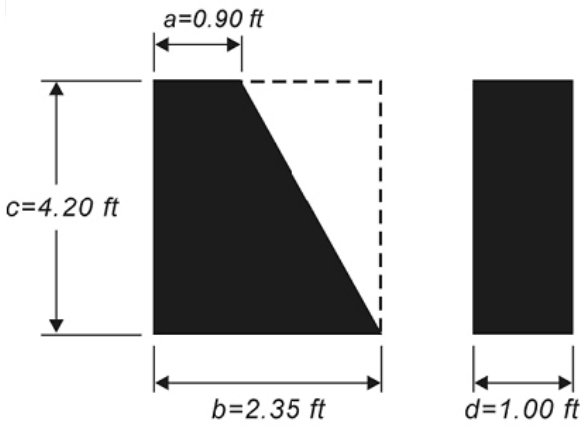
Equation 4-1.

See Appendix A for slides

Volume of Truck Bed with Deduction for Hydraulic Ram Cover

The hydraulic ram is recessed into the truck bed on some trucks, with a housing in the bottom front portion of the bed. If the trucks on the project have this, deduct the volume of the housing from the total volume of the truck bed as shown in the example below.

Example: Volume of Hydraulic Ram Cover



Hydraulic Ram Cover

$$\text{Volume of Hydraulic Ram Cover} = \left\lceil \frac{(a + b)\, c\, d}{2} \right\rceil \div 27$$

$$= \left\lceil \frac{(.90 + 2.35)(4.20)(1.00)}{2} \right\rceil \div 27$$

$$= 0.25 \text{ CY}$$

Net Volume of Truck Bed
NV= 12.08 (previous example) – 0.25
NV= 11.83 CY, round to 12 CY
Equation 4-2.

Acceptable Size

In the above example, the capacity of the truck bed, 11.83 CY, is less than an even number of cubic yards, which is not acceptable. It should be an even number of cubic yards or slightly over. To ensure an accurate count of the cubic yards of aggregate for which the contractor is paid, the bed capacity must be expanded. The easiest method to accomplish this is to add sideboards.

By adding a standard *2x4* on top of the metal truck bed sides, the capacity can be increased to slightly over 12 CY, which would be acceptable as a 12-cubic yard truck. The addition of boards (*2x4s* or *2x6s*) is common practice. This is acceptable if the trucks do not exceed the gross vehicle weight established by law.

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See Appendix A for slides

Section 6 – Rollers

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General

Key Terminology

After aggregate is placed on the asphalt, rollers orient the aggregate in its flattest dimension and seat it firmly into the asphalt binder.

A pneumatic roller is recommended for all seal coat and surface treatment work. TxDOT does not recommend a steel-wheeled roller because the flat, steel drum will tend to crush the aggregate, especially on the high spots. This is particularly true when lightweight aggregate is used. In addition, if the old pavement is rutted, a steel-wheeled roller will tend to bridge over the ruts failing to seat the aggregate firmly in the low spots of the wheel paths.

Identifying Data
Record the manufacturer's name (or brand name), model number, and serial number of all rollers used on the project.

Weight Certification
Manufacturers publish the gross weights of their product with water and wet sand as ballast. If either of these materials is used and the ballast tanks are full, the inspector can safely certify whether or not it meets the weight requirements.

If, however, the contractor uses another material, such as aggregate for ballast, it may be difficult to determine if the rollers meet the weight requirements. When in doubt, the contractor should be required to have the rollers weighed. A weight ticket should be obtained with a certified vehicle weight and included in the project folder.

Pneumatic Rollers
Pneumatic rollers operate on rubber, air-inflated (pneumatic) tires. Figure 4-40 shows a pneumatic roller typical of those used for seal coat and surface treatment work. All pneumatic rollers must be self-propelled and capable of operating in both forward and reverse.

See Appendix A for slides

Figure 4-40. Pneumatic Roller.

Weight. Many project plans will call for light pneumatic rollers which are described in Standard Specifications Item 210, "Rolling." This item requires that a light pneumatic roller be capable of ballast loading, to uniformly vary the total vehicle weight from 9,000 pounds to 18,000 pounds. Wet sand or aggregate may be used for ballast.

Contact Pressure. Contact pressure exerted by each tire is a function of the following combination of factors:

- Total vehicle weight,
- Number of tires on the roller,
- Tire size and ply rating, and
- Tire inflation pressure.

Item 210 requires a minimum contact pressure of 45 psi of tire contact area, as a minimum for the light pneumatic-tire roller. All tires must be smooth surfaced as shown in Figure 4-41.

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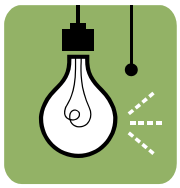
Figure 4-41. Smooth-Surfaced Pneumatic Tire.

Tire Inflation. The roller shall provide a uniform compression under all wheels. Specifications require that all tires be inflated so that there is not more than five psi variation within all tires.



Correct tire pressure is very important. If one tire is soft, it will not seat the aggregate as firmly as the other tires, and this could result in the aggregate in that path stripping away under traffic.

Appendix C of this manual contains a tire inflation chart. This chart provides tire pressures for all commonly used tire sizes and ply ratings.

Number of Tires. Specifications require that light pneumatic rollers have a minimum of nine tires. Most are manufactured with five wheels on the front and four on the rear. The rear wheels are the drive wheels; the front wheels are the steering mechanism.

Area of Coverage. Light rollers are required to cover an area approximately 60 inches wide on each pass. The rear tires must be offset to provide coverage of the areas between the front wheels as shown in Figure 4-42.

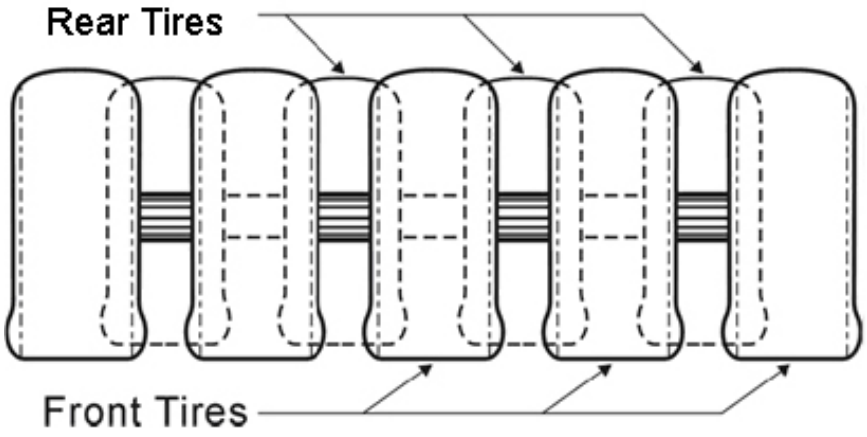


Figure 4-42. Wheel Configuration on Pneumatic Rollers.

Wheel Wobble. The wheels must not wobble when the roller is in operation. This can cause aggregate to be displaced. If any wheel is not operating smoothly, the roller should not be allowed to continue operation.

Free of Leaks. Like all other pieces of equipment on any construction project, rollers must not leak engine coolant, fuel, hydraulic fluid, or anything else that might contaminate the asphalt binder or aggregate. If any leaks are detected, immediately remove the roller from the project.

Smooth Operation. All rollers must be capable of smooth operation, especially when turning, stopping, or starting. If the brakes or drive train are faulty and cause jerking or excessive vibration when the roller is stopped or started, it should not be allowed to continue operation. If one of the wheels is out of alignment, it may cause "scuffing." None of these conditions should be permitted on the job.

Medium-Weight Rollers. Medium pneumatic rollers may be used on some projects. The information given for light pneumatics is also true for medium-weight rollers, with the exception of the weight, number of wheels, contact pressure, and width. Medium rollers must be capable of varying the weight, by adding ballast, from 23,500 pounds to 50,000 pounds. There must be no fewer than seven wheels, with contact pressure of 80 psi or more. The effective rolling width should be approximately 84 inches.

Tire Pressure. Tire pressure is probably the most critical inspection point for pneumatic rollers. The variation in the pressure cannot exceed 5 psi within the group of tires.

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The correct tire pressure is a function of these variables:

- Gross vehicle weight;
- Number of tires on the roller (Either seven or nine are required for this class of roller. Most rollers used on seal coats have nine);
- Tire size and ply rating; and
- Required ground contact pressure, as specified in Item 213.2. For light pneumatic rollers, contact pressure of 45 psi is required. For medium (Type A), 80 psi is required; for medium (Type B), 90 psi. These are the minimum amounts; higher contact pressures are allowed.

Assume that you are inspecting a light pneumatic roller. You have a certified weight ticket showing the gross weight of the roller as 17,700 pounds. It is a nine-wheeled roller. The tires are 7.50 x 15, 6 ply. Standard Specifications call for a minimum of 45 psi contact pressure per wheel.

First divide the number of wheels into the gross vehicle weight to determine the weight on each tire (wheel load).

$$\frac{17{,}700\ lbs\ wheel\ load}{9\ tires} = 1967\ lbs\ wheel\ load$$

Equation 4-3.

Next, turn to the Pneumatic Tire Pressure Table in Appendix C. Look in the left-hand column which gives tire size and ply. Find the block that applies to 7.50 x 15, 6 ply tires. The next column gives wheel load. Since the blocks are broken down into 250 pound increments, the chart shows 1750, then 2000 pound wheel loads. Since the 1750 block is less than the 1967 pound wheel load on our roller, go to the 2000 pound block.

The next column to the right is Inflation Pressure. Skip over this column, and go to the one titled Contact Pressure. The Specifications call for a minimum of 45 psi Contact Pressure. Again, there is a division of only 43 and 46 psi, so you must use the higher number. Reading back to the left one column (Inflation Pressure), you find that 40 psi is the minimum inflation pressure for the tire sizes used in our example.

See Appendix A for slides

Inspection Checklist

Thoroughly inspect all of the rollers to be used on the project. This visual check should include the following:

- Check overall condition of the equipment.
- Check for presence of leaks of any kind.
- Tires should be smooth (no tread pattern).
- All tires should be the same size and ply rating.
- The rollers should start and stop smoothly. Brakes should not "grab."
- The roller must be self-propelled and operate in both forward and reverse.
- There should be no wheel wobble, since this will scuff the cover aggregate.
- Check tire stability on turns. If there is unusual scuffing, it may mean a bad bearing or king pin, which might not be detectable when the roller is moving in a straight line.
- Roller tires should have no gouges that would alter the contact pressure of the tire.
- Certify the weight.

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Section 7 – Front-End Loader

General

Key Terminology

Front-end loaders are used to move aggregate from the stockpile into the haul truck.

Figure 4-43 shows a typical front-end loader. Loaders, like all equipment, must be in good mechanical condition. There are no particular components or adjustments that inspectors should monitor. More important than the machine itself is the way it is operated.

Figure 4-43. Front-End Loader.

Identifying Data

Record the manufacturer's name, model number, and serial number of the loader in the project folder. There are no stated specifications which must be met, but there should be a record that all equipment used on the project was inspected.

Visual Inspection

Inspect the power train, hydraulics, and lift mechanism for leaks. View the inside of the bucket to ensure that it is in good condition and free from any substance which might contaminate the aggregate. A visual check of overall condition should be performed with

See Appendix A for slides

particular attention given to any potentially harmful or unsafe condition.

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Section 8 – Heater and Storage Unit

Notes:

General

Sometimes the contractor will set up a heater and storage unit for large projects. The asphalt is hauled from the source by truck and pumped into the heater and storage unit. When it is used, it is pumped either into another transporter or directly into the asphalt distributor.

There is no standard configuration for a storage and heater unit. It may be a tank with heating and circulating equipment combined, or it may be an insulated tank with a separate heater unit with interconnected piping. Storage capacity and size vary according to the needs of the project.

The heater and storage unit, usually called a *heater unit*, is inspected at the beginning of a project along with the other equipment. Sometimes the contractor has manufactured the heater unit, so there may not be any identifying data. The only numbers on the equipment may be an engine serial number on the pump unit.

Temperature

Asphalt must be stored at specific temperatures, which are usually somewhat higher than the temperatures at which the asphalt is applied. The asphalts used in seal coat work are stored at the following *approximate* temperatures:

Asphalt cement	325°F to 400°F
Cutback asphalt	150°F to 200°F
Emulsions	150°F to 170°F

The higher temperatures are the maximum allowable storage and heating temperatures.

In order for these asphalts to be sprayed properly, with the desired results, the temperature must be closely controlled in order to maintain the correct viscosity for spraying. The heater unit operator must clearly understand the importance of the viscosity-temperature relationship.

The heating and storage unit must be equipped with a continuous recording thermometer so that the temperature of the asphalt may be closely monitored.

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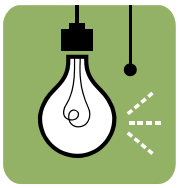
Safety

The operator must be aware of the flash point (temperature at which ignition could occur) of whatever type of asphalt binder is being used. It is his responsibility to ensure that all necessary safety precautions are taken, but this can never be assumed.



The flash point is especially critical with cutback asphalts. As an example, RC-250 has a flash point of 80°F. Standard Specifications Item 300.3 recommend that RC-250 be applied at temperatures between 125°F and 180°F. The maximum allowable temperature for application and storage is 200°F. With this type of asphalt, you are well into the dangerous range any time that you work with it.

The heater and storage unit are also dangerous, especially if using asphalt cement. Storage tanks, pipes, and valves are extremely hot. Take adequate safety precautions to ensure that any part that might be touched is insulated.

Extreme care must be taken when obtaining a sample of asphalt cement. Very hot asphalt cement (350°F) can easily splatter. Proper safety equipment and clothing should be worn.

Storage Tank

Inspect the storage tank for cleanliness and the presence of any condition that would permit contamination of the asphalt. There should be a continuous-recording thermometer on the tank, which records any fluctuations in asphalt temperature.

Heater

In some cases, the heater unit is a part of the storage tank. In others, it is a separate unit, consisting of a smaller tank with pump and heater. Inspect the heater unit, regardless of the system used.

It should have a burner that can be regulated to alter the intensity of heat. The burner should direct the flame into the flues, similar to the arrangement in an asphalt distributor. The pump should circulate the asphalt through the heater unit sufficiently to prevent the asphalt from burning next to the flues and from sticking (from cooling) near the outside of the tank.

Pump Unit

The pump unit should be checked for proper operation, but the primary concern is to ensure that the pump and associated piping

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protect the asphalt from contamination. It should be assembled so that no dirt or fuel can enter the piping or pump unit.

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Heater Unit Location
Although the location of the heater unit is the contractor's responsibility, the inspector should consider the location of the unit from the standpoint of safety for the motorists.

The heater unit will have transporters moving to and from it, as well as asphalt distributors or boosters pulling onto and off the highway in the vicinity of the heater. This traffic must be clearly visible to motorists driving through the construction area. Therefore, it should not be situated on or near blind curves and probably well clear of intersections.

If the heater unit is situated in the vicinity of the aggregate stockpile, separate it far enough away to ensure that no contamination of the aggregate occurs. Asphalt is often spilled around heater units, so it is best that the heater be situated well away from aggregate stockpiles, if practical.

Recording Thermometer
When the project begins, the inspector must pick up the record card from the continuous reading thermometer each day. A new card is installed when the old one is removed.

Transporter and Booster
Transporters sometimes belong to the contractor, sometimes to the petroleum company that supplies the asphalt to the contractor, and sometimes to independent truckers. Booster tanks are not used on all jobs but are frequently used on projects that cover 6 to 10 miles or more. These boosters cut down on the amount of time the distributor is tied up while being refilled.

Identifying Data
If the transporter and boosters belong to the contractor, record the standard vehicle identification information and include it in the project file. This would also apply if the contractor has leased the equipment.

If the transporter belongs to the petroleum company or to an independent trucker, record the company name and the truck license or other unique number. Although this may not be required, it is a good practice, in case there is a problem with the asphalt.

Manifest
Check the transporter's manifest before it is unloaded to make certain the asphalt in the truck is the right type for the project.

See Appendix A for slides

Unfortunately, some inspectors have found out too late that the wrong asphalt was pumped into the heater unit. Once again, this is the contractor's responsibility, but it will delay the project and can easily be prevented. Retain a copy of the manifest of each load of asphalt delivered on the job in the project folder.

Cleanliness
If the transporter belongs to or is leased by the contractor, it should be cleaned if a different type of asphalt was transported on a previous project. It is not usually possible for the inspector to determine exactly what type of asphalt had been hauled previously, so a good rule of thumb is to be certain it is clean before it hauls asphalt to the current project.

Contamination
Besides guarding against contamination from previous asphalts, the inspector should ensure that the transporter tank and piping protect the asphalt from contamination during offloading to the heater unit.

Booster Tanks
On some jobs, booster tanks are used to refill the distributors close to where asphalt application occurs. These vehicles should be inspected for cleanliness, to guard against contamination, and to have the identifying data recorded. Their piping and shut-off valves should be checked for leaks to guard against puddles of asphalt being left behind after they have refilled an asphalt distributor. This is especially important if the distributors are to be filled while parked on the pavement that is to be seal coated.

Sometimes a transporter is used as a booster tank on the job, transporting asphalt from the heater unit to where the distributors are filled directly from the transporter. If asphalt cement (AC) is being shot on the project, it must be shot near 300°F. This would necessitate having an insulated transporter in order to keep the asphalt hot between the heater unit and the distributor.

Insulation
Like the transporter, it may be necessary to ensure that booster tanks, if used to carry AC at high temperatures, are adequately insulated. Without proper insulation, the asphalt may cool enough to raise the viscosity above the limits for being pumped into the distributor, especially if there are any unexpected delays.

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Chapter 5 – Seal Coat/Surface Treatment Application Process

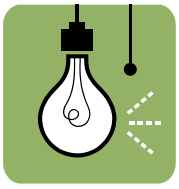
When this chapter is over, you will be able to:

- Describe the sequence of events during a full-width seal coat, strip/spot seal or surface treatment application.

Section 1 – Overview

General
In this chapter, we will describe the sequence of events during a full-width seal coat, strip/spot seal coat, or surface treatment application. It will include the following:

- Weather,
- Traffic control,
- Removing pavement markers,
- Cleaning the pavement,
- Placing temporary tabs,
- Setting the rock lands,
- Setting the asphalt shots,
- Checking the loader operation,
- Placing paper joints,
- Shooting the asphalt,
- Strapping the distributor,
- Spreading the aggregate,
- Timing for aggregate application,
- Rolling the aggregate,
- Patching or hand work,
- Intersections and irregular shapes,
- Brooming excess aggregate,
- Opening to traffic,
- Temporary or permanent pavement markings,
- Placing raised pavement markers, and
- Cleanup.



In order for the seal coat or surface treatment to be applied as planned, it usually requires three inspectors. The application of the seal coat is a fast-paced process and requires alert inspectors to ensure that it is done properly. The inspectors must work together as a tightly knit team because it is difficult to monitor every detail. If one inspector misses a detail, one of the others must pick it up. Communication and coordination must be excellent.

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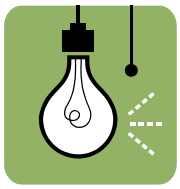
Section 2 – Weather

Introduction

Weather plays an extremely important role in seal coat operations. Many things can result from a sudden change in weather, most of which are undesirable in seal coat work.



The best conditions for applying a seal coat or surface treatment are when temperatures are high, humidity is low, and there is little or no wind. In most parts of Texas, these conditions are most likely to occur from June through September. Too early in the spring or too late in the fall brings temperature and wind problems. Always check the extended forecast.

Temperature

Key Terminology

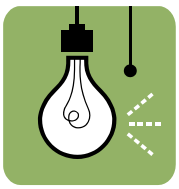
Item 316 of the Standard Specifications requires that seal coats and surface treatments be placed when the air temperature is above 50°F and rising. Seal coats and surface treatments may not be applied when the air temperature is below 60°F and falling. In all cases, no seal coat or surface treatment may be applied when the surface temperature is below 60°F.

If a polymer-modified asphalt cement is used, apply it when the air temperature is above 70°F and rising and not when the air temperature is below 80°F and falling. Surface temperature must not be below 70°F. When wintertime work is allowed, the engineer will approve the air and surface temperature for the asphalt application.

During the summer months, roadway temperatures are commonly 100°F or higher by 9 a.m. So in most cases, temperature is not a problem. An inspector must record the surface temperature every morning before any asphalt is shot. This can be done by placing a surface contact type of dial thermometer on the roadway. Place a surface contact type of dial thermometer of the roadway to obtain the surface temperature reading.

See Appendix A for slides

Humidity



If possible, asphalt is best applied when the humidity is 50 percent or lower, especially when emulsions are used. With any type of asphalt a lower humidity is better. High humidity can cause an invisible film of moisture to collect on the roadway surface, which may interfere with the asphalt sticking properly to the surface.

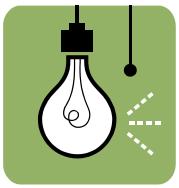
With emulsified asphalts, the emulsion will be slower to break in high humidity. With asphalt cement, which is shot at much higher temperatures than emulsions, steam can be seen rising as the hot asphalt hits the moisture on the roadway surface. As steam is trapped under the asphalt, small bubbles form and break as the air and moisture work their way to the asphalt surface.

Wind

Wind can be both a disadvantage and an advantage. When an emulsion is used, a gentle wind of constant velocity can accelerate the breaking of the emulsion and allow traffic on the roadway sooner. If the wind varies or is too strong, it can distort the fan pattern as the asphalt is applied. This may cause streaking and uneven distribution. Contractors may install a shield in front of the spray bar to minimize wind effects on the spray pattern.

Wind also tends to blow asphalt onto passing vehicles. It is particularly important to be careful of wind direction when applying modified asphalt cements. Small "cobwebs" of asphalt are blown around and are almost invisible until they land on a light-colored vehicle. To minimize the effects of blowing asphalt, the sequence of work should be considered.

Rain



No asphalt binders should be applied during rain. When using emulsions, rain can cause the asphalt to flush to the surface. If rain is in the vicinity and predicted for the area, consider suspending operations. If an unexpected shower arises during operations, shut off the asphalt distributor immediately and continue placement of aggregate until all asphalt has been covered. This area should be rolled well and watched carefully after opening to traffic. After a rain, always suspend operations until the pavement has completely dried.

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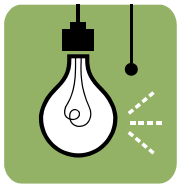
Section 3 – Traffic Control

Introduction



Since safety is one of the most important concerns, all required traffic control devices must be in place and installed properly. All traffic control devices should conform to the details shown on the plans or those indicated in the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

Pre-Positioning

For the operation to begin efficiently, the required barricades and signs should be in their proper locations no later than the day before the sealing begins. For strip/spot seal coat work, traffic control devices are normally placed on the day the work is performed. Generally, there should be one person who has full responsibility for traffic control. Traffic control includes erecting signs and barricades, placing traffic cones, flagging, and moving appropriate traffic control devices down the roadway as close as possible behind the seal coat equipment.

Project signing should be completed before beginning any seal coat work. Cover signs until they become effective and removed when no longer needed.

Displaying Signs

Before any work begins and before any equipment is moved onto the highway, all of the required traffic control devices must be:

- In the proper sequence,
- The correct distance and spacing leading up to the work,
- Clearly visible to motorists, and
- Positioned correctly so the devices do not pose a hazard to traffic.

Traffic Cones

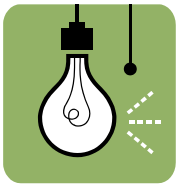
Traffic cones are typically used to keep traffic routed around the seal coat work area as shown in Figure 5-1. Traffic cone placement must be checked to ensure:

- Adequate sight distance prior to lane closure,
- Proper spacing and taper lengths,
- Cones are placed past the distance of the first asphalt shot, and
- Cones are placed outside the operating path of the asphalt, and distributor and aggregate spreader.

Figure 5-1. Traffic Cones in Position.

Flaggers

When flaggers are required, each flagger must be properly trained or certified. Ensure the flagger is using proper equipment, correct signals, and can verbally explain the situation to vehicle operators. If there are flaggers at both ends of the project, ensure they have adequate communication devices and that the devices are used properly.



The flaggers are vital to the safety of motorists in the work area. If the flaggers are not performing their duties properly, they must be corrected promptly.

Pilot Vehicle

A pilot vehicle and radio-equipped flaggers are often used for undivided roadways to improve the safety of the traveling public through a seal coat project. At a minimum, a pilot vehicle should have appropriate signing on the rear of the vehicle to guide the traveling public through the seal coat project.

Repositioning Traffic Control Devices

As work progresses down the roadway and as sections are opened to traffic, reposition appropriate traffic control devices and flaggers. Once the flaggers and appropriate traffic control devices have been repositioned, check them again to ensure proper placement and procedures.

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See Appendix A for slides

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Intersections

If the seal coat operation crosses intersections, traffic in these areas must be controlled. Care must be taken to prevent vehicles from crossing the asphalt before the aggregate is placed. This may require positioning other members of the traffic control crew at the intersection.

Arrow Boards

Arrow boards are often used to move traffic into the adjacent lane. These are especially used on four-lane highways and where there is a large volume of high-speed traffic.

See Appendix A for slides

Section 4 – Removing Pavement Markers

General

If directed, raised pavement markers should be removed from the pavement and disposed of properly in preparation for seal coat work. The best time to remove pavement markers is early in the day when temperatures are cooler. A motor grader, front-end loader, or other acceptable method may be used. Figure 5-2 illustrates a motor grader removing pavement markers. If pavement becomes damaged due to marker removal, pavement repair may be necessary. If marker removal is consistently causing pavement damage, consult with the appropriate engineer. Item 677, *Eliminating Existing Pavement Markings and Markers,* of TxDOT's Standard Specifications, governs this function.

Figure 5-2. Removal of Raised Pavement Markers.

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See Appendix A for slides

Section 5 – Cleaning the Pavement

Notes:

Introduction
Clean and sweep the pavement prior to, but not too far in advance of, the asphalt application. Cleaning should include removal of any vegetation and soil on the edge of the pavement. Sweeping is especially important under dusty conditions.

Safety During Sweeping Operations
Since the sweeper operates a considerable distance ahead of the other seal coat equipment, it is very critical that the sweeper is equipped with appropriate warning devices. Motorists do not always stay on the proper side of the traffic cones, or they may enter the roadway from a private drive or side road. The sweeper may sometimes create so much dust that visibility is reduced. When visibility is reduced, a flagger may be required.

Sweeping Pattern
Normally the sweeper will require two to three passes to adequately prepare a 12-foot lane. Each pass should progress toward the shoulder. Certain wind conditions or other unique situations could require a different pattern; however, it is always best to broom away from traffic and with the wind whenever possible.

Sweeping Distance from Operation
The sweeping operation should be far enough ahead that the sealing operation is never held up waiting for the sweeper. If conditions are very dusty, sweeping should not be more than one or two shots ahead of the asphalt distributor to prevent dust accumulation between the sweeper and the asphalt distributor. Additional sweeping may be required where dust or dirt is tracked onto the pavement from side roads or private access roads. Hand work may be required.

See Appendix A for slides

Section 6 – Placing Temporary Tabs

General

Prior to shooting asphalt, place temporary flexible-reflective roadway marker tabs to designate lane lines in accordance with applicable traffic control plans. TxDOT's Standard Specifications Item 662, *Work Zone Pavement Markings* governs the placement of temporary tabs.

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See Appendix A for slides

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Section 7 – Setting the Rock Lands

Introduction

Key Terminology

A rock land is the area covered, at the desired aggregate application rate, by one predetermined size truckload of aggregate.

The area of the rock land is calculated in advance and marked either on the pavement with paint or on the side of the road with flags. Setting rock lands for strip/spot seal coat work is not necessary if less than one truckload of aggregate will be used in a particular area.

Purpose

The rock lands are usually set at the start of a project to help the contractor calibrate the spreader box and assure that the correct aggregate rate is being applied. If the aggregate runs out before reaching the marker at the end of the rock land, the rate is too heavy. If there is aggregate remaining at the end of the rock land, the rate is too light. This is based on the assumption that the truck is carrying the predetermined amount of aggregate.

Calculating the Length of Rock Land

The desired rate of aggregate application is specified as 1 cubic yard of aggregate for a given number of square yards of roadway, such as 1 CY/125 SY.

For example, assume that the lane to be sealed is 12 feet wide, and the haul truck is filled with 14 cubic yards of aggregate. The desired application rate is 1 CY/125 SY.

Area of Rock Land	14 CY x 125 SY/CY = 1750 SY
Length of Rock Land	1750 SY x 9 SF/SY/12 ft = 1313 LF

Marking the Rock Lands

Using a calibrated Digital Measuring Instrument, start at the beginning of the first shot with the DMI set at zero. Drive down the roadway until the DMI reads the calculated length of rock land. Stop and mark the end of the rock land. Make certain that the markings for rock lands are a different color or are somehow distinguishable from the markings used for the asphalt shots. Reset the DMI at the end of each rock land, and repeat the process.

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Section 8 – Setting the Asphalt Shots

Introduction

An asphalt shot must be equal to the length of a specified number of full rock lands. For example, one asphalt shot should equal 1, 2, or 3 rock lands, not 1.7 rock lands. The area of the asphalt shot is calculated in advance and marked either on the pavement with paint or on the side of the roadway with flags. Marking asphalt shots in advance provides a way to check the asphalt application rate. Setting the asphalt shot for strip/spot seal coat work is not necessary if less than one truckload of aggregate will be used in a particular area.

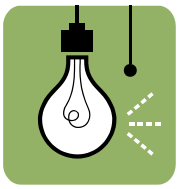
Asphalt Application Rate

The asphalt application rate shown on the plans is intended primarily for estimate purposes. The actual application rate should be based on several design variables as discussed in Chapter 3 of the Engineers Course.

If asphalt cement is to be applied at 0.36 gallons per square yard, this rate should be sprayed from the distributor. If emulsion is to be applied at a residual rate of 0.36 gallons per square yard, this is the residual amount of asphalt desired and *not* the amount to be shot from the distributor.

Emulsions consist of asphalt cement, water, and an emulsifying agent. After the emulsion is sprayed on the roadway, the water evaporates (the emulsion *breaks*), leaving only the asphalt cement. Various types of emulsions contain different amounts of water and emulsifiers. Typically, an emulsifying agent and water are 35 to 40 percent of the total emulsion. Therefore, an emulsion to be applied at a residual rate of 0.36 gallons per square yard with 60 percent residual asphalt should be sprayed at a rate of 0.60 gallons per square yard (0.36/0.60). The percentage of residual asphalt for any emulsion can be obtained from the Construction Division asphalt laboratory or the emulsion supplier.

Distributor Capacity



The capacity of the asphalt distributor must be considered when setting the asphalt shot. A distributor should never be completely emptied in an asphalt shot. This is especially important when shooting emulsions because emulsions tend to foam more than other types of asphalt, and the operator should stop spraying before the foam is reached.

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For a 2000-gallon distributor, it is good practice to leave at least 200 gallons in the distributor at the end of each emulsion shot or 100 gallons if AC is used. Recirculation of the remaining binder through the spray bar also reduces the chance that the thin film of asphalt remaining inside the pipes and spray nozzles will harden due to rapid cooling.

Calculating the Length of Asphalt Shot

The asphalt shot length should be based on full rock lands, which are governed by the number and size of trucks available. For example, assume one 12-foot wide section of roadway is to be sealed with AC at 0.36 gallons per square yard using a 2000-gallon distributor and haul trucks with a capacity of 14 cubic yards.

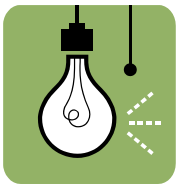
Desired Asphalt Rate	0.36 gal/SY
Distributor Capacity	2000 gal
Area of Rock Land	1750 SY (calculated in Section 7)
Length of Rock Land	1313 LF (calculated in Section 7)
Gallons per Rock Land	0.36 gal/SY x 1750 SY = 630 gal/rock land
Rock Lands per Shot	2000 gal (distributor capacity)/630 gal = 3.2 rock lands

Note: Shot length must be in full rock lands and should leave at least 100 gallons of AC in the distributor.

Gallons per Asphalt Shot	3 full rock lands x 630 gal/rock land = 1890 gal
Gallons Left in Distributor	2000 – 1890 110 gal (greater than 100 gal, OK)
Length of Asphalt Shot	3 full rock lands x 1313 LF = 3939 LF

Marking the Asphalt Shot

Using a calibrated DMI, start at the beginning of the first shot with the DMI set at zero. Drive down the roadway until the DMI reads the calculated length of asphalt shot. Stop and mark the end of the asphalt shot. Make certain that the markings for the asphalt shot are a different color or are somehow distinguishable from the markings used for the rock lands. Use a bright fluorescent spray paint on the pavement or a small, bright-colored wire flag may be stuck in the soil next to the pavement surface. Reset the DMI at the end of each asphalt shot, and repeat the process. By marking each shot, the contractor will know where to form a paper joint, which will be discussed later.



Do not apply asphalt to the roadway until the haul trucks are loaded with enough aggregate to cover the asphalt shot area, and the haul trucks are in place behind the aggregate spreader box. It is also critical to ensure that the production rates of the asphalt distributors, spreaders, and rollers are matched. Please refer to Section 15 for additional information on matching production rates.

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Section 9 – Checking the Loader Operation

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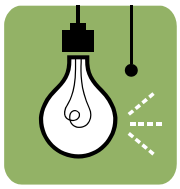
Introduction



The loading of aggregate from stockpiles into the haul trucks is very important to the success of a seal coat application. This operation is sometimes overlooked because it is somewhat removed from the center of activity. Make every effort to watch the loader operation activity early in the project and spot-check it periodically thereafter.

Loader Operation Checklist

Gradation. The loader operator should take a representative scoop of aggregate with each bucket. Graded aggregate will tend to segregate somewhat when it is stockpiled. Finer particles tend to sift between the coarse particles, making the stockpile show a greater content of coarse particles near the top and outside. The bucket on the front-end loader should penetrate the stockpile near the bottom and penetrate deeply enough to have a full range of the aggregate gradation.

Contamination. The loader operator usually tries to use every bit of aggregate available on the stockpile. In doing so, the bucket may scrape too close to the bottom of the stockpile allowing clay balls or grass to be picked up along with the aggregate. Do not use aggregate containing contaminants. If there is grass, clay, or soil being placed in the spreader box, the loader operation must be corrected immediately.

Degradation. Operate the loader carefully to avoid degradation of the aggregate. The operator should *not* operate the equipment in such a manner that causes the front wheels to roll over any of the stockpile. This will cause the larger pieces to be crushed into smaller particles changing the aggregate gradation.

Full Trucks. The operator should fill every truck to its predetermined calibrated level. This will ensure that the contractor is paid for the correct amount of aggregate and the aggregate is applied at the desired application rate.

Excessive Dust. Sometimes projects can have problems with excessive dust in the aggregate stockpile. If a cloud of dust occurs with every bucket load that is placed in the trucks, the dust may be detrimental to the seal coat performance. If dust is a problem, it may be reduced by lightly sprinkling the stockpile with water. Use only enough water to reduce the dust. This is only recommended when emulsions are being used.

Section 10 – Placing Paper Joints

Introduction
Pace paper joints to ensure an even, straight, and sharp beginning and end of each asphalt shot. Paper joints may or may not be needed for strip/spot seal coat work.

Equipment
The most efficient method of placing paper joints is to have two people with a truck assigned to this responsibility. This crew will need a small load of aggregate, shovels, push brooms, and a large roll of heavyweight brown paper or other approved material (36 to 48 inches wide).

Beginning of Asphalt Shot
At the beginning of an asphalt shot, place a strip of paper across the full width of the lane being sealed and anchored down with a small amount of aggregate spread over the paper. If the distributor operator is inexperienced, a wider mask of paper may be needed. Place a second or third sheet of paper adjacent to the first, overlapping each one by at least two or three inches.

Sweep away any aggregate that has spilled onto the pavement surface. As soon as the distributor has started the shot, remove the paper. Figure 5-3 shows a typical paper joint being placed.

End of Asphalt Shot
At the end of the asphalt shot, place another paper joint. It is placed just like the first joint except that the *rear* edge of the paper is placed on the mark for the end of the shot. Turn off the asphalt distributor sprayer as the spray bar passes over the paper.

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Figure 5-3. Placing a Paper Joint at Beginning of Shot.

Subsequent Asphalt Shots with Multiple Distributors
As soon as one distributor has completed an asphalt shot, pull the paper joint to the side of the road and dispose of later. Before the next distributor begins the next shot, spread the aggregate over the fresh asphalt where the paper joint is to be placed for the starting joint of the next shot by shovel. Place another paper joint over the end to form a starting joint for the next shot.

Care must be taken to clean all excess aggregate off the unsealed pavement to preserve the clean, sharp end. Position the edge of the paper exactly above the end of the asphalt shot as shown in Figure 5-4.

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Figure 5-4. Paper Joint in Place at Beginning of Second Shot.

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Section 11 – Shooting the Asphalt

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Introduction
The asphalt distributor is a complex piece of equipment. For a smooth operation, the equipment must be in good working condition and the correct procedures must be followed.

Distributor Preparation
Heating asphalt binder always constitutes some degree of hazard, with the exception perhaps of emulsions. The most hazardous are cutback asphalts because of the highly volatile solvents used. Extreme care must be taken not to allow open flames to come in contact with the cutback asphalt or the gases from hot cutback asphalt. When working with asphalt cement, the major safety concern is related to the high temperature of the binder. Contact with asphalt cement at 300°F will cause severe burns.

When switching from one type of asphalt binder to another in the same asphalt distributor, thoroughly flush or clean out the previous binder from the system. This will minimize contamination of the new binder and enhance safety of the seal coat operation. When switching from emulsion to AC, do not fill the distributor to more than half full for the first two or three asphalt shots to minimize foaming and possible overflow via the manhole of the tank. Emulsion in the spray bar is sufficient to cause foaming and tank overflow when the hot asphalt cement is circulated through the spray bar. Switching from cutback asphalt to AC can create a potential explosion hazard, and extreme caution should be exercised.

Fill the distributor from the heater unit, booster tank, asphalt storage tank, or transporter as shown in Figure 5-5.

Figure 5-5. Transferring Asphalt from Transporter to Distributor.

When the distributor is full, record the number of gallons. A strap stick should be used to measure the gallons as described in Section 12.

Check the asphalt temperature in the distributor to ensure that it is within the recommended application temperature range. If the temperature is low, the operator should light the burners of the heater unit and start the pump to circulate the asphalt through the pipes. It is also important for the spray bar to be hot. Circulating the asphalt through the system should heat the bar adequately.

The operator should increase the pump speed to make certain the correct pressure is set for the asphalt to be applied. This is important on the first shot of the project, even though the distributor was inspected earlier. Do this on the first shot each morning as well.

Blow the Nozzles

Move the distributor to the side of the road until the correct shooting temperature is reached. When the asphalt has reached the correct temperature and the spray bar is completely off the pavement and in a flat area, place one or two layers of joint paper under the spray bar, and turn the sprayer on momentarily to "blow out" the nozzles. While spraying, visually check each nozzle to make certain no nozzles are clogged and the spray pattern looks correct.

If any nozzles are clogged, they should be removed and cleaned out with an appropriate solvent. After cleaning any nozzles as needed, the nozzles should be blown out, and the spray pattern should be checked again. Check the spray system for leaking asphalt. If no leaks

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are apparent and all nozzles are working correctly, the distributor may be moved into position at the beginning of the asphalt shot.

Check Spray Bar Height
To check the spray bar height before applying the asphalt, refer to Chapter 5, Section 3. The distributor should stand by in a ready position while other final equipment checks are made.

Final Equipment Check
Make a final check to ensure that all the other equipment is in position and ready before allowing any asphalt to be sprayed. The aggregate spreader box should be in position and ready to begin. Position the required number of haul trucks needed to cover the asphalt shot behind the spreader box. If a patching crew will be used on the job, they should be ready to follow the haul trucks as closely as possible. All the rollers should be ready to begin.

Paper Joint Check
The paper joint should be in place for the beginning and the end of the asphalt shot. It should be of adequate width for the type of distributor being used and the skill of the operator. The distributor spray bar should be positioned over or behind the paper joint for the beginning of the asphalt shot. This will enable the spray bar nozzles to be opened on the paper joint at the beginning of the asphalt shot. Figure 5-6 shows the correct position for the distributor.

Figure 5-6. Correct Starting Position over Paper Joint.

Transverse Alignment
When the distributor is in position over the paper, visually check the transverse alignment. The end nozzle should be directly over the line, which the operator will use as a guide. As soon as the transverse alignment is correct, the operator should set the guide bar so that alignment is in position over the reference line.

Applying the Asphalt
As soon as all the preceding checks have been made, including strapping the distributor, the application of asphalt may begin. The inspector should be in position to closely observe the early part of each shot to see that the fan pattern is correct and all nozzles are spraying properly. Closely inspect the asphalt applied on the roadway surface to detect any variation. It should appear as a uniform sheet of asphalt across the entire width of the shot. If any streaking, ridging, puddling, or flowing of asphalt off the roadway surface is observed, stop the operation immediately and make corrections.

After completion of the asphalt shot, the distributor should be strapped as described in Section 12.

Timing for Aggregate Application
For best results, apply aggregate on any type of asphalt binder as soon as possible without causing the rocks to turn over or the asphalt to be picked up on spreader box, haul truck, or roller tires. That is, the aggregate spreader should follow closely behind the asphalt distributor. Refer to Section 14 for more information on spreading the aggregate.

Additional Distributors
If additional distributors are used, make certain that the same checks are performed on all distributors. If the distributors are identical number them so that they can be easily distinguished.

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Section 12 – Strapping the Distributor

Introduction
Before and after each distributor load of asphalt is sprayed, strap the asphalt distributor.

Key Terminology

The term "strapped" means a calibrated measuring stick is used to measure the asphalt in the tank.

For strip/spot seal coat work, generally the asphalt distributor should be strapped before and after all work is completed for each roadway or at the end of the day, whichever occurs first. When using a computerized asphalt distributor for strip/spot seal coat, the asphalt quantity can be obtained from the gauges on the equipment and strapping is only necessary for calibration purposes.

If payment is by volume, it is necessary to strap the distributor to keep an accurate record of the amount of asphalt that is used on the project. If payment is by weight, the distributor must be strapped to verify the application rate.

Determining Asphalt Application Rate
Strapping the distributor is important for pay purposes and also for determining the average asphalt application rate for each shot. This allows for immediate information needed to make adjustments from one shot to the next. Use the following procedure to strap the distributor:

- Immediately before and after the asphalt shot, the operator should stop the distributor on a level spot. The tank must be as level as possible. Some distributors have a level attached to the tank. If not, a 3- to 4-foot carpenter's level may be used.
- Clean the strap stick that the level of asphalt can be easily read. Open the manhole cover at the top of the tank, and insert the strap stick into the tank, holding it as nearly vertical as possible.
- Lower the strap stick down into the asphalt until it touches the bottom of the tank.
- Remove the strap stick from the tank. Read the number of gallons at the top of the line covered by asphalt. On some distributor models, the strap stick itself is not graduated and

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must be held up against a graduated scale mounted on the side of the tank.

Example:

Area of Asphalt Shot	5625 SY
Gallons before asphalt shot	2000 gal
Gallons after asphalt shot	225 gal
Gallons used for asphalt shot	2000 – 225 = 1775 gal
Average application rate	$\frac{1775\ gal.used}{5625 SY}$
	=0.315 gal/SY

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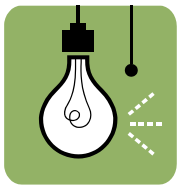
Section 13 – Spreading the Aggregate

Introduction



Position the aggregate spreader and all other equipment to begin before the distributor applies the asphalt shot. The required number of haul trucks needed to cover the asphalt shot must be in position behind the spreader box. If a patching crew will be used on the job, they should be ready to follow the haul trucks as closely as possible. All the rollers should be ready to begin.

For strip/spot seal coat work, a dump truck tailgate spreader is commonly used for spreading the aggregate instead of a self-propelled spreader box.

Aligning the Spreader Box

As the distributor begins to apply the asphalt shot, move the spreader to within a few feet of the starting point. While the joint paper is being removed, the operator should align the spreader.

Once the spreader is in position, the operator should make sure that all of the necessary discharge gates are open to ensure complete coverage of the asphalt shot. If the discharge hopper is wider than the asphalt, close some of the gates.

Truck Hookup

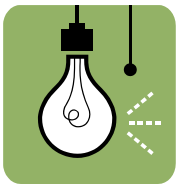
Back the waiting haul truck up to the aggregate spreader and stop slightly short of coming in contact with the spreader. This allows the spreader operator to back the spreader into the truck, so that the hitches connect. Use a spotter to ensure correct connection.

Place the haul truck transmission in neutral to allow the spreader to tow the truck backwards as the aggregate is spread. Upon signal from the spreader operator, release the truck tailgate latch. The truck bed is raised allowing the aggregate to fill the receiving hopper. The haul truck driver must remain ready to lower the bed on signal to prevent the hopper from overflowing.

As soon as the aggregate begins to pour into the receiving hopper, engage the conveyor belts. The aggregate begins to flow into the discharge hopper and is distributed across the discharge gates. When both the receiving and discharge hoppers are nearly full, the spreader

operator, or his assistant, signals the truck driver to lower the truck bed to stop the flow of aggregate into the spreader.

Test Strip



Before any asphalt is applied, a short test strip may be applied on bare pavement to visually check for uniform aggregate coverage.

If a test strip is to be applied, the spreader operator may disengage the truck hitch and have the truck move away from the spreader. This allows the spreader operator to test his equipment for a few feet without the truck being attached. There should be enough aggregate in the spreader to run perhaps a 50-foot test strip. Correct any gates not functioning properly. Once the spreader gate settings are correct and the equipment is functioning properly, terminate the test.

Spreading the Aggregate

If the truck was disengaged from the spreader to perform a test strip, the truck and spreader should be joined together again. As the spreader and truck move forward, open the gates just before reaching the beginning of the asphalt shot. Raise the truck bed enough to keep the receiving hopper full until the truck bed is empty.

For best results, apply aggregate on any type of asphalt binder as soon as possible without causing the rocks to roll over or the asphalt to be picked up on the spreader box, haul truck, or roller tires. That is, the aggregate spreader should follow closely behind the asphalt distributor. Refer to Section 14 for more information on the proper time to begin spreading the aggregate.

Once the truck bed is empty, give a signal to lower the truck bed. This will allow the truck to separate from the spreader without causing the tailgate or rear of the truck bed to strike the top of the receiving hopper.

Truck/Spreader Separation

The spreader will normally continue to move forward while the truck bed is being lowered. Before the spreader is completely empty, the operator should release the truck. Most hitches can be released without stopping the spreader, but the spreader must eventually stop to hook up to the next truck. After the spreader stops, back it up a few feet to allow the second truck to link up. The process is then repeated.

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See Appendix A for slides

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See Appendix A for slides

Rock Land Marker

After hooking up with the second truck and resuming the spreading, the spreader should pass the marker for the end of the first rock land. The end of the first rock land should be slightly farther than the second truck hookup, because there should be some aggregate in the spreader remaining from the first truckload.

If the spreader passes the first rock land marker before the first truck is empty, the aggregate is being applied too thinly. If the second truck is hooked up more than 25 feet before the first rock land marker, the aggregate is being applied too heavily. In either case, adjust gate openings accordingly.

Visual Checks

The inspector assigned to watch the aggregate application should be positioned to have a good view of the aggregate as it leaves the discharge hopper. There should be a thin "curtain" of aggregate dropping through the gates. The curtain should be uniform across the entire width of the discharge hopper. The curtain of aggregate should be only one aggregate particle thick, and light should be easily seen through the curtain. Any dark streams suggest a gate is open too wide. Any unusually light streak means not enough aggregate is being released. If the aggregate appears to be stacking as it is placed on the asphalt, it is being applied too heavily.

Visually check the scalping grate on top of the discharge hopper as well. There should be a steady flow of aggregate passing through it. An accumulation of clay balls, grass, or rocks on top of the grate indicates that the loader operator is picking up contaminants. Correct this problem immediately.

Behind the spreader, check the pavement surface for contaminants and streaking of thin or thick rows of aggregates. Evidence of thick and thin alternating streaks running transversely (a ripple effect) indicates that the spreader speed is too high.

Recording Truck Loads

It is important to keep accurate records of the number of truck loads of aggregate placed on the roadway. One method is to write down the identification numbers of each truck on the project. Each time a truck finishes emptying a load into the spreader, a mark is placed beside that truck's number.

Asphalt on Tires

Occasionally, the tires on the spreader and the haul trucks should be checked for asphalt (and aggregate) sticking to them. Correct this problem immediately.

Tires may pick up asphalt under the following conditions.

- Aggregate is rolling over causing asphalt to be exposed to the tires. This can be caused by not using enough asphalt to hold the aggregate or by applying too much aggregate. Refer to Section 14 for more information on the proper time to begin spreading the aggregate.
- Too much asphalt has been applied.
- A puddle of asphalt may have leaked or spilled onto the pavement without cleanup prior to aggregate application.
- One of the discharge gates on the spreader may have clogged momentarily, preventing the aggregate from covering the asphalt.
- Failure to use deflector nozzles and overlapping the shot in the second lane causes an excess of asphalt.
- Detouring traffic onto the fresh seal may cause aggregate pickup.
- Construction and other traffic accelerating, turning, and braking abruptly on the fresh seal can dislodge aggregate. Accelerating quickly may cause a tire to spin because of the soft asphalt and unrolled aggregate. Turning quickly may cause the aggregate to roll over, exposing some of the asphalt. Braking suddenly may cause the wheels to lock and shove aggregate. These situations can occur with any asphalt but are most likely to occur when using asphalt emulsions.
- Improper tire inflation pressures on construction vehicles.

If any of the above situations occur, the seal patching crew should repair the spot before rolling. Clean tires immediately and remedy the condition before the situation gets worse.

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See Appendix A for slides

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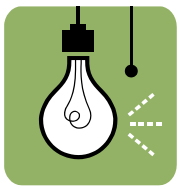
Section 14 – Timing for Aggregate Application

Introduction

This section is intended to provide guidance for determining the proper time to begin applying aggregate on fresh asphalt. The following paragraphs will address applying aggregate as soon as possible.

Immediate Aggregate Application



For best results, apply aggregate to emulsified asphalt or hot AC immediately. That is, the aggregate spreader should follow closely behind the distributor.

Applying the aggregate while the asphalt is very liquid maximizes aggregate embedment depth and aggregate-to-asphalt adhesion and thus enhances quality and economics of the seal coat. As the emulsion breaks or cures, the residue is deposited up the sides of the aggregate particles, and a meniscus is formed as shown in Figure 5-7.

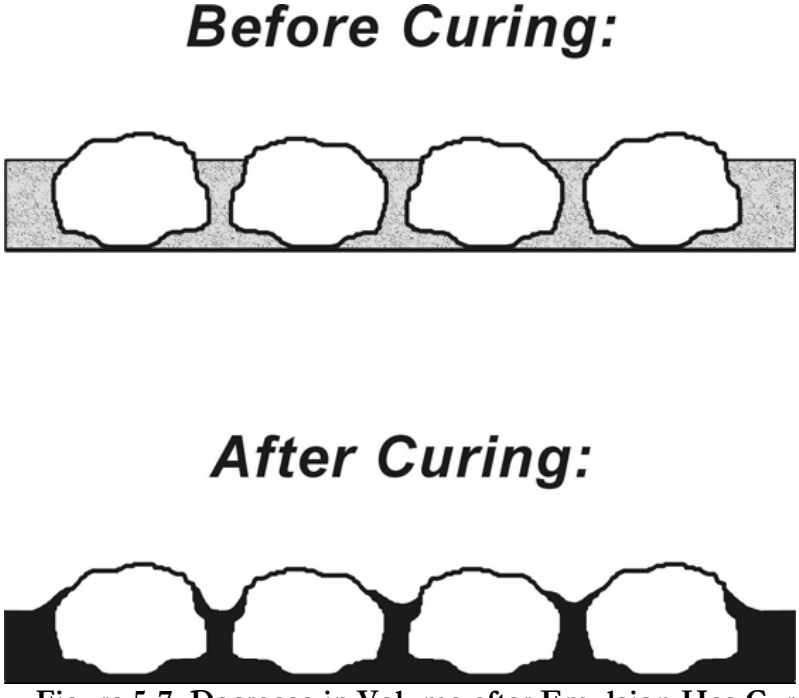


Figure 5-7. Decrease in Volume after Emulsion Has Cured.

See Appendix A for slides

This cannot occur with cool AC or emulsion after it breaks. High embedment depth minimizes shelling, particularly when the seal coat experiences rain or cold weather shortly after placement. One reason for using emulsified asphalts is that they typically require less residual asphalt than hot AC when the aggregate is properly applied to achieve adequate embedment depth.

When applying emulsions for seal coats, many crews wait until the emulsion begins to break before applying the aggregate. Similarly, when applying hot AC, they wait until it cools before applying the aggregate. They do this because when they apply the aggregate to the fresh (very liquid) emulsion or hot AC, the aggregate particles strike the pavement surface and bounce or roll forward often coming to rest with a coating of asphalt on the upper surface of the aggregate particle. Subsequent aggregate seating using a pneumatic roller may pick up some of those aggregate particles with a sticky asphalt coating on top and thus create major problems during the rolling process.

Waiting for the emulsion to break or the AC to cool before applying the aggregate often results in undesirable subsequent circumstances.

- The first is very low embedment depth. When emulsified asphalts begin to break, particularly polymer-modified emulsions, they often form a skin on the surface. This skin prevents adequate embedment of the aggregate particles into the emulsion layer and reduces aggregate-to-asphalt adhesion. Allowing AC to cool before applying aggregate causes similar problems.
- Low aggregate embedment depth and poor adhesion present the potential for shelling, particularly for seal coats placed late in the season, just before fall rains and cool weather begins.
- To offset the potential for aggregate shelling, the emulsion or AC application rate is often increased, particularly late in the season, when there is concern about shelling. This excess asphalt may cause flushing during the following summer.

Aggregate roll-over is *not* a result of low viscosity of the emulsion or hot AC, but it may be caused by the forward motion (horizontal velocity component) of the aggregate particles when they strike the pavement surface. One possible solution may be a strategically located "striker plate" fastened to the aggregate spreader at the appropriate angle to redirect the aggregate so that it falls essentially straight downward onto the pavement surface without bouncing or rolling forward. That is, the aggregate particles should have no forward motion during application. Once the striker plate is in place and the proper speed has been determined to cause the aggregate to drop straight downward, operate the aggregate spreader at that predetermined speed. Some late-model aggregate spreaders are designed to apply the aggregate with no forward momentum.

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See Appendix A for slides

Section 15 – Rolling the Aggregate

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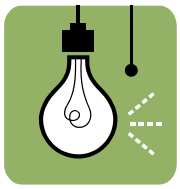
See Appendix A for slides

Introduction



Roll the aggregate immediately with approved self-propelled pneumatic-tired rollers. Steel-wheeled rollers are not recommended because they can crush the aggregate. Immediate rolling provides better embedment and assists with rapid wetting of the aggregate by the binder. If you are using emulsion, the inspector should make sure the emulsion has broke before rolling. This will keep the roller tires clean.

There should be enough rollers to cover the entire mat width in one pass (one direction). Rolling should be in a staggered pattern making a minimum of five passes for asphalt cement or three passes for asphalt emulsions. Additional rolling may be required during cooler air temperatures. If rollers are unable to keep up with the spreader, asphalt application should stop until rollers catch up or additional rollers should be furnished.

The distributor controls the overall production because no other piece of equipment can begin to function until the distributor has applied binder to the surface. Therefore, to ensure a high standard of quality control, the spreader and roller operations must be able to keep up with the production of the distributor. The number of rollers, the rolling time, and keeping pace with the distributor are critical for a successful seal coat.

Rolling Pattern

The rolling pattern used for seal coats will depend largely on the number and types of rollers. For a 12-foot wide asphalt shot, the most efficient rolling system will typically involve three or four pneumatic rollers. With this number of rollers, it is possible to provide coverage with three passes (acceptable for emulsions): one forward, one in reverse, and the final pass forward extending into the first pass of the next section. It is usually better to have the rollers operating continuously rather than sitting idle. Normally, more rolling is better unless aggregate degradation is occurring.

When three or four pneumatic rollers are used, the rollers should be staggered in an echelon pattern. The lead roller is usually on the inside, and each of the others offset approximately one-third the roller width. The sketch in Figure 5-8 illustrates the echelon pattern.

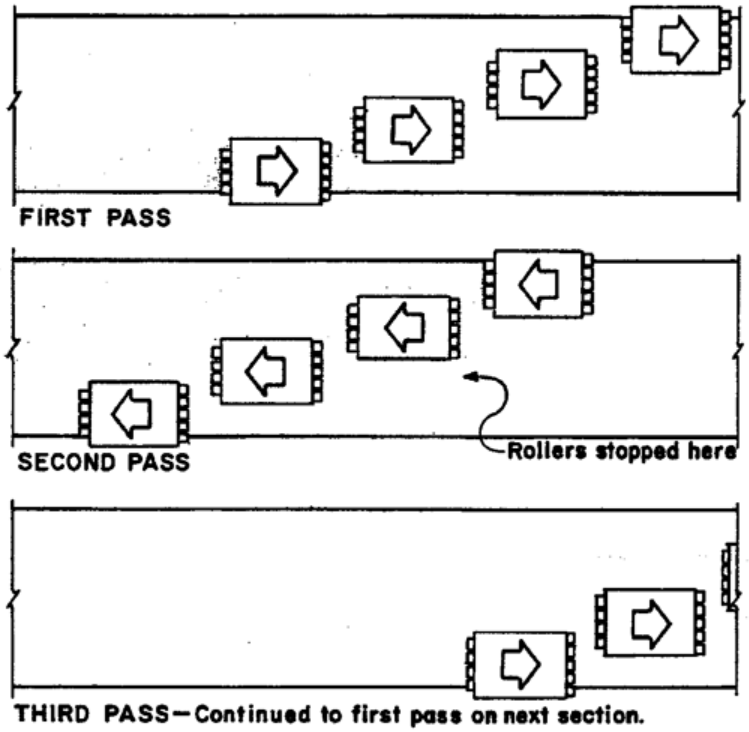


Figure 5-8. Illustration of Echelon Rolling Pattern.

Checking the Rolling Pattern

Check the rolling pattern to verify that complete coverage and proper embedment are achieved. Rollers should cover both edges completely as well as the center of the lane. After the rollers have completed one section, the aggregate orientation should be visually evaluated. If the aggregate particles are lying in their flattest dimension, the rolling is adequate. If many of the aggregate particles are still situated upright, additional rolling should be required. Monitor the rolling operation carefully to ensure that none of the roller operators stop and start too quickly causing scuffing on the fresh seal.

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See Appendix A for slides

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See Appendix A for slides

Section 16 – Patching or Hand Work

Introduction
Many things can occur during the seal coat operation that requires some minor patching or hand work. A crew of two or three people is sometimes assigned the responsibility for patching. They should be equipped with a pickup containing a supply of aggregate, shovels, push brooms, and sometimes buckets with patching asphalt and swabs or mops to apply it. They usually follow behind the chain of haul trucks and make repairs before the rollers reach the troubled spot.

Immediate Repairs
The patching crew may be required to make minor, on-the-spot repairs that will not interrupt the seal coat process. These repairs may include the following:

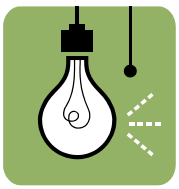
- Removing and/or brooming small mounds of excess spilled aggregate on top of the sealed surface. The majority may be shoveled back into the truck, and the remainder swept to the side of the shoulder.
- Occasionally a double layer of asphalt may be sprayed on a joint. This usually happens because the joint paper was not exactly at the edge of the aggregate when a joint was made. Asphalt may ooze up through the aggregate at this point. All the patching crew can do is cover the asphalt with additional aggregate to prevent it from sticking to the roller tires. Later, it should be removed and the section replaced. Otherwise, there will be a noticeable bump.
- Sometimes asphalt splashes outside the coverage of the spreader. These streaks of asphalt must be covered with aggregate so the asphalt will not stick to the roller tires.
- Removal of grass or clay balls. If the patching crew finds any grass or clay balls that have passed through the spreader, it is their responsibility to remove the contaminants and replace with aggregate.
- If a spot has been missed by the asphalt distributor because of a clogged nozzle, or any other reason, the patching crew should apply asphalt on the bare spot followed by aggregate.

Delayed Repairs
Some repairs are beyond the capability of the patching crew and must be delayed until later. These are usually large areas that have failed for various reasons. The method of repair for these large areas should be determined after discussion with the engineer.

Section 17 – Intersections and Irregular Shapes

Notes:

Introduction



In general, intersections and irregular shapes should be seal coated before the main lanes. This will minimize aggregate loss due to turning movements from construction equipment and provide a sharp longitudinal joint.

Transitions

Transitions are shot in a similar manner to shoulders. It is good practice to start at the narrow end, whenever possible. Then as the surface widens, one or two nozzles can be turned on quickly at the right time. If progression is toward the narrow end, there is more potential for overspray error. In some cases, it is not practical to start at the narrow end.

In some cases, transitions may require some touch-up with the hand sprayer in order to even up the outside edge. The inside joint at the full lane should be straight and sharp. The outside edges can be touched up easier than a ragged joint.

Radii at Intersections

To seal the radii at intersections, apply the asphalt with the distributor hand sprayer and apply the aggregate with the spreader or by hand.

Crossovers on Divided Highways

Sealing the crossovers on divided highways normally entails a combination of techniques used for transitions and intersection radii.

Driveways and Private Roads

Driveways and private roads, which provide access to the highway, are not normally sealed even though they are within TxDOT's right of way.

Problems with Hand Work

Anytime that hand spraying and manual aggregate spreading is required, achieving uniform application rates will be difficult. It is desirable to keep hand work to a minimum. Any lack of uniformity will usually result in some type of problem, either immediately or in the future.

See Appendix A for slides

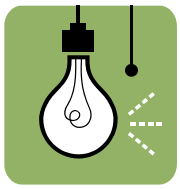
Section 18 – Brooming Excess Aggregate

Notes:

See Appendix A for slides

Introduction
After the aggregate is spread and rolled, there will be some loose aggregate. Remove this excess aggregate to prevent it from being whipped up by vehicle tires. Loose material may act to dislodge other aggregate under traffic shear forces.

Timing



Do not broom the excess aggregate off the roadway as soon as the rolling is finished. The asphalt is still too soft and must be allowed to stiffen or cure before brooming. Otherwise, the broom will strip the aggregate away from the binder.

If necessary, perform *light* brooming before opening to traffic to remove excess aggregate that is not embedded in the asphalt. *Final* brooming should be done as soon as the binder is fully cured: on the same day or the following morning. Best results are obtained by waiting until the following morning (as early as possible). Temperatures are lower during the early hours and the aggregate will be held more firmly in place with only the excess aggregate removed.

Equipment
The only equipment needed is a rotary broom or a vacuum sweeper for curbed roadways. One or two pickup trucks may accompany the broom, especially if there is a high volume of traffic. One truck may lead and the other follows the sweeper as a warning to traffic. Pickup trucks and sweepers must have appropriate warning devices.

Procedures
The sweeper should begin at the centerline and sweep the aggregate toward the outside edge of the roadway. It is always best to broom excess aggregate away from traffic. Regardless of how many passes are required, the objective is to broom the excess aggregate off the roadway surface.

Inspection
Ensure that all excess aggregate is removed from the roadway surface including intersections. Extra brooming may be required at the transverse joints where aggregate tends to overlap. Take care to ensure that large quantities of aggregate are not swept onto adjacent private property. In addition, carefully observe the operation to assure that the sweeper is not dislodging aggregate that is embedded in the binder. Also ensure that sweeping is performed safely and with minimum interruption or delay of traffic.

Section 19 – Opening to Traffic

Introduction
Keep traffic off the fresh seal coat as long as possible. This section discusses the various factors that can affect when it is appropriate to open the seal coat to traffic.

Traffic Volume
Roadways with a low-traffic volume may be opened to traffic sooner than high-traffic volume roadways.

Truck Traffic
On roadways with a high volume of truck traffic, hot asphalt needs longer to cool (and stiffen), and emulsions need longer to cure so that trucks will not damage the surface.

Traffic Speed
When sealing roadways where traffic speeds are high, it is best to allow additional time for asphalt to bond to the aggregate securely prior to opening to traffic. This not only prevents damage to the freshly placed seal coat but also reduces the potential for vehicle damage.

Allowing slow-moving traffic on a new seal coat after final rolling is one of the best means to reduce premature aggregate loss. Slowly moving vehicles seem to provide a level of aggregate orientation not achievable by conventional pneumatic rollers. One method to assure the traffic will move slowly is to use pilot vehicles.

Asphalt Type and Weather Conditions
The type of asphalt binder used will affect the amount of time prior to opening the lane to traffic.

Asphalt Cement. Asphalt cements stiffen sooner and binds the aggregate with greater tenacity than asphalt emulsions, and thus may be opened to traffic sooner.

Asphalt Emulsions. Emulsions are typically shot at about 150°F which is near the pavement temperature during the summer, so there is little loss of binder temperature. However, high humidity requires more time for emulsions to break. When humidity is greater than 50 percent, traffic should be kept off the seal as long as possible.

If it rains and emulsions are in use, keep traffic off the fresh seal or it is likely that most of the aggregate and much of the binder will be lost.

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See Appendix A for slides

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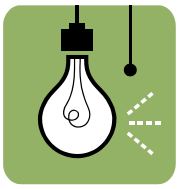
Changing Lanes

When a lane is finished and it is time to turn traffic onto the fresh seal, take extreme care to avoid confusion and ensure the safety of motorists and construction personnel. The critical issue is that complete and positive control is exercised over the traffic, movement of equipment onto the opposite side, and the resetting of traffic cones.

See Appendix A for slides

Section 20 – Temporary or Permanent Pavement Markings

General



When the seal coat is applied, the center stripe and lane markings are obliterated. For the safety of motorists, replace markings as quickly as possible.

Temporary Markings

Temporary tabs should be placed before the seal coat operation begins and the covers removed from the tabs as soon as possible after the rollers have finished or no later than the end of the day. When the adjacent lane is to be sealed on a different day, use tabs with double covers to prevent the need to apply a second set of tabs.

Permanent Markings

Apply permanent markings within the time frame specified on the plans. Temporary markings must be removed after placement of permanent markings.

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See Appendix A for slides

Section 21 – Placing Raised Pavement Markers

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General

Remove temporary tabs placed prior to shooting the asphalt and install raised pavement markers. The surface should be free of dirt, grease, oil, moisture, or loose aggregate prior to marker installation.

See Appendix A for slides

Section 22 – Cleanup

Joint Paper
Collect and properly dispose of the paper used for the construction of transverse joints from the side of the road.

Spilled Asphalt
Sometimes small quantities of asphalt are inadvertently spilled where distributors were loaded and around the heater units. Remove and properly dispose of any spilled asphalt.

Stockpile Area
Remove all excess aggregate at the stockpile area. Remove any trash and leave the area in a condition acceptable to TxDOT.

Signs and Barricades
Remove all warning signs and barricades used on the project from the area after the project has been accepted. Ensure all construction sign supports are completely removed to avoid future tire damage.

Repairs to Damaged Property
Carefully inspect the areas around stockpiles and any other area where equipment has been used. Inspect fences, mailboxes, and other private property for damage. Repair any damages.

Notes:

See Appendix A for slides