5-2 Bituminous Surface Treatment

5-2.1 General Instructions

Refer to Chapter 5-4.1 for a general discussion of responsibilities and attitude of the Inspector on bituminous paving work.

It is very important that the Inspector on construction of Bituminous Surface Treatment Class A (penetration treatment) and Classes B, C, and D (seal coat) be entirely familiar with the specifications and methods applicable to the work, as construction of these types of surfaces proceeds very rapidly. If the work is begun without proper preparation and planning, it is entirely possible that a major portion of the job will be completed before correction of any improper methods or procedures can be made.

Careful review of Section 5-02.3(10) of the *Standard Specifications* concerning unfavorable weather and calendar cutoff dates should be made well in advance of any bituminous paving work. In no case should bituminous surface treatments be placed before May 15 or after August 15 of any year without review by the State Construction Office and written order of the Regional Administrator.

The following table gives the number of gallons per ton @ 60 F° for the various asphaltic materials. To correct the volume of the material to 60° F, there are several handbooks that contain tables of temperature volume corrections for the different asphaltic materials.

Grade	Gallons per Ton @ 60° F
Cutback Asphalts	
70	253
250	249
800	245
3,000	241
Emulsified Asphalts	
All Grades	240

When payment for asphaltic materials is by the ton, they should be measured by weighing. When it is impractical to weigh the materials, the quantity of asphaltic material used may be measured by the gallon and the number of gallons converted to tons with the appropriate temperature volume correction.

5-2.2 Duties Before Construction

See Chapter 5-4 for preliminary duties of the Inspector.

Traffic Control

Refer to Chapters 1-2.3 and 5-4 of this manual for instructions concerning preliminary arrangements to be made for control of traffic.

Inspection Tools and Equipment

Before construction begins, the Inspector shall secure from the Project Engineer all equipment necessary to carry out the inspection duties. This equipment shall include air and asphalt thermometers, a device to measure surface temperature, wind gage, sieves and scale, tapes and rules, canvas sample sacks, containers for sampling asphalt, notebooks, ticket books and diary book.

Inspection of Contractor's Equipment

Prior to construction of the bituminous surface, the Inspector shall make an inspection of the Contractor's equipment. The Inspector shall check to see that all required equipment is available, and see that the equipment is in good condition and is properly adjusted.

A careful check of the asphalt distributor shall be made to ensure that it meets the requirements of the specifications. The capacity of the distributor shall be determined, and ensure that the volume gauge is calibrated to correctly indicate quantities in the tank.

Special attention should be given to the condition and adjustment of the asphalt pump, spray bar and spray nozzles. The nozzles should be set uniformly at the proper angle from the axis of the spray bar, normally 15 to 30 degrees, to eliminate interference of the sprayed material from one nozzle with that from an adjoining nozzle. Each nozzle should be set at the same angle. The height of the spray bar must be checked to see that the correct overlap of the spray from each nozzle is obtained. This can be accomplished by plugging alternate nozzles and adjusting the height of the spray bar until the edges of the spray fans from the unplugged nozzles just meet at the roadway surface. When all nozzles are spraying, an exact double coverage of asphalt will be obtained, resulting in an application of asphalt free from longitudinal streaking.

The asphalt pump must be checked to ensure that the required pressure can be maintained uniformly.

The Inspector must check the motor patrol graders, rollers, spreader boxes, etc., to ensure that they are in good operating condition. The Inspector should see that the motor patrols are equipped with the required moldboard brooms. The capacity of hauling trucks and water tanks must be determined from measurement obtained on the job, the results being recorded for future reference.

5-2.3 Inspection of Bituminous Surface Treatment, Class A

Preparation of Roadway

The roadway to be treated shall be processed, shaped and compacted to a smooth, uniform grade and cross-section before application of the asphalt. It is essential that the grading of the surfacing material be uniform over the area to be treated to allow uniform penetration of the asphalt. This is different work than that associated with shaping and compacting of crushed surfacing as required in Section 4-04.3(5) of the Standard Specifications. The quality and smoothness of the finished roadway depends to a great extent on the quality of the work done in preparing the roadway. Careful inspection during this operation will lay the groundwork for a smooth riding and uniform appearing finished project.

In many instances, the surfacing course upon which the bituminous surface treatment is to be placed will be segregated, rutted and pot-holed by traffic using the roadway prior to oiling. Such a surface must be completely processed to the depth of the ruts or potholes, and re-laid. Do not allow the Contractor to merely lightly blade the surfacing course, filling the holes with loose, segregated material. Such procedures are sure to result in a rough uneven pavement, due to differential compaction and penetration.

The surfacing must be thoroughly rolled to obtain a dense, unyielding base for the bituminous surface treatment. A final coverage with the steel-wheeled roller will produce a smooth surface upon which to apply the prime coat.

The blading and rolling of the surfacing shall be coordinated so the asphalt will be applied while the surfacing material is still damp. If the surfacing material compacts to a very tight surface, the asphalt material will not penetrate as much as if the material is more open. If this is the case, the inspector should be careful to not apply too heavy a coat of asphalt.

Application of Asphalt and Aggregate

Immediately prior to starting an application of asphalt, the Inspector should require that the spray bar and nozzles be tested to see that the asphalt will be sprayed properly. The distributor should be placed with the spray bar over building paper and the nozzles opened so that the spray may be checked visually for evidence of non-uniformity. The building paper and asphalt must be picked up and disposed of in accordance with environmental regulations.

Building paper shall be placed at the joint, each time the distributor starts, in a manner that assures a uniform asphalt spread across the area of the joint.

During the application of the asphalt, the Inspector shall maintain a close inspection of the roadway to see that the asphalt is applied in a uniform manner. If any evidence of improper application is apparent, the operation must be stopped at once and required corrections be made to eliminate the trouble. The Inspector must check to see that the asphalt pump pressure and the speed of the distributor are maintained at uniform rates to ensure even application of the asphalt. A record shall be made of each distributor load applied, showing area treated, gallons (liters) spread, temperature of asphalt, etc. The Inspector should compute the yield of each spread in gallons per square yard (liters per square meter).

Part of the prime shot asphalt applied to the surfacing penetrates the material and the rest remains on the surface and surrounds the aggregate, usually $^1/_2$ inch (12.5 mm) screenings. The clean screenings (chips) are used in place of cover stone to promote the venting of volatiles from the cutback asphalt needed for penetration. Constant checking needs to be made to ensure that enough asphalt product is being applied to fill the voids and stick the aggregate. This may change during the day because of weather or the preparation crew's efforts to stay ahead of the oiling crew. Some bleed can be tolerated on the prime shot as it can be corrected on the second (tack) shot if uniform in nature. The final mat will be thicker and better if the maximum amount of asphalt possible, without excessive bleed, is shot on the first (prime) shot. Succeeding shots are placed as seal coats described in Chapter 5-2.4 of this manual.

The stockpiled aggregate shall be inspected to determine the grading of the material, and to see that it is damp at the time of loading onto trucks for hauling to the roadway. If dry or dusty, the material in stockpile must be watered to produce a surface damp condition. The asphalt does not readily coat a dry dusty surface. During good warm weather, the moisture on the surface of the aggregate will quickly evaporate after the aggregate is spread on the asphalt on the roadway.

The Inspector must frequently check the truckloads of aggregate at the point of delivery on the roadway, to see that the trucks are completely loaded and that the material is damp. Tickets shall be issued for each load of material received or a receiving report record made as the loads of material are received and a record made of the quantities of material used on each section.

Following the application of asphalt, the Inspector is responsible for seeing that the aggregate is applied in accordance with the specifications, watching especially that the aggregate is applied at the correct rate within the time limit allowed. The roadway shall be inspected for signs of skips or omissions in the application of the cover stone and to see that any omissions are immediately covered by hand-spotting methods. The Inspector must not allow excessive amounts of aggregate to be applied, which will only result in waste of the material, and require harmful excessive brooming.

Careful inspection and control of the rolling operation must be made to see that the requirements of the specifications are met. It is important that rolling be conducted as soon as possible following application of the aggregate in order to properly imbed the aggregate in the asphalt.

Chips are broomed the day following the shot because loose chips are of no value in protecting the mat and any loose aggregate on the roadway promotes wheel tracking. Areas of severe bleed will need to be blotted with $^1/_4$-inch

(6.3-mm) material during the cure period. Cutback asphalts are curing as long as you can smell the volatiles on a warm day. Emulsions do not really cure except to shed water when they break. Either asphalt will be tender for awhile, although probably ready for the next construction step.

When the asphalt has started to cure and the chances of it bleeding are remote, the excess aggregate on the edge of the roadway should be broomed off as it is a hazard to traffic and reduces the usable width of the roadway.

5-2.4 Inspection of Bituminous Surface Treatment, Classes B, C, and D

Preparation of Roadway

Prior to the application of the seal coat, the Inspector shall see that the existing surface is broomed clean and that holes and breaks are patched as required. The Inspector should inspect the existing surface carefully over the length of the job, noting the surface characteristics of the roadway, so that the rate of application of asphalt best suited to the conditions can be determined. The Inspector should make note of varying conditions and plan to vary the application of asphalt accordingly.

Any areas of the roadway showing failure caused by soft subbase or poor drainage must be removed and the cause of the failure corrected.

If any open or porous surfaces, particularly on recently constructed bituminous pavements, are found in the area to be treated, the Inspector shall require the application of a "pre-seal" treatment to be applied before construction of the seal coat. If this pre-seal treatment is not shown on the plans, the Inspector will inform the Project Engineer of the situation, so that a supplemental agreement may be reached with the Contractor.

The Inspector is responsible to see that a newly constructed bituminous surface be allowed the required time for curing before allowing construction of the seal coat over the affected area.

Construction of Seal Coat

Refer to Chapter 5-2.3 for instructions covering inspection duties during application of asphalt and screenings or cover stone.

In the construction of a seal coat, the quantity of asphalt spread is very critical, due to the thinness of the layer of aggregate placed on the asphalt. Constant checking must be done to ensure that embedment of the major stone in the asphalt is 50 to 70 percent. Where $^1/_2$-inch (12.5-mm) chips are used on routes with moderate traffic volumes, $^1/_4$-inch (6.3-mm) material may be used either ahead of or immediately behind the main rollers. Some bleed is inevitable at intersections, on steep hills, and at severe horizontal or vertical curvature. This is less objectionable than losing rock on long sections in between, due to insufficient asphalt.

The Inspector must maintain continual inspection of the application of aggregate on the freshly spread asphalt, to see that the material is placed within the allowable time. The Inspector must make certain that the spread of asphalt is not extended beyond the area which the Contractor is capable of covering within the allowed time.

Omissions or skips in the spreading of aggregates must be immediately covered by the hand spotting crew.

The best seal coats are obtained on those jobs where the time elapsed between spreading of asphalt and application of aggregates is held to the shortest possible time.

The Inspector must see that the rolling operation is not allowed to lag far behind the spreading of aggregates. It is important that the particles of aggregate be rolled into the asphalt film as soon as possible following application.

Spreading Fine Screenings

When constructing Bituminous Surface Treatment Class B or Class C, the specifications require the application of fine screenings following spreading and rolling of the coarse aggregates. The Inspector must exercise judgment in determining the time for applying the fine screenings. When using emulsions, the fine screenings should be applied immediately, sometimes even before initial rolling.

Fine screenings, applied at the proper time, will key the interstices between the particles of coarse aggregate and provide a smoother riding surface, as well as absorb any free asphalt which might "bleed" to the surface of the coarse particles.

By observing conditions and results carefully, the experienced inspector will determine the procedure producing the best results under any particular condition.

If the sealed roadway is rained on before the asphalt has cured and the asphalt starts to emulsify under the traffic, the roadway can usually be saved from damage by applying fine screenings on the roadway to prevent the traffic from picking up the asphalt. The spill prevention control and countermeasures plan should be referred to for guidance on using Best Management Practices (BMPs) to protect the environment.

5-2.5 Inspection and Sampling of Materials

Asphalt

The shipments of asphalt arriving on the job by tank truck shall be inspected by the Inspector. Each shipment must be accompanied by a weigh bill and shipper's certificate. The tank must be inspected after unloaded to see that no asphalt remains in the tank.

The Inspector must check and record the temperature of each load of asphalt delivered to the roadway for spreading.

Samples of the asphalt shall be taken as required in Chapter 9-4.2 of this manual, and shall be submitted to the State Materials Laboratory for Testing.

Aggregates

No aggregate shall be used without the approval of the State Materials Laboratory. If material available in stockpile for use on the contract has been approved at some previous date, screen analysis must be made of a sample of the material to see that the material meets grading requirements. If any question arises concerning quality of the material, a sample shall be sent to the State Materials Laboratory for testing before use and preferably during plan preparation.

5-2.6 Miscellaneous Inspection Duties

Protection of Structures

When spreading asphalt near curbs, bridge rails, or other structures, adequate protection must be provided to prevent asphalt from splashing or blowing on the structures. The Inspector shall see that any asphalt sprayed on a structure is satisfactorily removed by the Contractor.

Control of Traffic

Frequent checks should be made of traffic control operations to see that traffic is being conducted through the job in a safe, orderly manner. When spreading asphalt, traffic should not be allowed to travel past the distributor. Control of the speed of traffic is very important, especially during the early curing stage of the asphalt, so that the aggregate covering the asphalt is disturbed as little as possible. Control of traffic must be maintained as long as required to prevent excessive pickup and whipping-off of the aggregate. The Inspector must see that all warning signs are properly in place throughout construction. See Chapter 1-2.3 of this manual for further instructions on construction signing.

Maintenance and Finishing Roadway

The Inspector shall see that the newly completed roadway is properly maintained until brooming is completed, usually the next day. The Contractor shall be required to keep sufficient equipment on the job to adequately handle any situation that may develop. Before the work is accepted, the Contractor shall be required to finish the roadway and clean up any debris resulting from their operations, as required in the Specifications.

Measurement of Stockpiles

Before construction is begun, stockpiles from which materials are to be removed shall be measured and quantities computed. Upon completion of the work, the Contractor shall be required to leave the remaining materials in neat, presentable stockpiles, and the stockpiles shall again be measured and quantities determined. The difference in quantities obtained by this procedure will aid in checking pay quantities determined by truck volumes. It will also serve as an accurate basis for reporting quantities withdrawn from stockpiles. Measurement of stockpiles will not be necessary on projects where the aggregate is furnished by the contractor.

Notice to Maintenance Superintendent

The Project Engineer should keep the area Maintenance Superintendent informed of the Contractor's proposed progress schedule so that maintenance operations can be coordinated to accommodate the construction work. The Project Engineer must also notify the Maintenance Superintendent of the date when the Contractor's maintenance period will expire so that maintenance of the roadway may be taken over by WSDOT and maintained without interruption. These notices should be given sufficiently in advance to enable the Maintenance Superintendent to provide equipment and organize the work.

5-2.7 Reports and Records

A Daily Report of BST Operations, Form 422-644, shall be made at the end of each day's work, showing type of work, areas treated, quantities used, etc. This report shall be submitted in duplicate for the Project Engineer and Region.

Records of quantities of asphalt and aggregate used shall be kept in the Inspector's Daily Report, and shall be checked daily against quantities shown on tickets issued to the Contractor. Accurate, neat records are invaluable to the Project Engineer in preparing estimates and final records. See Chapter 10-2 of this manual for instructions concerning quality control procedures.

The Inspector shall enter in the Inspector's Daily Report all pertinent information concerning each day's work.

5-3 Stress Absorbing Membranes

5-3.1 General

Stress absorbing membranes are seal coats similar to bituminous surface treatments except that paving grade asphalt mixed with rubber is used for the binder. The grades of asphalt allowed are specified in the contract special provisions as are the rubber requirements. The rubber is usually a ground or powdered substance manufactured from used tire carcasses. There are two types of stress absorbing membranes:

(1) SAM; a stress absorbing membrane used as the finish wearing surface of the roadway.

(2) SAMI; a stress absorbing membrane interface used between an existing roadway surface and a new layer of asphalt concrete to prevent existing cracks from reflecting through to the new surface.

5-3.2 Duties Before Construction Begins

See Chapter 5-4 of this manual for preliminary duties of the Inspector.

5-3.2A Traffic Control

See Chapters 1-2.3 and 5-4 of this manual for traffic control arrangements.

5-3.2B Inspection Tools

Before construction begins, the Inspector should gather together the tools needed to perform inspection duties: the equipment required includes air and asphalt thermometers, sieves and scale, tapes and rules, sample sacks, quart cans for sampling asphalt, notebooks, forms, ticket books, and diary book.

5-3.2C Inspection of Contractor's Equipment

Section 5-02.3(1) of the *Standard Specifications* details the equipment requirements. In addition, self-propelled power brooms will be required to clean the existing pavement. The only rollers allowed will be self-propelled with pneumatic tires. The Inspector should also review Chapter 5-2.2 of this manual.

5-3.3 Inspection of Mixing Process

There are two mixing processes currently being used. The specifications for both processes require that the asphalt and rubber be combined in the proportions of two pounds (one kilogram) rubber to one gallon (4.2 liters) of asphalt. The Inspector must determine the percentage by mass of the asphalt and rubber incorporated into the mixture. When a diluent is used, it must have a boiling point of at least 250 F (176°C) and should be mixed as rapidly as possible when introduced to the asphalt along with the rubber. The other process utilizes an extender oil, with the mixture then being heated to 400 F (205°C).

5-3.4 Inspection of Application and Sampling Materials

The following application procedures are used for SAMs and SAMIs.

(1) The existing surface is cleared and patched as required by Section 5-04.3(5)A of the *Standard Specifications*. Existing cracks $^1/_4$ inch (6 mm) or larger should be filled before application of stress absorbing membranes. The use of a power broom is required.

(2) The hot rubber mixture is applied at a rate of 0.50 gallons (2.25 liters) plus or minus 0.05 gallons (0.2 liters) per square yard (meter) dependent upon the absorption of the mixture into the existing pavement, surface texture of existing pavement and absorption of the mixture into the cover stone.

(3) Aggregate spreading *must* start within 15 seconds after application of the hot rubber mixture. The amount of aggregate spread is 25 to 40 pounds (13.5 to 22 kilograms) per square yard (meter) for a SAM. The SAMI will be overlaid with a course of asphalt concrete pavement, therefore only the minimum amount of aggregate needed to protect the membrane from equipment is needed. This is estimated to be 25 pounds (13.5 kilograms) per square yard (meter). If preheated aggregates are used they should be kept at specification temperature or slightly above or there will be problems with the spreader belts elongating.

(4) Rolling is started immediately following the aggregate spread. At least four complete passes are required to imbed the aggregate in the hot rubber mixture. A 25-ton (22-tonne) roller is desirable for best results.

(5) If traffic is to be allowed upon the fresh surface and precoated aggregate is used, then an additional layer of aggregate, $^1/_4$ inch-0 (6.3 mm-0), may be required after rolling. The aggregate would be applied at a rate of 5 to 10 pounds (2.7 to 5.4 kilograms) per square yard (meter). If the aggregate embedment is less than 50 percent, a fog seal is recommended. Also, discontinue the application of $^1/_4$ inch-0 (6.3 mm-0).

(6) Samples of the rubber and asphalt mixture shall be taken as required in Chapter 9 of this manual, and shall be submitted to the Materials Laboratory for testing.

5-3.5 Reports and Records

Same as Chapter 5-2.7.

5-4 Hot Mix Asphalt

5-4.1 General Instructions

The technology of asphalt materials and mixes is continuously changing. It is imperative to study contract documents and specifications prior to the start of any paving contract. There also are many excellent handbooks that can be obtained to assist paving inspectors and testers. It is recommended that the Project Engineer obtain copies of these handbooks as a resource for their office. Recommended books include "Hot Mix Asphalt Materials, Mixture Design and Construction" by the National Center for Asphalt Technology and "Hot-Mix Asphalt Paving Handbook" by the US Army Corps of Engineers.

Good work and a successfully completed job depend on good equipment, skillful operation of the equipment, competent, knowledgeable supervision and inspection, and open lines of communications. Maintaining open lines of communication through informal daily meetings between the project inspector and contractor, can greatly improve the success of any job. Hot mix asphalt (HMA) projects, are not always built as originally scheduled. Changes may occur because of material supply, equipment breakdown, contractor and subcontractor schedules, and weather conditions. Informal meetings on a regular basis provide a forum for the exchange of information and discussion of problems. To begin the communication process a prepaving meeting is recommended. The Project Engineer, paving inspectors and testers together with Contractor superintendents, foremen, screed operators, rakers, roller operators and plant operators should be present to go over all activities and plan the entire operation. It is also advisable to include traffic control personnel. The following check list may be used as an outline for the prepaving meeting:

Prepaving Check List

1. Review the HMA contract requirements with the Contractor. This will include the class of HMA, grade of asphalt binder, evaluation and acceptance procedures, mix design verification and test section requirements (both HMA mixture and compaction).

2. Go over procedures in Standard Specification 5-04.3(7)A for modifying the job mix formula.

3. Discuss construction of test sections, both mixture (Section 5-04.3(8)A item 3E) and compaction (Section 5-04.3(10)B item 2) where required. Review what is needed for the test section to be acceptable.

4. Go over the procedure and timing in obtaining density gauge correlation factors.

5. Discuss the communication procedure to be used for weather shut downs, use of mix in trucks and silos, and other potential construction problems.

6. If material transfer equipment (vehicle or device) is required by a special provision what type does the contractor plan on using and does it meet the requirements of the special provision?

7. Discussion of what to do if segregation of the mix is occurring.

8. Discuss the preparation of the existing surface (Section 5-04.3(5)A) including cleaning the pavement, application of tack, pickup problems and weather limitations (Section 5-04.3(16).

9. Go over asphalt densities: Who, When, and How, notification of results, request for cores, and utilization of core results.

10. Mix sample and testing: Who, When, and How, notification of results, composite pay factors (CPF), and Contractor's use of challenge test specifications. If the paving contractor is a subcontractor, the CPF should also be provided directly to the paving contractor.

11. Obtain a copy of the temperature-viscosity curve and the maximum recommended heating and discharge temperatures (Sections 5-04.3(6) and 5-04.3(8) respectively) for the type(s) of asphalt binder being used on the project. The Contractor will supply the information from the manufacturer of the asphalt binder.

12. Traffic control procedures and lines of communication including allowable times for lane closures.

13. Other factors specific to Contract or of concern by those attending.

In the construction of HMA, it is extremely important that the material meets all requirements of the specifications. It should be remembered that specifications are not arbitrarily arrived at, but have evolved through the years as a result of experience and research.

Experience has shown that pavements that do not meet all specifications will not perform satisfactorily, resulting in high maintenance costs. The responsibility for obtaining a mixture in close conformance with the project mix design and meeting the specification requirements rests with the Contractor. The importance of this cannot be overemphasized, since the best possible construction at the lowest cost to WSDOT cannot be obtained unless the mixture produced at the plant is uniform and of good quality. The key word used to describe quality production of HMA is UNIFORMITY.

- The aggregate in the stockpile must be of UNIFORM quality and gradation;
- Aggregate must be fed into the plant in a UNIFORM, controlled manner;
- The heating and drying of the aggregate must be UNIFORM;
- The separation of the aggregate in the bins must be UNIFORMLY controlled;
- The aggregates and asphalt must be combined and mixed in a UNIFORM, consistent manner.

In order to achieve this uniformity of quality, it is necessary that the entire operation be conducted so that each phase of the production operation is in balance with all other phases. To accomplish this most Contractors have a Quality Control (QC) program.

With the advent of Quality Assurance (QA) specifications and statistical evaluation of HMA, the role of inspection has evolved from one that was highly involved in the operation of the asphalt plant to one that is involved in verification that the material the Contractor produces is in conformance with the job mix formula and in accord with the specifications.

Various testing procedures are available to ensure that the component materials and the completed mixture meet the requirements of the specifications. However, since only relatively small samples of each day's production can be tested, inspection duties and responsibilities involve more than merely performing the required tests. Inspectors and testers must be familiar with the working of the asphalt plant and be observant during the production of the HMA for any changes that may occur in the Contractor's production of HMA. The Contractor is responsible for the uniform production of HMA so that the end product is of uniform quality. Only when the product is uniform can samples be considered representative of the material produced. The Inspector, through communications and observations of plant operation, can work with the Contractor to assure that the mix is being produced uniformly. If problems are observed, the plant foreman should be notified as the foreman is responsible for making the necessary corrections. If violations or misunderstanding of the specifications arise that cannot be promptly settled, the Project Engineer must be notified immediately.

Instructions in all cases shall be issued to the Contractor's designated representative rather than the workers. A diary must be kept, showing all instructions received from the Project Engineer and instructions issued to the Contractor.

Careful review of Section 5-04.3(16) of the *Standard Specifications* concerning weather limitations and calendar cutoff dates should be made in advance of any HMA paving work so that paving can be planned and completed prior to any unfavorable weather. Pavement performance is highly dependent on the weather conditions in the first weeks and months following paving . Invariably, when these specifications are not closely adhered to, early pavement performance problems occur. Therefore, between October 1 and April 1, no wearing course is to be placed without written approval of the Project Engineer. The Project Engineer will review this decision with the Region Headquarters prior to approving any paving outside these dates.

In addition, use of a pneumatic tired roller is required from October 1 to April 1. It has been shown that during warmer weather, traffic will knead the HMA providing a more durable pavement. To duplicate this benefit for late season paving, use of pneumatic tired rollers is part of the specifications. Placement of dense graded mixes of 0.10 foot or less is not recommended between September 1 and April 1. Heat loss in thin lifts is very quick and in most cases inadequate time is available for placement or to achieve needed compaction.

5-4.2 Inspector Roles and Responsibilities

Testing Equipment

Before production commences, the Inspector needs to ensure that all of the necessary equipment that will be needed to accomplish all of the test procedures has been obtained. In addition, chapter 9-8 lists the equipment that needs to be calibrated or verified. The Inspector needs to make sure that this equipment is in good working order and has a current calibrated or verified sticker on it.

The Inspector is charged with responsibility for care and safekeeping of all testing equipment that is issued. The equipment must be maintained in a clean and proper operating condition to ensure accuracy of test results. Special care must be exercised in the use and maintenance of sieves to see that they do not become clogged or damaged. Thermometers must be handled carefully to avoid breakage.

Electronic scales are expensive, desirable, and delicate equipment. Particular care should be taken to protect them from theft or voltage spikes.

The ignition furnace is a high temperature oven, care must be exercised in its operation and testers must be qualified in its use.

Given reasonable care, HMA testing equipment will give long and satisfactory service.

Required Tests

The Project Inspector is responsible to the Project Engineer for the required field tests as well as for submission of required samples to the State Materials Laboratory for testing. Testers must be qualified in the "Asphalt Module" or for the particular method of sampling and testing they will be performing. It is the intent of QA specifications that the Contractor is made totally responsible for the maintenance and operation of equipment and the production of the HMA. It is the Inspector's role to sample and test the material to assure that WSDOT is getting a uniform and specification product. However, it is not possible or desirable for the WSDOT Inspector to take a "hands off" approach to the production of HMA. If the Inspector notices anything at all that affects the quality of the HMA, this information should be brought to the Contractor's attention in a cooperative manner so that the situation can be corrected.

5-4.2A Hot Plant Inspection

Plant Inspector's Check List

Some of the most important details of inspection on asphalt plants are listed below:

1. See that testing tools, equipment, and samples are on hand at the plant site and in good condition. Make sure you understand all tests.

2. Inspect all components of the asphalt plant; make sure all deficiencies are corrected *before* production is begun.

3. Verify that the truck scales are currently certified in accordance with Section 1-09 of the *Standard Specifications*.

4. Post mix designs, including all revisions to the job mix formula.

7. Watch for evidence (dark smoke from plant exhaust and oily coating of aggregate) of incomplete combustion of burner fuel.

8. Check frequently the temperature of the asphalt and volume accumulation from flow meter.

9. Observe plant operator occasionally to see that correct weights and proportions are obtained, including asphalt content.

10. Make frequent visual inspections of mix leaving plant for evidence of non-uniformity or incomplete mixing.

11. Check temperature of mix frequently.

12. Inspect truck beds before loading; see that bed is free of congealed chunks of mix and excess bed release agent.

13. Check frequently with Street Inspector concerning workability and uniformity of mix at the paving machine and density test results.

14. Take samples of mix for field tests and submission to laboratory.

15. Make accurate, complete record of all test results, asphalt used, and other pertinent data.

16. Have copies of all test reports available for review.

17. Fill out the required daily reports.

18. Keep in constant communication with the plant foreman and the street inspector and give immediate notification regarding any problems.

Field Tests

On all projects involving HMA, job site samples shall be obtained, tested, and recorded in accordance with the *Standard Specifications*, the contract special provisions, and Chapters 9 and 10-3.5 of this manual. A split of the field sample will be retained by the field tester for further testing if necessary. This sample may be used when test results are challenged by the Contractor per *Standard Specification* 5-04.3(8)A. Asphalt content of the mix shall be determined by use of the Ignition Furnace in accordance with AASHTO T308, and gradation determined in accordance with WAQTC FOP for AASHTO T30.

Samples Required by Materials Laboratory

When taking a sample of the mixture for mix design conformation, a sufficient quantity of the mix should be obtained so that a portion of the same sample may be submitted to the State Materials Laboratory for testing. Samples shall be taken as provided in Chapter 9 of this manual and forwarded to the State Materials Laboratory in the amounts and at intervals therein specified.

Sampling Methods

Samples of the complete asphalt mixture should be taken from the hauling conveyance in accordance with the current test method and quartered down to the desired size for testing. Remember that the value of material quality testing is dependent on exact parallel tests of identical splits from representative samples.

Verification of the Ignition Furnace Calibration Factor

The Project Engineer shall verify that the "Ignition Furnace Calibration Factor" shown on the asphalt mix design is valid. The verification of the "Ignition Furnace Calibration Factor" shall be determined in accordance with current test methods and should be done prior to beginning the production of any paving mixture using initial mix design. The verification shall be done using the furnace that will be used for acceptance testing. In some circumstances it may be necessary to use production data to verify acceptance results but should be only utilized when all verification procedures have been used and validated.

5-4.2A(1) Inspection of Mixing Plant

Project Inspectors should familiarize themselves with plant operations prior to beginning of paving. A visit to the plant will do this and additionally provide an opportunity to inspect the plant for conformance to WSDOT specifications. Specification violations should be brought to the attention of Contractor so they may be corrected prior to beginning paving.

When doing plant inspection, particular attention should be given to examination of gates, feeders, drier and dust collector, screens and bins, pugmill, and all thermometers, pyrometers, and weighing scales. To assist in this inspection, one of the previously recommended hot mix asphalt paving handbooks will provide excellent guidance. In addition, the manual from the WSDOT Asphalt Concrete Testing Procedures training class provides an excellent resource.

With the increased emphasis on aggregate structure and void content, it may be necessary for the Contractor to use multiple stockpiles.

Allowable methods of heating the asphalt are stated very clearly in the specifications, and the limits of the range of application temperatures are also specified. An asphalt thermometer is required to be installed in the asphalt line. This thermometer should be checked for accuracy before work starts. Close control of variations in temperature of the asphalt binder is very important, as overheating of asphalt oils will cause hardening and may cause substantial decrease in pavement life. When using modified Performance Graded (PG) asphalt, the asphalt manufacturer may recommend a higher mixing temperature. The Project Engineer may approve of increasing the mixing temperature, in accordance with the manufacturer's recommendation, as allowed in the *Standard Specifications*.

Section 5-04.3(1)A of the *Standard Specifications* requires that a valve be placed in either the asphalt supply line to the mixer or the storage tank for sampling the asphalt. This valve should provide a safe method of obtaining samples of the asphalt material that are representative of the material being incorporated in the mixture. All samples must be taken in the Inspector's presence. If for any reason the asphalt oil is suspected to have become mixed or contaminated in the storage tank, additional samples from the asphalt supply line should be taken and noted on sample submittals.

During the preliminary inspection of the asphalt mixing plant, the Inspector should note any violation of safety rules concerning machinery safeguards, such as lack of guards on belts, sprockets and the like. The Inspector should call to the attention of the Contractor any such violations and request that corrections be made. If the violations directly affect the functions of the engineers and inspectors, the Project Engineer should refuse to allow mixing to begin until conditions are safe for sampling, inspecting, etc. Section 1-05.6 of the *Standard Specifications* requires the Contractor to provide safe facilities for inspection of the plant and the work.

5-4.2A(2) Inspection During Mixing Operations

After the mixing begins, and throughout the day, the Project Inspector working with the qualified tester shall make the required tests of the mixture. It is very important, however, that the Project Inspectors and testers spend some of the time observing the operation of the plant and the condition of the mixture being produced. Changes in the mixture can quickly be detected by observing changes in appearance or color of the mixture.

Periodic checks of the temperature of the liquid asphalt, as well as the mixture produced must be made to ensure that maximum allowable temperatures are not exceeded and a uniform material production is being produced. The Contractor will choose the desired temperature of the mixture within specification limits, depending on weather conditions, length of haul, and other factors. Project inspectors should watch for excessive variation in temperatures, and notify the contractor of any variation that occurs. Variable temperatures of the mix may cause compaction and segregation problems and close monitoring of temperatures is an essential part of HMA paving.

When stockpiled, aggregates may contain a high percentage of moisture. With moisture in the aggregate difficulty may be encountered in heating the material to the proper temperature. In some cases, the contractor may try to correct this condition by increasing the amount of fuel oil fed to the burner. This can be done satisfactorily until incomplete combustion of the fuel oil occurs. Black smoke coming from the exhaust stack is an indication that incomplete combustion is occurring. Black smoke is also a sure sign that air quality standards are being violated. The Inspector should watch for this condition, as the unburned fuel will deposit a sooty, oily film on the aggregate particles that is detrimental to proper coating of the material with the asphalt film. A reduction in the amount of aggregate fed to the drier will usually correct the situation and allow proper heating and drying of the material.

Frequent inspections of the condition of the mixture leaving the plant should be made, noting the consistency of the mix, the distribution of asphalt and aggregate throughout the mixture, and the temperature of the mixture. Trucks should be loaded by multiple dumps of three or more as recommended by the National Asphalt Pavement Association (NAPA). If the quality of the mixture varies from truck to truck, an immediate check should be made to locate the source of trouble. Uniform distribution of the asphalt throughout the mix is extremely important. If portions of each truckload vary from rich to lean, the Inspector shall advise the Contractor to correct the problem. It may be necessary to increase the mixing time to correct this situation. By examining the mixture in bright light, the experienced Inspector can quickly detect non-uniformity in the mixture.

5-4.2A(3) Miscellaneous Duties of the Plant Inspector

One of the duties of the Plant Inspector may be to oversee the work of the scale person on truck weighing scales at the plant, and see that the required tests of the scales are performed. The Inspector must see that tickets are properly made out and issued for each truckload of mixture delivered, and shall also see that daily totals are promptly obtained and entered on the daily report.

Before trucks are allowed to be loaded at the plant, a check shall be made to see that the truck beds are properly lubricated as required in the specifications. No pools of bed release agent shall be allowed to remain in the truck bed following this operation. The truck bed should be raised to allow any excess material to be drained off.

When the Contractor is using a site furnished by WSDOT, the inspector should see that the Contractor shapes up any remaining aggregate into neat stockpiles, and removes all debris from the plant site when the project is complete.

5-4.2B Street Inspection

General

In the construction of HMA pavements, it is the responsibility of the Street Inspector to see that construction methods and equipment used, as well as the finished pavement, meet the requirements of the specifications. In order that the Inspector may properly discharge this responsibility, it is necessary that the Inspector thoroughly understand the *Standard Specifications*, the special provisions of the contract, and the instructions set forth herein. The Inspector must also have a good working knowledge of methods and equipment involved in the construction.

A means of communication between the Street Inspector and the Plant Inspector must be established, and the Street Inspector shall keep the Plant Inspector informed of any difficulties encountered in the laying of the mixture or of any faulty mixture received at the paving site.

Street Inspector's Check List

Some of the most important details of inspection on HMA paving are listed below:

1. Check condition and adjustment of paving machines and rollers.

2. Has width of spread in successive layers been determined?

3. See that traffic control is organized and functioning properly; make sure required signs are in place and document it.

4. Check application of tack coat; do not allow tacking of more base than will be paved each day. Be sure that the pavement is swept and clean ahead of the tack application (Section 5-04.3(5)A).

5. Examine pavement base, see that required patching and/or pre-leveling is done. Do not be afraid to get the front of your shirt dirty; do a lot of "belly-grading." Make a check of surfacing depths before paving begins.

6. See that paver guidelines are set and adhered to (Section 5-04.3(3)).

7. Check transverse joint for smoothness and appearance a straightedge should be used.

8. Watch trucks dumping into paver hopper for adverse effect on paver operation. Pay particular attention to constant uniform paver speed and minimum operation of the hopper wings.

9. Check temperature of HMA occasionally and watch for evidence of incomplete mixing.

10. Maintain constant inspection of mat behind paver for signs of roughness or non-uniformity of mixture.

11. See that longitudinal joint is raked and compacted properly.

12. Make frequent checks of yield and depth.

13. Watch rolling operation and verify that the rollers are operated in accordance with the manufacturers recommendations (Section 5-04.3(4)). See that nuclear density readings are maintained. Check internal temperature of mix to verify that vibratory rolling is not used below 175° F.

14. Keep record of truckloads used each day; check with Plant Inspector concerning masses.

15. Make sure the job is in good shape before you leave at the end of the day, that the transverse night joint is properly constructed (Section 5-04.3(11)) and see that any excess paper is trimmed from the transverse night joint.

5-4.2B(1) Duties Before Paving Begins

The Street Inspector is a key participant in the prepaving meeting and typically oversees all aspects of the operation at the jobsite. The street inspector should be knowledgeable as to the project limits, hours of operations, the direction in which paving is to proceed, methods of performing any unusual features of work peculiar to the project, proposed traffic control methods, etc. The plan of operation agreed upon at the prepaving meeting should be followed faithfully whenever possible.

Traffic Control

The Contractor shall conform to the requirements of Section 1-07.23 of the *Standard Specifications*. The Project Engineer and the responsible inspector must work closely with the Regional Traffic Engineer and the Contractor to ensure that the proper signs are placed in the best possible manner. All applicable signs shall be installed on the job before paving begins. Chapter 1-2.3 of this manual includes additional sign installation details.

Inspection Tools

Before paving work begins, the Street Inspector must see that all tools and equipment necessary for the inspection work are available. These would include such things as surface and probe thermometers, tape measure, depth gauge, tire pressure gauge, 10 foot straightedge, notebooks, diary, report forms, etc.

Inspection of Paving Equipment

It is the duty of the Street Inspector to inspect the Contractor's paving equipment to verify the equipment meets the contract specifications. In order that the best possible surface finish will be obtained, it is essential that all machines are in good condition and all parts are in proper adjustment. All equipment, including trucks, should be observed for hydraulic and fuel leaks when systems are under pressure.

Listed below are some of the most important details the Inspector should check during the inspection of paving equipment:

(a) Paving machines. Several types and makes of paving machines are in use in this State, all of which are capable of producing satisfactory surface finishes. The differences between types of paving machines are primarily in the methods used in striking off, compacting, and smoothing the mixture. The Inspector should be familiar with the mechanical features of the type of paver to be used on each job.. Handbooks of operating instructions are available from each manufacturer, in which the various adjustments and operating details are shown. The Inspector should obtain copies of these instructions from the Contractor or the manufacturer. The requirements for paving machines are in Section 5-04.3(3) of the Standard Specifications. The inspector must be familiar with the specifications

Extensions may be added to the paving machine to allow the Contractor to pave a wider section. When the extensions are used in the traveled way they are required to have augers and screeds that vibrate and are heated. Most newer paving machines will be equipped with automatic screed extensions.

On all track paving machines, correct adjustment of the track linkage is essential for smooth operation. A poorly adjusted track, or a badly worn one, can produce an uneven, lurching movement in the travel of the machine which will be reflected in an uneven, "choppy" pavement surface. Observation of the machine in motion will usually show up any defects in the track or drive mechanisms.

Some pavers are suspended on rubber-tired wheels. For proper operation of this type of paving machines all tires must be inflated to the correct pressure and the drive system must not have any slack.

(b) Rollers. The proper operation of the roller is a key factor in quality pavement. When done properly the HMA will be compacted to a dense uniform mat free of defects. Improper operation produces a poor quality mat that may include tears, roughness and low or uneven compaction. All of these will result in a reduced life of the HMA and increased cost.

Steel-wheeled rollers must be inspected to determine that the wheels are capable of rolling a true plane and are in good condition. The Inspector should be especially watchful for flat spots on the wheels. The steering and driving mechanisms must be free of excessive play or backlash. Observation of the roller in motion and reversing direction will disclose any deficiencies in the drive and clutch mechanisms. The manufacturer of the roller provides the maximum rate of travel.

Pneumatic-tired rollers, to function properly, must have tires of equal size and in good condition. All tires must be equally inflated, so that all exert equal unit pressure on the pavement. Tire pressures may be varied to suit conditions on the job, but, in general, should be such that ground contact pressures range between 40 and 80 psi. The Inspector should observe the roller in motion to see that all wheels are rolling true, without wobble or creep. . Pneumatic tired rollers should have full skirts as the tires must be warm to prevent "picking." (When the cool tires roll over the hot HMA mix, the mix tends to stick to the tires, and is "picked" up from the mat onto the tires.)

(c) Other items. The Inspector should be satisfied that the Contractor is properly equipped with portable barricades, cones, or other means of protecting the freshly laid pavement from damage by traffic.

Upon completion of the check of the paving equipment, the Street Inspector should call any deficiencies of equipment to the attention of the Contractor, so that correction can be made.

Preleveling

The Engineer must give careful consideration to the use of a preleveling course over areas of unusual roughness, wheel ruts, or sags in the profile of the pavement base. The Contractor should be given as much advance notice as is possible of the intent to place a preleveling course. The areas that need prelevel should be marked out and reviewed with the contractor prior to the pre-pave meeting. The extent of prelevel and the methods to be used should be discussed at the pre-pave meeting.

There are several methods the contractor is allowed to use for preleveling. One method used for preleveling may be using a motor patrol grader. A paving machine may be used when the Engineer has determined that better results can be obtained by this method and particularly where long undulations occur. When conditions warrant, a reference line may be erected for preleveling and a long multi-footed ski-type reference should be used for placement of subsequent pavement courses. Ruts can be economically preleveled by dragging a paver screed. Because of the possible detrimental effect on the equipment, it should only be done with the consent of the Contractor or if required by the plans. In order to outline areas and amount of preleveling, the Contractor should be encouraged to erect a single reference line along the crown point for the first pass. The practice of directly marking depths and limits of preleveling required on the pavement surface is considered beneficial. When the area is small or irregular the Contractor may choose to use hand methods to prelevel.

The nominal compacted depth of any layer of any course, including preleveling lifts, shall not exceed the depths outlined in the *Standard Specifications* for the class of mix being used. The purpose of this requirement is to reduce the differential compaction that takes place and to ensure adequate compaction of thick lifts between two humps. Compaction should be accomplished with a pneumatic roller.

To produce a satisfactory riding surface, preleveling, in theory, should continue regardless of quantities until a uniform lift of HMA can be placed by paving machines with the multi-footed ski-type reference. If it appears that the plan quantity of prelevel must be exceeded due to the condition of the existing pavement, the situation should be immediately brought to the attention of the Project Engineer, and the Region Construction staff. The Engineer must take care to clearly distinguish between preleveling operations and paving operations, especially leveling courses.

Preparation of Untreated Roadway

Section 5-04.3(5)B of the *Standard Specifications* covers the work of preparing the untreated roadway quite thoroughly. When the roadway is carrying traffic, public or construction, it may be necessary to construct the prime coat treatment to maintain the roadway to the desired line, grade and cross-section until the first course of pavement is constructed. When a prime coat is required it will be designated in the plans. If there is no traffic problem, it may be desirable to eliminate the construction of the prime coat treatment.

Weather conditions must be satisfactory for construction of the prime coat treatment and the prime coat must be allowed to cure for a minimum of 5 days before proceeding with paving. When the weather limitations cannot be met or the minimum curing period would present a hardship and it is desirable to pave the roadway, elimination of the prime coat should be considered.

5-4.2B(2) Duties During Paving Operations

Prior to beginning of paving work each day the Inspector shall see that guidelines are set for the day's work, that the base is properly prepared, and that the tack coat has been applied through the area to be paved during the day. It is not a good practice to apply the tack coat over more area than can be paved in a day or an hour or two if the weather appears to be questionable. Traffic conditions may also dictate how far the tack coat should be placed ahead of the paving operation.

The specifications require an application of tack coat that is uniform and free of streaks and bare spots. The application rate will depend on several factors and include the condition of the existing pavement, the Contractor's equipment, the type of asphalt used, if it has been diluted with water and the application temperature. Tack coat is always applied prior to the placement of HMA including projects that have multiple lifts of HMA. For many pavements an application rate of approximately 0.05 gallons per square yard of residual asphalt is adequate. When paving a second lift of HMA a lower application rate is typically applied. Thin lifts of pavement require heavier applications of tack coat to prevent raveling, spalling, and delamination. As a guide, existing surfaces that are coarse, dry or milled require a higher application rate of tack coat than surfaces that appear rich or bleeding.

Joints

The *Standard Specifications* provide that butt joints be constructed. The use of heavy paper is recommended to form the butt joint at the end of the day's work, with a temporary ramp laid on the paper beyond the joint to assist traffic over the change in elevation. Paper protruding above the pavement shall be carefully trimmed flush with the pavement so that there will not be an illusion of a hazard at night. When the ramp and paper are removed prior to beginning the succeeding day's paving, a well-constructed joint will require a minimum of cutting back to form the required butt joint. When hand raking is performed on a joint, all segregated coarse aggregate shall be removed, to avoid a coarse, porous surface at the joint.

If the roadway is open to traffic, the transverse joint must be feathered to provide a smooth transition for the traveling public and joints between successive lifts in each lane should not be less than 100 feet apart. The higher the speed on the roadway, the longer the taper on the joint must be to provide an acceptable transition. The required slope ratios is 1 vertical to 50 horizontal or flatter.

This slope will usually require use of more than one width of paper. Sufficient material must be temporarily placed in front of the paver to prevent a deformation from occurring in the permanent ACP behind the joint. Care should be taken to construct a straight line taper without humping.

The open longitudinal joint resulting from any day's operation should be abutted by paving the adjacent lane on the next day.

At the beginning of the day's work, special care must be exercised in the construction of the transverse joint joining the freshly laid mixture with the previous day's work. The paver should be allowed to proceed at a low rate of speed (creep) ahead of the joint, until hand finishing of the joint is completed. The paver should not come to a full stop or the screed may settle and cause a dip at that point. The Inspector should check this work closely, using the 10-foot straightedge to see that the requirement for surface smoothness is met.

Spreading and Finishing

In the construction of HMA pavements, it is extremely important that the paving machine be in good adjustment and that the machine and screed operators be experienced and capable. The Inspector should be quick to note operational practices that have an adverse effect on the work, and *request* the Contractor to make immediate corrections.

Compaction procedures will be as specified in Section 5-04.3(10) of the *Standard Specifications*.

During the paving operation, constant inspection must be maintained to see that the machine is producing a smooth pavement having the required characteristics of texture and uniformity. The Inspector must require immediate action be taken to correct any trouble that may develop and should attempt to assist the Contractor in locating the source of the trouble.

Listed below are some common difficulties encountered on HMA paving work, together with the most common causes of the difficulty:

- *Wavy surface (short, choppy waves):* Worn or poorly adjusted tracks or drive train; truck driver setting brakes too tightly; excessive paving machine speed.
- *Wavy surface (long waves):* Excessive variation in amount of mix carried in auger box ahead of screed; over-controlling screed; roller operating too fast.
- *Excessively open surface texture:* Improper adjustment of strike off; screed plate rough or galled; excessive paving machine speed.
- *Varying surface texture:* Insufficient mixing; trucks being loaded improperly at the plant; segregation of mix in trucks; poor gradation control at mixer; screed not uniform across paving machine.
- *Streaked surface texture:* Insufficient mixing; segregation of mix in trucks; worn or damaged screed plate.
- *Bleeding patches on surface:* HMA not uniformly mixed; excessive moisture in mix.
- *Irregular rough spots on pavement:* Roller standing on fresh surface; abrupt reversing of roller; trucks backing into paver; poor workmanship at transverse joints.
- *Cyclic open texture, that usually matches up with the distance that each truck load of material covers:* This may be caused by a couple of problems. One is the result of thermal segregation. In this case the differential temperatures in the HMA result in inconsistent compaction and a cyclic open texture. The use of a mass transfer vehicle (MTV) or mass transfer device (MTD) will reduce or eliminate thermal segregation. Secondly, the machine operator may be allowing the head of material to fall below the top of the augers or by dumping the wings of the paver when the hopper is low on material. Hopper wings should be operated only occasionally and then with some load in the hopper.

Certified Max. Ground Contact Pressures
Smooth Tread Compactor Tires
Issued by

Bituminous Equipment Manufacturers Bureau

	2000	3000	4000	2000	3000	4000	2000	3000	4000	2000	3000	4000	Wheel Loas
7:50 x 15	50	50	50	60	60	60	70	70	70	90	90	90	TIP
10 ply	46	53	57	56	65	68	60	67	73	67	75	82	GCP
7:50 x 15	50	50	50	70	70	70	90	90	90	110	110	110	TIP
12 ply	53	60	66	60	69	75	69	77	84	75	83	89	GCP
7:50 x 15	50	50	50	70	70	70	90	90	90	110	110	110	TIP
14 ply	59	66	71	65	73	79	72	80	86	78	87	94	GCP

	2000	4000	6000	2000	4000	6000	2000	4000	6000	2000	4000	6000	Wheel Load
9:00 x 20	35	35	35	50	50	50	75	75	75	90	90	90	TIP
10 ply	48	55	58	53	62	66	64	75	81	68	82	88	GCP
9:00 x 20	35	35	35	50	50	50	75	75	75	90	90	90	TIP
12 ply	47	55	57	53	61	66	64	75	81	68	82	88	GCP
9:00 x 20	35	35	35	75	75	75	90	90	90	105	105	105	TIP
14 ply	42	49	55	57	68	74	62	74	81	67	81	89	GCP
9:00 x 20	35	35	35	75	75	75	90	90	90	105	105	105	TIP
16 ply	40	50	57	57	68	75	64	75	82	69	81	89	GCP
10:00 x 20	35	35	35	70	70	70	85	85	85	100	100	100	TIP
14 ply	40	48	53	51	60	66	56	66	71	61	72	77	GCP
10:00 x 20	35	35	35	70	70	70	100	100	100	125	125	125	TIP
18 ply	40	48	54	51	60	66	61	72	78	67	80	87	GCP
11:00 x 20	35	35	35	50	50	50	70	70	70	90	90	90	TIP
14 ply	42	47	51	45	51	58	54	63	70	68	75	82	GCP
11:00 x 20	35	35	35	70	70	70	90	90	90	105	105	105	TIP
16 ply	42	47	51	54	63	70	68	75	82	69	83	88	GCP
11:00 x 20	35	35	35	70	70	70	90	90	90	105	105	105	TIP
18 ply	42	47	51	54	63	70	68	75	82	69	83	88	GCP

	4000	6000	8000	4000	6000	8000	4000	6000	8000	4000	6000	8000	Wheel Loas
13:00 x 24	35	35	35	60	60	60	80	80	80	100	100	100	TIP
18 ply	50	54	57	63	66	69	71	75	79	80	85	88	GCP
13:00 x 24	35	35	35	60	60	60	80	80	80	100	100	100	TIP
22 ply	50	54	57	66	69	72	77	81	84	87	91	95	GCP
13:00 x 24	35	35	35	60	60	60	80	80	80	100	100	100	TIP
26 ply	54	59	62	69	73	76	81	85	89	91	96	100	GCP

GCPGround Contact Pressure

TIP Tire Inflation Pressure

Note: Interpolation is necessary between either/or Loads and Pressures. Each axle of pneumatic roller should be weighed separately and ballasting done accordingly to provide uniform tire load and contact pressure.

Figure 5-1

- *Crooked or irregular longitudinal joint lines:* Careless machine operation or no guide string placed for the machine operator to follow.

Some paving machine operators have a tendency to operate the paver at speeds in excess of that required to handle the quantity being produced at the plant, resulting in a jerky, stop and go operation. *This must not be allowed.* Generally, when the paver is operated consistent with plant production and roller capacity, the finished surface will be smoother. The ideal speed of the paver will be that which will result in a smooth, nearly continuous process with a minimum of stops required in waiting for trucks and/or the compaction equipment. If the production rate of the mixing plant is very high, requiring excessive speed of the paver, the Contractor will be required to correct the situation by slowing his production or using additional paving machines and generally, additional compaction equipment. Delivery must be adjusted to match production and uniform lay down. A formula is provided in Section 5-4.2(C) to help determine the approximate paver speed for continuous operation.

The Inspector should periodically check for difficulties while dumping truckloads of mixture into the hopper of the paving machine. Trucks must not be allowed to back into the paver in such a manner that they bump the paver, nor shall trucks that bear against any part of the machine other than the pushing rollers be permitted to dump into the paver. Any mix spilled onto the pavement in front of the paving machine must be shoveled into the hopper of the machine or back into the truck before paving is resumed. The Inspector should be especially watchful to see that mix spilled in the paths of the tracks or wheels of the machine is removed.

Checks should be made of the crown adjustment of the screed, to ensure that the finished surface will conform to the required section.

Particular attention must be given to the construction of the longitudinal joint when paving adjacent to a previously laid lane. The Inspector must insist that hand raking be held to a minimum, by adjusting the screed so that the freshly laid pavement is of the proper depth, allowing for compaction, to meet the grade of the previously laid lane. The uncompacted mixture immediately adjacent to the joint should be left slightly high so that the roller can compact the mixture thoroughly at this point. The rakers must not be permitted to cast excess mixture over the uncompacted, freshly spread lane. The Inspector must insist that segregated coarse particles of mix remaining after making the joint be removed and wasted, to avoid construction of a coarse, porous joint.

Surface Smoothness

When a leveling course is being constructed, an attempt must be made to remove all depressions and sags in the grade line by adjusting the depth of the course. The Inspector should work closely with the screed operator to accomplish this result by pointing out irregularities in the base far enough ahead of the machine to allow proper adjustment of the screed to eliminate the irregularity. The objective to be attained during construction of the leveling course is the complete elimination of all irregularities, so that the placing of the wearing course can be accomplished with a minimum of screed adjustments. If the base is excessively rough, pre-leveling should be done prior to construction of the leveling course.

Section 5-04.3(3) of the *Standard Specifications* require the use of automatic screed controls on the paver. It must be remembered that as the equipment becomes more sophisticated, it also becomes more necessary that it be properly adjusted and operated or satisfactory results will not be achieved. With proper operation, this equipment will give excellent performance.

When reference lines are required, or the Contractor elects to use reference lines, particular attention must be given to see that the line is properly set and tensioned. If the line is offset too far from the paving machine, vibrations of the machine may affect the operation of the automatic controls, which in turn affect the smoothness of the pavement. The reference line for asphalt paving machines normally will not be used when the roadway is under traffic. The specifications provide that if the course that the pavement is to be placed on is superior to established smoothness requirements, the paver may operate from a mat referencing device such as a “multi footed ski” instead of the wire. The inspector must ascertain that smoothness of the pavement continues to be superior to the requirements of the specifications.

Normally, when the surface for paving is properly constructed using a reference line, or the first course of pavement is constructed using a reference line, subsequent courses of pavement may be constructed using a mat referencing device with continued improvement in the surface smoothness.

Manual operation of the screed controls will be permitted in the construction of irregular shaped and minor areas, such as gore areas, road approaches, left turn channelization, and tapers.

Surface smoothness and good riding qualities of a pavement are secured only by hard work and strict attention to small details. The Inspector should continually study the conditions peculiar to the job, and strive to obtain the smoothest surface possible. A smooth riding pavement costs no more than an unsightly, poor surface, but it does require constant, careful inspection of all details of construction to obtain the desired results.

Section 5-04.3(13) of the *Standard Specifications* outlines the smoothness requirements using a 10 foot straight edge oriented in both the longitudinal and transverse directions. Smoothness checks should be made at the starting point of paving, at transverse “night joints”, whenever the paver is stopped for any length of time, or where ever the inspector suspects a smoothness problem.

5-4.2B(3) Compaction

General

Compaction of the HMA is very important in the construction of a durable pavement. When good compaction is coupled with the proper mix design, extended service life of the pavement can reasonably be expected.

The importance of thorough, compaction of HMA cannot be over stressed. Two major factors are working simultaneously in a well-designed mixture to resist good compaction - (A) the stability of the mix in place increases with each pass of the roller, and (B) the viscosity of the asphalt increases as the temperature drops. A temperature-viscosity curve for the type of asphalt used in the mix is a useful tool in determining the ideal compaction temperature of the mix.

Although densities for some HMA may be increased at temperatures below 175° F, vibratory rollers may damage the mat internally in ways that cannot be seen at the time of compaction. To prevent this damage, compaction with vibratory rollers is not allowed below the minimum specification of 175° F. When paving in air temperatures over 90° F, some or all of the compactive effort may have to be delayed, but in no case should it be delayed below 175° F mat temperature.

The desirable end point of a properly compacted HMA is a dense and nearly impermeable mat. Acceptable densities can be obtained if the mix proportions are proper. If not, no reasonable amount of compaction can produce acceptable density. Without proper density, the HMA will be subject to early distress and failure. Some mixes may be difficult to compact because they will move under the roller instead of compact. This is referred to as a tender mix and may result from several causes including gradation, fracture and asphalt binder properties. Mixes that have a gradation that crosses the max density line in the restricted zone or have excessive natural sand are more likely to be tender. Having available the 0.45 power plot of the design and production mixes will help the Inspector know what to expect in terms of compaction difficulty.

The asphalt binder content in a mix is based on several factors including traffic levels, aggregate structure and asphalt binder properties. The contractor develops the mix design to meet specific volumetric properties. Changes in the mix design asphalt content should only be allowed after careful consideration of all of the impacts. The Region Materials Laboratory is a good resource to contact when considering changes in the asphalt binder content.. Increasing the asphalt binder content on high traffic volume routes carries more long term performance risk than on low volume roads.

The use of thicker lifts of pavement permits more time for compacting and will increase the effectiveness of the equipment. With careful organization and planning, the production of over 400 tons per hour may be compacted by as few as three rollers on deeper lifts. It is also apparent that high production rates with thin lifts might require twice as many rollers or more. It is the Contractor's responsibility to determine how many rollers are needed to match the asphalt plants production rate.

Usually the Contractor has a companion group of rollers, pavers, and production equipment that is used together on paving projects and have proven to be compatible. By consulting with the Region Staff, it may be determined if the full complement is present or just what past experience has been. Before production begins, the Regional Materials Engineer should be notified to arrange for the coring of the pavement to correlate nuclear densities to core densities for calculation of a gauge correlation factor.

In general, compacting should begin on the outer edge of the course and progress toward the center of the pavement except on superelevated sections where the initial effort shall be on the lower side with the progressive compaction toward the higher side.

The type of rollers and their relative position in the compaction sequence shall generally be at the Contractor's option provided specification densities are attained and it's not specified otherwise in the contract provisions. An exception is that the pneumatic tired roller is required between October 1 and April 1. On wearing course, coverage with the vibratory or steel roller may precede pneumatic tired rolling. The maximum speed of rollers shall not exceed the recommendations of the manufacturer of the roller for the compaction of HMA. When requested by the Project Engineer the Contractor is required to provide a copy of the manufacturer's recommendations. When the roller reverses direction the vibrators turned off momentarily.

The vibratory roller is generally used for the primary compaction on ACP mixes and sometimes for finish rolling in a static mode. Two terms frequently used with vibratory rollers are frequency and amplitude. Frequency is how often the impacts are applied and is normally stated in cycles per second. Amplitude is the greatest vertical movement, up or down, of the drum during a cycle.

Vibratory rollers achieve their compaction effect from the kinetic energy produced by the vibrating components of the roller. Vibratory rollers usually work best when operated with high frequency and low amplitude on dense graded leveling and wearing courses. On hills, it usually works best to operate the vibrators only while traveling uphill. Over vibrating can cause decompaction. Operated in the static mode, despite their apparent bulk, they are less effective than even intermediate size conventional steel wheel rollers due to their lower mass.

Vibratory rollers may not be practical in areas where there are mortar joint concrete or certain other vintage pipe used for utilities or irrigation. Compaction can be achieved with pneumatic rolling if the mix is good. Elimination of vibratory rolling is not consistent with the *Standard Specifications*, and will generally require a special provision or change order before an alternate method of compaction is considered for use.

With pneumatic roller breakdown it will be necessary to hold in about 6 inches from unsupported edges to avoid lateral displacement. Keep the tires dry and the roller within 200 feet of the paver and in constant motion. A narrow overlap of successive trips is desirable. During the initial compaction, the rollers direction should be such that the powered wheel passes over the uncompacted mix first. Breakdown tiller wheels will be turned the least possible amount in the uncompacted area and thereby avoid pushing and shoving the hot mat in a local area. Avoid stopping the roller in the same place. Continue pneumatic breakdown rolling until deep tire tracks are ironed out as much as possible and the roller walks out to the top of the mat, and then move ahead. The most desirable arrangement is to have two similar pneumatic rollers about 6 feet wide with the "air-on-the-run" feature and posi-traction type differential followed by a tandem steel wheel roller. The steel wheel roller should follow closely behind the pneumatic roller to compact the centerline joint and the edge of the pavement as well as iron out the pneumatic tire marks. The steel wheel roller will exert extra pressure on the uncompacted edge and should have no difficulty in properly compacting this edge if the roller is close behind the pneumatic rollers. Cold rubber tires usually "pick" the mat. Every effort should be made to warm the tires before compacting the mat. Sending the rollers for a drive before the work is fully organized prior to paving will help with the tires.

The axles of the roller are weighted by the use of iron pigs, chain, rivets or other concentrated loading in addition to the usual water and aggregate tank loading to control the total roller weight. Ground contact pressure is determined by the tire inflation pressure, a ground contact pressure of 70 psi is a reasonable pressure to start with. Variation in the mixture and tire pressures will soon determine the most desirable combination of mixture, temperature, contact pressures and number of applications.

Steel wheel rolling is generally used for finish rolling; however, it is sometimes used for breakdown and primary compaction. It is important that vibratory roller operation on pavement with temperatures below 175° F not be permitted. Over-rolling by the steel wheel roller may damage the pavement more than under-rolling.

Preferably, rolling equipment should be wide enough so that a uniform application of compactive effort can be distributed over the entire course without creating hard streaks or leaving narrow porous strips. Breakdown and intermediate rolling should be completed while the mixture is above 185° F with the finish rolling completed above 150° F. With lower temperature mixes and thin lift applications it becomes obvious that the rollers must be kept up close to the paver.

Compaction Test Sections

Compaction of HMA is an important part of paving and the construction of a compaction test section can be a key component in achieving the proper density.

For HMA requiring a specified level of relative density a compaction test section may be constructed prior to production paving at the Contractor's option. If the contractor elects to not construct a test section for compactibility of the mix, the mix is considered compactible. Equally important for a Contractor to construct a test section(s) is to determine what rolling pattern with his compaction train will give best results. Test sections are financially important to both WSDOT and the contractor and therefore need careful attention. Although it is the responsibility of the contractor to show that a mix is compactible and determine the rolling patterns, it is to WSDOT's best interest to assist in construction of test sections.

When the compacted course thickness of HMA is 0.10 foot or less for any mix in the traffic lanes, or when paving shoulders and other nontraffic lane areas, regardless of course thickness, a test section will be constructed to establish a rolling pattern. The test section shall be constructed in accordance with the following instructions (Steps 1 through 6) except that the proposed rolling pattern and equipment shall be used. The number and timing of passes with an approved compaction train that will yield the maximum density as determined in the test section, is the determining factor that adequate density is being achieved.

When paving with prelevel a test section will not be required. The test section(s) provide for varying compactive efforts. If the compaction equipment and compaction conditions are right, values should increase with increasing number of roller passes. Ideally, the values should rise until a maximum compacted mat has been reached and then flatten out as compactive effort increases. An exception to this can occur when the vibratory roller is used as it can pull the mat apart and lower the density if operated after the temperature cools to below 175° F. If the mat does not react to the compactive procedures described, then the Inspector should review the directions for test procedures to ascertain what corrective action to take.

The procedures for a test section are as follows:

1. Select a test section on a reasonably level portion of the project providing a consistent paving depth and uniform underlying conditions.

2. Compaction equipment used in the test section should be the most effective units. Pneumatic tired rollers and/or vibratory equipment in the vibrating mode are normally the most effective units.

3. Select a section approximately 200 feet long of course thickness depth.

4. Select a test spot within the section near the center of the traveled lane and near the middle of a truckload discharged to the paver. Avoid longitudinal ruts or nonrepresentative locations (severely alligatored, patched pothole).

5. After each roller pass, a density reading is taken with the nuclear gauge at the test spot.

6. After finish rolling, densities are then to be determined at two additional locations, 15 to 25 feet each side of the test spot and in line longitudinal with the direction of paving. Evaluation of the compactibility of the mix shall be made on the average of the three densities.

7. If the average test spot density is greater than 92 percent, but less than 96 percent of Rice density for wearing courses or less than 98 percent of Rice density for base and leveling courses, a satisfactory test section has been completed. If the test section values are beyond these limits, the mix design should be changed. The State Materials Laboratory can provide assistance as needed.

The test section should be repeated when:

1. The results of previous tests are not considered by the Engineer to be reliable.

2. The Engineer directs a change in mix composition. Note that slight adjustments in bin masses are not considered a change in mix composition.

2. Routine control tests indicate changes from results found in previous qualifying test sections. (In this instance, the Inspector should check the contractor's rolling pattern for changes and check plant test results for mix changes. Any changes should be noted on the compaction report.)

Compaction Control

Compaction is controlled by testing with the nuclear density gauge for all classes of HMA where the paving is in the traffic lanes and compacted course thickness is greater than 0.10 foot. The nuclear gauge testing shall be conducted in accordance with current test methods. The specification requirements shall be a quality level of 1.00 or greater referenced to a minimum density of 91 percent of the maximum density (Rice density) as determined by WSDOT FOP for AASHTO T 209.

Cores of the finished pavement may be substituted for nuclear gauge readings to determine densities, provided they are requested by the Contractor by noon of the next day after paving. If this alternate is done at the request of the Contractor, WSDOT shall be reimbursed for the coring expenses at the rate of $125 per core. If the cores show the materials to be within specification limits, then there will be no charge for the cores.

Control lots not meeting the prescribed minimum density standard of 0.75 CPF need to be evaluated for removal and replacement with satisfactory material. At the Engineer's option, control lots with a CPF between 0.75 and 1.00 may be accepted at a reduced price in accordance with current policies.

For preleveling mix, the compaction control shall be to the satisfaction of the Engineer.

For all other conditions, the Contractor shall construct a test section in accordance with instructions from the Engineer. The number and timing of passes with an approved compaction train that will yield maximum density with the nuclear gauge in the test section shall be used on all succeeding paving. The Inspector should make sure the Contractor is making the required number of passes and reconstruct a test section if conditions change.

5-4.2B(4) Miscellaneous Duties of the Street Inspector

When constructing plant-mixed pavement adjoining gutters, curbs, cold pavement joints, manhole castings, etc., the Inspector shall see that all contact surfaces are painted with an approved asphalt material before placing the adjoining pavement.

A detailed Inspector's Daily Report (Forms 422-004, 422-004A, and 422-004B) shall be kept by the Inspector, noting all unusual occurrences, orders received from the Project Engineer, orders issued to the Contractor, and other pertinent information.

The Asphalt Concrete Pavement Compaction Report, Form 350-092, shall be prepared by the Density Inspector and distributed as shown on the form.

5-4.2B(5) Multiple Asphalt Plants

When two or more asphalt plants are used on one project, the mix from each plant must be placed with separate paving machines and compaction equipment. This is necessary because of the required adjustments on each paving operation to accommodate the different mixes and the various rolling patterns that may be necessary. Otherwise the test sections would not reflect true data for compaction controls due to different characteristics for the different aggregates or asphalt plants.

5-4.2B(6) Weed Control Under Asphalt Pavement

Weeds cause considerable damage to thin asphalt pavements such as sidewalks, shoulder overlays, and asphalt lined ditches. It is typically recommended that chemical weed control be used under all asphalt pavements less than 0.35 foot in depth unless a full depth base preparation was included in the construction. Check the contract requirements to see if soil residual herbicide is required.

5-4.2C How to . . .

Calculate Approximate Paver Speed for Continuous Operation

To assist in working with the Contractor to determine paver speeds, the following formula can be used to calculate approximate speeds required to handle various production rates at varying depths. Section 5-04.3(3) of the *Standard Specifications* requires the paving machine to be operated at a uniform speed consistent with the plant production rate and compaction train capacity, which will allow a smooth, *continuous* paving operation.

$S = [(T \div 0.076) \div (W * D)] \div 60$

where: T = Tons per hour
W = Width in feet
D = Depth in feet
S = Paver speed in feet per minute

Based on 2.052 tons per c.y. =
0.076 tons per c.f.

Compute Yield

During the paving operation, a careful record shall be kept, showing truckloads, the weight of each truck and other pertinent data. Periodically, the Inspector shall compute the quantity of mix placed per square yard, and shall compare the yield against the proposed quantities. Overruns or underruns in quantities may be avoided by making a constant check of quantities placed.

HMA pavements are designed on a weight-volume relationship of 137 pounds for one square yard of pavement of a compacted depth of 0.10 foot. It is the intention in the construction of the pavement to spread the mixture according to an average yield in pounds per square yard.

Remember that the minimum compacted depth of pavement must also be met. If the aggregates are heavier than anticipated when the quantities were computed, or if the surface that the pavement is being constructed on is not true, the average yield can be attained without meeting the minimum thickness requirement.

Weigh tickets shall be collected and a daily total weight of mixture received shall be obtained and entered on the daily report for submission to the Project Engineer. To eliminate possible errors, totals as recorded by the Plant Inspector shall be compared against the total obtained by the Street Inspector. Careful attention given to those details may save argument with the Contractor concerning pay quantities.

Determining Minimum Lift Thickness

On occasion, the thickness of an individual lift of HMA is not specifically indicated on the roadway sections, or a contractor requests permission to place the HMA in more than one lift. Although maximum lift thickness is specified in the Standard Specifications, there is no guidance as to the minimum.

Lift thickness is governed by aggregate size. Adequate lift thickness ensures proper aggregate alignment during compaction, so that density and an impermeable mat can be achieved. Lifts placed too thin can lead to aggregate segregation, tearing, more rapid cooling and it is generally more difficult to achieve proper density and pavement smoothness. As a guide, the following table may be used to determine the minimum lift thickness for the various classes of mix.

HMA Class	Minimum Lift Thickness (feet)
Superpave 3/8”	0.08
Superpave 1/2”	0.12
Superpave 3/4”	0.20
Superpave 1”	0.25

5-4.3 Mix Design

Establishing Mix Proportions

The Contractor is required develop a mix design for each of the classes of HMA in the contract. When the contractor has completed a mix design it is submitted to the Project Engineer along with representative samples of the mineral materials that will be used for HMA production. The mix design and samples are shipped to the State Materials Laboratory in Tumwater for verification of the mix design.

During production it may be necessary to make adjustments in aggregate gradation and asphalt content on the job to fit field requirements such as workability, compactibility, and volumetric properties (Va, VMA and VFA). Section 9-03.8(6)A of the *Standard Specifications* provides the limits of change, both for the aggregate and the asphalt binder content, that can be approved by the Project Engineer. These changes can be made at the request of the contractor provided the change will produce material of equal or better quality. The Project Engineer may order a change in the asphalt binder content.

Adjustments for asphalt binder content greater than ± 0.3 percent may be approved by the State Materials Laboratory or the State Construction Office. Based on past experience in the Region, the Regional Administrator or the Regional Construction Engineer may wish to change the asphalt content beyond the ± 0.3%. To accomplish this, the Region may direct the Project Engineer to increase or decrease the asphalt content by notifying the Project Engineer in writing, or by e-mail, and sending a copy of this direction to the State Materials Laboratory. It is intended that this action include consultation with the State Materials Laboratory or the State Construction Office to provide the best asphalt paving material possible.

During construction, guidance for adjustments is provided through the use and interpretation of the compaction test sections and compaction control testing results.

The Contractor’s plant operator shall be advised of all results of sampling and testing performed so that the proper gate settings may be established at the cold aggregate feeders.

5-5 Cement Concrete Pavement

5-5.1 General Instructions

Concrete paving is a highly complex, mechanized operation involving tens of thousands of dollars worth of pavement in a single day's production. Proper organization and planning of the work are essential on the part of both Contractors and Engineers. Cement concrete pavement has a relatively high initial cost and WSDOT expects many years of satisfactory service from this type of pavement. It is imperative that the Project Engineer and Inspectors are thoroughly familiar with the specifications and techniques applying to the work, if this objective is to be attained.

Before construction begins, the Project Engineer should review all phases of the work, and see that all members of the crew are familiar with the duties to which they are to be assigned. Advance planning and organization of the engineering and inspection teams will do much to eliminate the confusion and improper construction sometimes found during the first day's work. All inspection equipment and testing tools should be on hand in advance of beginning of paving, and demonstrations should be made to acquaint Inspectors with their proper use.

The Project Engineer should make certain that all Inspectors are instructed in the proper methods of keeping notes, records and diaries. Accurate records of construction progress and test results are absolutely essential in evaluating pavement performance through the years.

5-5.2 Pre-Pave

5-5.2A Subgrade Preparation

The subgrade should be shaped and thoroughly compacted. Special attention should be directed to see that all parts of the subgrade are firm and unyielding. Soft spots should be removed and backfilled with suitable material. The subgrade should be prepared to a width that will accommodate the paving equipment without visible distortion.

The subgrade must be trimmed to the proper subgrade elevation and shape. After trimming, the subgrade shall be thoroughly wetted and compacted to achieve a dense unyielding surface. The subgrade must be kept in this condition until the concrete is placed.

The elevation of the subgrade should be checked either by stretching a stringline between the control wires and measuring down to the surface or by another method that provides for a satisfactory check. Extra checks should be made through crown and super transitions to be sure proper adjustments were made in the machine through this area and that no high spots exist.

5-5.2B Controls

If control stakes have not been set for previous operations, they need to be installed at this time. If the control stakes have previously been set, the installation of the wire shall be checked to verify that it is set to the proper line and grade. This is especially important if the wire is offset from its original position.

5-5.2C Equipment

Before paving operations begin, the Inspector should check to see that all the required paving equipment is on the project, it meets the requirements of the specifications, is in good working order, and is properly adjusted.

Inspection of Mixer

The following instructions apply primarily to portable mixing plants set up specifically for the project. Refer to Chapter 6-2.2 for inspection of permanent ready mix plants.

An inspection should be made of the mixing drum, to see that the mixing blades are not excessively worn. A worn blade will show wear at the center of the blade, while the ends receive very little wear. Since new mixing blades are generally straight, the amount of wear can be determined by use of a stringline or straightedge. Blades worn more than $^3/_4$ inch must be removed and new ones installed. Make sure the interior of the drum and the blades are clean, and that accumulations of hardened mortar are all removed.

The batch counter, or timer, should be checked to see that a batch receives the full specified period of mixing before the first part of the batch emerges from the discharge gate.

The water meter should be checked for calibration to ensure that the indicated quantity of water is delivered into the mixing drum. By diverting the discharge water into a suitable container and weighing the quantity delivered, the accuracy of the meter can be checked. This check of the calibration should be made at a minimum of three different settings of the meter control, covering a somewhat wider range than that expected to be used on the job. If the quantity of water delivered does not check with the setting on the gauge, a curve should be plotted, showing actual quantity delivered for a given gauge setting.

The Inspector should check to see that no water valves or lines are leaking, resulting in loss of control of water content of the mix and should make sure that no other means are available for the mixer operator to add unauthorized water.

A careful inspection of the mixer prior to beginning of work will pay dividends in better control of the mix once the job is underway.

Inspection of Batch Trucks

Nonagitating trucks are permitted to haul plant mixed concrete provided the concrete is delivered and discharged within 45 minutes after the introduction of mixing water to cement and aggregates, and the concrete is in a workable condition when placed. The trucks shall be inspected for tightness and ability to dump or empty. If square cornered truck beds are used, corners should be baffled to prevent bridging and hanging-up of concrete.

Inspection of Paver

The slip form paving equipment must be self-propelled and capable of placing, spreading, consolidating, screeding, and finishing the freshly placed concrete to the proper pavement elevation and cross-section within the specified tolerances. Sliding forms on the paver must be rigid to prevent spreading of the forms. The paving equipment must finish the surface in a manner which will minimize hand finishing.

Slip form pavers contain various combinations of all or some of the following components: auger spreader, spud vibrators, oscillating screeds, tamping bars, and pan floats. The equipment should be checked for calibration and satisfactory operation in accordance with the manufacturer's manual before paving is allowed to proceed.

Critical features include, checking all screeds with a stringline to ensure a true plane or crown, checking the height of the finished pavement elevation, checking vibrating frequency of the vibrators and screeds, checking the feelers or sensors for sensitivity, and the related stringline for tightness to ensure adequate control of line and grade. The paver should be checked to see that it can accomplish the desired crown break section and any transition adjustments required from this section to a one plane section.

If it is necessary to stop the forward movement of the paver, the vibratory and tamping elements should also be immediately stopped. No tractive force should be applied to the machine except that which is controlled from the machine.

Inspection of Miscellaneous Tools and Equipment

The power saws shall be checked to see that they are in proper running order and adjustment to the crown of the roadway and the required depth. Extra blades shall be on hand and sufficient lighting to operate at night.

The curing compound applicator shall be checked to see that it is capable of applying the curing compound as specified at a uniform rate.

5-5.2D Mixing Operations

Batching

Refer to Chapter 6-2.2 of this manual for instructions concerning inspection of the batching operations.

Mixing

It is essential that careful, diligent inspection of the mixing of the concrete be maintained. A great many features of the work require constant attention in order that properly mixed concrete of uniform consistency will be placed on the subgrade. The concrete must be properly mixed in order that the pavement will have the desired characteristics of strength and durability. So that concrete may be finished uniformly and result in a smooth profile, it is essential that the mix be of uniform consistency.

Several items of work that the Inspector must watch are listed below:

(1) The addition of water during the mixing period is of utmost importance. Every effort should be made to see that the total water content of the mix remains uniform. Variations in water content result in variations in the strength and shrinkage characteristics of the separate batches. Over-watered batches will cause difficulties in finishing, edge slump, and also will result in random cracks due to excessive shrinkage.

If variations occur in slump, look for:

- variation in the moisture content of the aggregates,
- leakage of water from the discharge valve into the drum,
- variations in batch sizes due to errors in weighing or spillage, or
- non-uniformity in grading in each size of aggregate.

(2) If an air-entraining agent is added at the mixer, checks need to be made of the quantity added to each batch by the automatic dispenser. Tests for air content of the mix should be made with the air meter. The automatic dispensers have been known to malfunction, resulting in an excess of air entrained in the mixture, or no air entrained at all. For this reason, occasional checks should be made to see that the dispenser is functioning properly by comparing the amount of air-entraining agent used against the number of batches mixed.

(3) Speed of the mixing drum in RPM's should be checked when the mixer is in operation. Specifications require that the drum shall revolve at the speed shown on the manufacturer's name plate.

(4) Occasional checks should be made of the mixing time. Once the mixing timer is set and locked, it must not be changed except on order of the Engineer.

(5) Check to see that the concrete is well mixed with no segregation when emptied from the mixer.

(6) The Inspector should make daily inspections of the mixer for wear of mixing blades, and to see that hardened concrete is not allowed to accumulate on the blades or sides of the drum. Proper mixing is dependent upon a clean drum with full-sized, clean mixing blades.

Transporting

The trucks transporting the concrete are to conform to the load limits specified in Section 1-07.7 of the *Standard Specifications*. If the trucks travel on or off the edge of existing pavement, see that the edge of the pavement is protected from damage by the trucks.

See that there is no segregation in the concrete when it is discharged from the truck and that the complete batch is discharged. See that the trucks are properly cleaned at the end of each day's operation.

5-5.3 Paving

5-5.3A Preparation

Ahead of the paving operation, the subgrade must be properly prepared with some type of "fixed" control template to accommodate the width of the paver. The subgrade must be properly dampened so as to have no water demand from the mix, but, also, the concrete must not be placed on subgrade on which pools of water have formed. If concrete is delivered by trucks on the grade, subgrade disturbance should be kept at a minimum.

A very important factor in obtaining a superior product with slip form paving is uniformity of operation. The Engineer should ensure that the plant, mixing facilities and hauling units are in quality and quantity balance to supply the paver with an adequate quantity of concrete for continuous operation at the recommended speed, without sacrificing uniform slump. Considerable pavement roughness can be attributed to spasmodic operation, and this should be held to a minimum.

It is very important that uniform consistency of the concrete be maintained. The *Standard Specifications* no longer require the slump be maintained between $^{3}/_{4}$ inch and $1^{1}/_{4}$ inch unless otherwise modified by the Engineer. The current requirements for water/cement ratio and edge slump are intended to control consistency.

5-5.3B Placing

As paving progresses, the Inspector should be alert to the wire position just ahead of the machine, since the most precisely set control can be disturbed by workers or equipment hitting it. If you notice anyone or anything bumping, touching, leaning on or otherwise in contact with the control wire, notify the Contractor immediately. It is much easier to correct a misaligned control wire than repair the pavement after it has been placed.

The unconsolidated concrete in front of the paver should be kept well distributed by spreading or by dumping. As the truck or mixer discharges the mix onto the grade in front of the paver, the forces delivered to the machine should be held to a minimum, with all systems functioning as designed. If the paver is not moving, the vibration should be off. When vibration is in progress, it is important that the concrete becomes uniformly plastic for the full slab width as it passes through the vibration area. A lack of consolidation at one position on the machine could cause a potential fracture line parallel to the direction of movement and also a rough and uneven finished surface. The machine should always operate with a full head of material in front of it to prevent an abrupt reduction in slab thickness.

It is possible that experimentation may be necessary at the beginning of paving. To start, no trailing forms should be used on the machine and all finishing equipment should be engaged. This could then be modified if problems occur. One of the prime contributors to edge slump is high slump concrete. This should not be tolerated. Another is tie bar insertion for abutting lanes, which should be installed ahead of the final finishing.

Edge slump of the unsupported sides behind the paver is one of the major problems to be combated on slip form paving. The surface should be immediately straight edged by the Contractor and methods corrected to deliver a consistently true edge. Trailing forms can be used to give support beyond the length of the paver, but this may not be the answer. It is possible that more damage than good is done by trailing forms in some cases, by drag resistance pulling down the edge, or by mechanical vibration transmitted through the paver linkage to the form. This comment is also applicable to a trailing finisher. Remember that the concrete is between the moving forms only a few minutes and does not take its initial set until long after the forms leave it.

If water is added to the surface from a spray bar at the rear of the machine it should be in the form of a fine fog spray to avoid washing of the surface and extreme care must be exercised to see that the amount of water added is held to a bare minimum. Addition of excessive amounts of water during finishing will weaken the surface of the concrete and may result in hair checking or scaling of the pavement surface at an early date. If a considerable amount of water is continually required to finish the concrete, it may be better to add more water to the concrete mix to reduce the need for spraying water on the surface. Rain on a green unformed slab can cause disastrous edge slump and erosion. The Contractor should be encouraged to halt operations previous to this circumstance, and should be prepared to protect the pavement at all times.

Although the paver template was established true "dry", soon after paving starts, and periodically thereafter, the slab template should be checked by stretching a line over the wires (transverse) and measuring down to see that the machine has not changed due to the concrete support. This check should also be made through curves and transitions to ensure that the proper section adjustments are being made.

Behind the paver, a grout rod 4-inch to 6-inch aluminum pipe is dragged parallel to and at a skew with the pavement to heal minor faults in the surface. This may be replaced with other methods at the Contractor's discretion.

The slip form paver behaves similarly to an asphalt paver with the front probe approximately $^3/_{16}$-inch higher than the rear. This will probably vary with the machine, due to mass distribution, etc.

Slope of less than this produces an unstable characteristic and an undulating profile, slopes in excess of the correct one cause the machine to repeatedly build up and then slump down. If the symptoms occur, this is one place to check. The machine also has about $^3/_4$-inch convergence in the sides, to encourage stability. Hand finishing, water adding, and other surface manipulation should be kept at a minimum.

5-5.3C Installing Tie/Dowel Bars

Tie/dowel bars must be installed where specified in the *Standard Plans*. Tie bars must be placed so that equal lengths of the bars project into the two lanes of adjoining pavement. When paving two or more lanes at a time, the tie bars are placed at the juncture of the lanes by mechanical means. The Inspector must be alert to see that the bars are set at the proper spacing and depth and are properly centered between the two lanes.

When placing tie/dowel bars in the edge of a slab, the ends of the bars projecting from the forms should be protected against disturbance that might destroy the bond between the concrete and steel. The bars already in place shall be bent to lie close to the slab to permit preparation of the subgrade of the adjoining lane, and carefully straightened to their proper position before placement of concrete.

5-5.3D Finishing

After the concrete has been given the preliminary finish by the paving machine, the Contractor shall check the surface with a straightedge device not less than 10 feet in length. High and low areas indicated by the straightedge shall be corrected. The requirements of checking the surface with the straightedge may be waived if it is demonstrated that other means will consistently produce a surface that meets the requirements for surface smoothness.

Before the concrete has taken its initial set, the edges of the pavement on each side of transverse construction joints shall be edged with a $^1/_8$-inch edger.

The pavement shall be given a final finish by texturing with a comb perpendicular to the center line of the pavement. The comb shall produce striations approximately 0.01 foot minimum in depth in the fresh concrete with spacing of the striations at approximately $^1/_2$ inch. If the striation equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment. It is important that the comb be used when the concrete is at the proper consistency. If the concrete is too soft, it will not retain the proper texture obtained by the comb, and if the concrete is too hard, the proper texture will not be achieved. The comb should be set up and ready to use well in advance of the time it will be required.

In general, the paving contractor is responsible only for the pavement placed by them. This includes the smoothness of the pavement on both sides of any and all joints constructed. On the other hand, the Contractor would not be responsible for pavement placed by another contractor or if the work abuts a bridge or approach slab constructed on a separate contract. When leaving or approaching such joints, the center of the profiler will be started or stopped on the pavement to be profiled at a point approximately 15 feet from the joint. The remaining areas that are unprofiled would be checked for smoothness with the 10-foot straightedge in accordance with current practices used on bridge decks.

Since the primary goal is to obtain a smooth pavement, it would be advisable to run the profiler over the joints at the beginning and end of the project, as well as any intermediate joints as described above, and exclude these readings from the profile index. Should these areas meet straightedge tolerances, but not that for the profiler, the consideration should be given to grinding which would be performed at WSDOT's expense.

Section 5-05.3(12) of the *Standard Specifications* requires that the pavement smoothness be checked by not later than 5 p.m. of the day following the placing of the concrete by the Contractor in the Engineer's presence using the computerized recording profiler to determine whether the equipment and methods used by the contractor are producing a pavement meeting the smoothness required by the specifications. For the purposes of determining the "daily profile index", two or more profiles may be averaged together (see example in WSDOT Test Method 807). The "daily profile index" may also be used to identify those areas having high points in excess of 0.3 inches which must be reduced by abrasive means until reruns indicate the area does not exceed the allowable deviation. The longitudinal "profile index" of the pavement is based on the elevation of any point on the pavement relative to the elevation of points 12.5 feet ahead of and behind the point. This is measured by a 12-wheeled vehicle having a 25-foot wheelbase and a reference wheel, free to move in a vertical direction, suspended midway between the outer wheels. The vehicle is calibrated to record longitudinal travel and vertical variations in elevation on a continuous strip chart as it traverses a section of pavement. The "profile index", which is determined from the recorded chart of each 0.1-mile section, is defined as the cumulative total of recorded elevation extremes above or below a standard variation of ±0.1 inch.

For example, if the chart for a 0.1-mile section showed all elevation extremes to be within the +0.1 inch standard, except for 2 points which measured +0.2 inch and +0.3 inch respectively, the "profile index" would be 0.3 inch per 0.1 mile, or 3 inches per mile.

The "daily profile index" may be used for acceptance purposes should the various individual indexes used to determine the "daily profile index" not exceed 0.7 inches per any 0.1-mile section or 7 inches per mile.

Grinding depths should be limited to $^3/_8$ inch. If the specifications cannot be met with this, the section should be removed. Low areas which grinding cannot feasibly remedy shall be sandblasted, filled with epoxy bonded mortar and textured by grinding. The epoxy bonding agent shall meet Standard Specification Section 9-26.1(1)B for Type II epoxy. Areas which exhibit improperly finished surfaces and would require extensive patching should be removed at the Engineer's discretion.

5-5.3E Curing

Immediately following final finishing of the concrete, or after free water leaves the surfaces, the curing compound should be applied. The purpose of curing, whatever method is used, is to prevent the loss of moisture required to hydrate the cement so that the concrete will gain its proper strength and durability. It is essential that a complete coverage of curing compound be applied to seal the exposed surface of the pavement.

On most paving work, specifications will call for machine application of the curing compound. It should be seen that the spray nozzle is adequately protected from the wind by shielding so that the compound is not blown off the pavement surface. The Inspector shall check to see that the specified rate of coverage is obtained.

The efficiency of the curing compound in preventing escape of moisture from the concrete is dependent upon the thickness of the membrane. For this reason, it is essential that the compound be evenly applied over the exposed surface at a rate of application not less than that specified.

The curing membrane must be protected from damage by foot traffic or equipment. There is a certain amount of foot traffic required in sawing joints, operating the profiler and other operations. This traffic should be held to a minimum, and if damage from undue scuffing or other causes does occur, the area shall be re-sprayed with the required amount of curing compound. Care must be exercised so that curing compound is not sprayed into saw cuts, as the joint sealing compound will not adhere to the concrete in the joints if the curing compound is present.

When pavement is being constructed in early spring or late fall, the Engineer must be alert to predictions of freezing weather, and see that the Contractor is prepared to protect the fresh concrete from freezing, as required in Section 5-05.3(14) of the *Standard Specifications*.

When special protection against freezing is required, the protective earth or straw covering must be placed against the sides of steel forms, if used, as well as on the surface of the pavement, since steel offers poor insulation to the change in temperature.

5-5.3F Joints

Contraction Joints

As concrete cures and hardens, a change in volume occurs due to loss of moisture and cooling. This shrinkage results in tensile stresses being set up in the pavement, causing cracks to develop. History has shown that transverse cracks will develop at about 15-foot intervals along the length of a slab, and that a slab wider than 15 feet may crack longitudinally. Random spacing is specified to break up the harmonics occurring from the wheels rhythmically crossing joints (see the *Standard Plans*).

The purpose of contraction joints is to control the cracking of the concrete, thereby preventing ragged random cracks that spall and require expensive maintenance. Good construction of these joints is of the utmost importance, and inspection of this work is one of the most important phases of the Engineer's duties.

Contraction joints are weakened planes that collect the cracking into a controlled joint. These joints are made by sawing and pouring a hot or cold filler into the joint. The purpose is to create a maintainable joint in the slab and cause the crack to form along the plane of the joint.

This type of joint is constructed by sawing a groove in the hardened concrete to create a plane of weakness along which the crack will form. The saw cuts are made with the circular saw blades edged with abrasives or diamonds. On full width construction, a gang sawing machine using several blades simultaneously is generally used to saw the transverse joints. When the gang sawing machine is used, the Inspector must see that the individual blades are properly aligned and set to cut the required depth.

It is necessary to control the time of sawing transverse joints very carefully, so that sawing may be done when concrete has hardened as much as possible without delaying so long as to allow development of random cracks. It is impossible to state a sawing schedule that will be ideal for every job, since curing conditions vary a great deal from job to job. Some generalizations can be made concerning sawing, but the Engineers on each job must determine from experience the most suitable schedule for that job.

It is desirable to delay sawing as long as possible to allow the concrete to gain enough strength to resist raveling adjacent to the saw cut. Sawing green concrete produces excessive wear on the saw blades, and causes washing, raveling, and other structural damages to the concrete near the joint. However, it may be necessary to make some early cuts to control cracking.

In general, a program of sawing control joints should be followed, sawing every fifth joint, not to exceed 64 feet, as soon as the concrete hardens sufficiently to resist excessive raveling. The time of beginning sawing may vary from about 6 hours on hot, dry days to as long as 18 hours when the weather is cool and the humidity high. The Inspector must use good judgment in controlling the sawing sequence. Sawing of the intermediate joints should follow the sawing of the control joints. It will usually be found possible to delay sawing of the final joints until the day following placement of the concrete (see the *Standard Plans*).

By observing the frequency of cracking and opening of joints the next day, it will be possible to lay out a sawing schedule that will give best results. If only the control joints are cracked, the sawing of the intermediate joints can be delayed further, given fairly constant weather conditions.

Sawing of the longitudinal joints on full width pavement can be delayed as long as 3 days with no danger of random cracking.

The Engineer should mark off the locations of the transverse joints and should check frequently to see that the specified depth of cut is sawed. Since much of the sawing will be done at night, the Inspector should be equipped with a good flashlight to properly examine the condition of saw cuts and to watch for random cracks.

When paving a lane adjacent to a previously paved slab, an early morning examination of joints in the existing lane will show the joints that are open and working. These locations should be marked for sawing control joints in the second lane. Friction at the construction joint and the tie bars will transmit stresses to the new slab and may cause random cracking to occur. For the same reason, uncontrolled cracks in the first lane should be matched with a control joint in the second. In addition, a bond breaker, such as a small piece of roofing felt, should be over each working joint to prevent uncontrolled migration of the crack into the adjacent slab.

Construction Joints

A construction joint shall be made at the end of each day's paving by placing a header board transversely across the pavement. Uncapped dowel bars should be installed in the joint, seeing that the dowels are parallel with the centerline and profile of the pavement. The ends of the dowels projecting from the header should be protected so that they will not be disturbed or moved from their correct positions.

Upon beginning paving the following day, any broken curing seal on the end of the previous day's work must be re-sprayed with curing compound. In addition, the exposed dowel bars shall be "greased" to allow for future slab movement.

5-5.4 Post Paving

5-5.4A Sealing Sawed Contraction Joints

Prior to opening of the pavement to traffic, sawed joints must be sealed with an approved type of filler material. Before application of the filler material, the joints must be thoroughly clean and dry. In most cases, it will be necessary to clean the saw cut with a carborundum blade saw and remove dirt and dust with a jet of compressed air. It is important that the saw cut be completely filled to within $^1/_4$ inch of the top with the filler material. The Inspector can check this by probing the joint after sealing with a stiff wire and watching for sagging of the filler below the top of the joint.

5-5.4B Thickness

Section 5-05.5(1) of the *Standard Specifications* outlines procedures for thickness determinations and provides penalties when prescribed tolerances are exceeded. Before final payment, the thickness tests will have to be made in order to determine the quantities.

5-5.4C Opening to Traffic

During the curing period designated for the concrete mix, the pavement must be properly barricaded to close it to all traffic. If necessary, the Contractor may be required to furnish a person to prevent traffic from using the pavement.

When the pavement has developed a compressive strength of 2500 psi, as determined from cylinders made at the time of placement, it may be opened to traffic. The pavement should be cleaned either by brooming or a pickup sweeper prior to opening.

5-5.5 Unfinished Cement Concrete Pavement

5-5.5A Forms

Metal side forms, conforming to the requirements of Section 5-05.3(7)B of the *Standard Specifications,* shall be used for the construction of unfinished cement concrete pavement unless the Contractor requests to use an approved slip form machine.

It is essential that the base of the steel forms have full, equal bearing upon the subgrade throughout their length and width. They should be set true to alignment and grade and firmly staked with steel pins to avoid movement. Steel forms must never be set on blocks or pedestals. After the forms are firmly staked in place, a final inspection of line and grade should be made by sighting along the tops of the forms. Minor adjustments in grade can be accomplished by tamping additional subgrade material under the form base by an approved mechanical form tamper.

If major changes in alignment or grade are required, the forms should be removed and the subgrade reshaped to the proper elevation and recompacted before resetting the forms.

5-5.5B Joints

Contraction joints will be provided by scoring the surface 1 inch deep to create a weakened plane. The joints shall match transverse joints on adjacent concrete pavement and be at 15-foot intervals transversely on other areas.

5-5.6 Testing Equipment/Reports

5-5.6A Testing Equipment

Specified screens, sieves, and scales

Air meter

Straightedges and stringlines

Thermometers

Stop watch

Flashlights

5-5.6B Records

The Project Engineer is responsible for the keeping of proper records that must include the following information:

Record of cement received and used

Record of batches weighed and mixed

Record of daily yield

Screen analysis of aggregates (see Chapter 9)

Record of cement factor

Record of density of fresh concrete

Air-entraining agent used, and air meter test results

Rate of application of curing compound

Inspector's diaries

Record of surfacing depth determinations (see Chapter 4-4.4)

5-5.7 Check Lists

For the convenience of the Inspector, some of the most important inspection duties on concrete paving work are listed below:

Pre-Pave

1. Review contract requirements (plans, standard specifications, amendment to the standard specifications, and special provisions)

2. See that all testing tools and equipment are on hand and in good condition.

3. Inspect Contractor's paving equipment; see that all deficiencies are corrected before paving is begun, Section 5-05.3(3).

4. Check preparation of subgrade; watch for soft spots. Check subgrade elevations to ensure there are no high or low spots, Section 5-05.3(6). If HMA pavement placed on subgrade prior to PCCP, refer to Section 5-04 for HMA requirements.

5. Check that forms are in good condition and are set securely, true to line and grade, Section 5-05.3(7)B. If a slip form paver is used, check position of wire, string line across the wire and check the depth to subgrade or HMA pavement in at least three locations across the proposed paving area at each pin location.

6. Check that subgrade or HMA is moist before the concrete is placed, Section 5-05.3(6).

Paving

7. Watch for variations in slump of mixed concrete batches, Section 5-05.3(2). In the case of slip-form paving, make frequent checks of the condition of the wire and edge slump, Section 5-05.3(11).

8. Make tests of air content, temperature, compressive test cylinders, and make complete, accurate records of test results and computations, Section 5-05.3(4)A, 5-05.3(5)A and Chapter 9. If maturity meters are used, document locations and periodically check output against maturity curve

9. Check tie bars and dowel bars for rust and defects, that they are installed properly, and secured to the grade if placed in baskets. Ensure that dowel bars receive a bond breaker if they are not precoated, Section 5-05.3(10).

10. Watch for excessive movement of forms under weight of concrete paving equipment.

11. Check frequently to see that vibrators are operating properly, Section 5-05.3(7). If a dowel bar inserter is used, check spacing and alignment of dowel bars. Ensure that PCCP is consolidated after the bar is inserted and that slurry does not fill the insertion point.

12. Watch finishing operations to make sure excessive amount of water is not added to surface; allow fine spray only to be used, Chapter 5-5.3B

13. Check the surface texturing operation to see that proper, uniformly textured surface is obtained, Section 5-05.3(22).

14. See that curing compound is placed uniformly, at the required rate, and at the proper time. The curing compound needs to completely coat the surface of the concrete, Section 5-05.3(13)A. Note other curing methods are allowed in Standard Specifications.

15. See that concrete is consolidated properly at night headers, Section 5-05.3(8)C.

Post Pave

16. Inspect joint sawing operation to see that required depth is cut, and that the best possible saw cuts are obtained, Section 5-05.3(8)A.

17. Watch removal of forms; see that damage to pavement does not occur; require curing compound to be applied on edge of slab immediately following form removal, Section 5-05.3(7)B.

18. See that additional curing compound is applied over areas scuffed by foot traffic.

19. Check that pavement is protected from traffic with necessary barricades, lights, etc, Section 5-05.3(16).

20. See that sawed contraction joints are sealed properly. Fill to ¼ inch below surface and minimize any overflow, Section 5-05.3(8)B.

21. Review surface smoothness tests each day, Section 5-05.3(12).

Note: "Section" references are to the Standard Specifications and "Chapter" references are to the Construction Manual.