5-01 Cement Concrete Pavement Rehabilitation

5-01.1 Description

This Work consists of rehabilitating or replacing section(s) of cement concrete pavement in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or established by the Engineer.

5-01.2 Materials

Materials shall meet the following requirements of the following sections:

Cement	9-01
Fine Aggregate	9-03
Coarse Aggregate	9-03
Combined Aggregate	9-03
Joint Filler	9-04.1
Joint Sealants	9-04.2
Closed Cell Foam Backer Rod	9-04.2(3)A
Dowel Bars	9-07.5
Tie Bars	9-07.6
Concrete Patching Material, Grout, and Mortar	9-20.1
Curing Materials and Admixtures	9-23
Water	9-25
Epoxy Resins (bonding agents)	9-26

Parting Compound shall be a curing compound, grease or other substance approved by the Engineer.

Dowel Bar Retrofit

Dowel bar expansion caps shall be tight fitting and made of non-metallic material, which will allow for ¼ inch of movement at each end of the bar.

Chairs for supporting the dowel bar shall be epoxy coated according to Section 9-07.3 or made from non-metallic material.

The foam insert shall be closed cell foam faced with poster board material or plastic faced material on each side commonly referred to as foam core board by office suppliers. The foam insert shall be capable of remaining in a vertical position and tight to all edges during the placement of the concrete patching material. Caulking filler used for sealing the transverse joint at the bottom and sides of the slot shall be a silicone caulk.

5-01.3 Construction Requirements

5-01.3(1) Vacant

5-01.3(1)A Mix Designs

The Contractor shall use either concrete patching materials or cement concrete for the rehabilitation of cement concrete pavement. Concrete patching materials shall be used for spall repair and dowel bar retrofitting and cement concrete shall be used for concrete panel replacement.

5-01.3(1)A1 Concrete Patching Materials

1. **Materials –** The prepackaged concrete patching material and the aggregate extender shall conform to Section 9-20.1.
2. **Submittals and Mix Approval –** The Contractor shall use the Manufacturer's recommended proportions for the mix design to be submitted to the Engineer for the concrete patching material. The Contractor's submittal shall include the mix proportions of the prepackaged concrete patching material, water, aggregate extender, and the proposed sources for all aggregates. If not approved for use on the QPL, submit test data indicating compliance with Section 9-20.1.

5-01.3(1)A2 Cement Concrete for Panel Replacement

Cement concrete for panel replacement shall meet the requirements of Sections 5-05.3(1) and 5-05.3(2) and be air entrained with a design air content of 5.5 percent. Cement concrete for panel replacement may use rapid hardening hydraulic cement meeting the requirements of Section 9-01.2(2). Rapid hardening hydraulic cement will be considered a cementitious material for the purpose of calculating the water/cementitious materials ratio and the minimum cementitious materials requirement.

5-01.3(1)B Equipment for Panel Replacement

In addition to Sections 5-05.3(3)A, 5-05.3(3)B, 5-05.3(3)D, and 5-05.3(3)E the following shall apply:

1. Mobile volumetric mixers shall be calibrated in accordance with Section 6-09.3(1)H. The references to the latex admixture shall not apply.
2. The equipment for grinding cement concrete pavement shall use diamond embedded saw blades gang mounted on a self propelled machine that is specifically designed to smooth and texture concrete pavement. The equipment shall not damage the underlying surface, cause fracture, or spalling of any joints.

5-01.3(2) Material Acceptance

5-01.3(2)A Concrete Patching Material

Acceptance shall be based on field verification of the prepackaged patching material, and whether the amount of added water and aggregate extender complies with the mix design.

5-01.3(2)B Cement Concrete for Panel Replacement

The point of acceptance will be at the discharge of the placement system.

The concrete producer shall provide a certificate of compliance for each truckload of concrete in accordance with Section 6-02.3(5)B.

Acceptance testing for compliance of air content and 28-day compressive strength shall be conducted from samples obtained according to FOP for WAQTC TM 2. Air content shall be determined by conducting FOP for AASHTO T 152. Compressive Strength shall be determined by FOP for AASHTO T 22 and FOP for AASHTO T 23. The lower Specification limit for air content shall be 3 percent, and the upper Specification limit for air content shall be 7 percent. The lower Specification limit for compressive strength shall be 4,000 psi.

The Contractor shall provide cure boxes in accordance with Section 6-02.3(5)H, and protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period in accordance with Section 6-02.3(6)D. Payment for cure boxes shall be in accordance with Section 6-02.5.

5-01.3(2)B1 Conformance to Mix Design

Acceptance of cement concrete pavement for panel replacement shall be in accordance with Section 5-01.3(2)B. The cement, coarse, and fine aggregate weights shall be within the tolerances of the mix design in accordance with Section 5-05.3(1).

5-01.3(2)B2 Rejection of Concrete

Rejection by the Contractor: The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the Contracting Agency. The replacement material will be sampled, tested and evaluated for acceptance.

Rejection without Testing: The Engineer may reject any load that appears defective prior to placement. Material rejected before placement shall not be incorporated into the pavement. No payment will be made for the rejected materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected materials tested, a sample will be taken and both the air content and strength shall be tested by WSDOT.

Payment for rejected material will be based on the results of the one sample, which was taken and tested. If the rejected material fails either test, no payment will be made for the rejected material and in addition, the cost of sampling and testing, at the rate of $250.00 per sample shall be borne by the Contractor. If the rejected material passes both tests the mix will be compensated for at actual invoice cost and the cost of the sampling and testing will borne by the Contracting Agency.

5-01.3(3) Vacant

5-01.3(4) Replace Cement Concrete Panel

5-01.3(4)A General

Curing, cold weather Work, concrete pavement construction in adjacent lanes, and protection of pavement shall meet the requirements of Section 5-05.3(13) through Section 5-05.3(15). The Contractor, at no cost to the Contracting Agency, shall repair any damage to existing pavement caused by the Contractor's operations.

5-01.3(4)B Sawing and Dimensional Requirements

Concrete slabs to be replaced as shown in the Plans or staked by the Engineer shall be at least 6.0 feet long and full width of an existing pavement panel. The portion of the panel to remain in place shall have a minimum dimension of 6 feet in length and full panel width; otherwise the entire panel shall be removed and replaced. There shall be no new joints closer than 3.0 feet to an existing transverse joint or crack. A vertical full depth saw cut is required along all longitudinal joints and at transverse locations and, unless the Engineer allows otherwise, an additional vertical full depth relief saw cut located 12 to 18 inches from and parallel to the initial longitudinal and transverse saw cut locations is also required. Removal of existing cement concrete pavement shall not cause damage to adjacent slabs that are to remain in place. In areas that will be ground, slab replacements shall be performed prior to pavement grinding.

Side forms shall meet the requirements of Section 5-05.3(7)B whenever a sawed full depth vertical face cannot be maintained.

5-01.3(4)C Dowel Bars and Tie Bars

For the half of a dowel bar or tie bar placed in fresh concrete, comply with the requirements of Section 5-05.

For the half of a dowel bar or tie bar placed in hardened concrete, comply with the Standard Plans and the following.

After drilling, secure dowel bars and tie bars into the existing pavement with either an epoxy bonding agent Type I or IV as specified in Section 9-26.1, or a grout Type 2 for non-shrink applications as specified in Section 9-20.3.

Dowel bars shall be placed at the mid depth of the concrete slab, centered over the transverse joint, and parallel to the centerline and to the Roadway surface, within the tolerances within the table below. Dowel bars may be adjusted to avoid contact with existing dowel bars in the transverse joint at approach slabs or existing panels provided the adjusted dowel bars meet the tolerances below.

Tie bars shall be placed at the mid depth of the concrete slab, centered over the joint, perpendicular to centerline, and parallel to the Roadway surface, within the tolerances in the table below. The horizontal position of tie bars may be adjusted to avoid contact with existing tie bars in the longitudinal joint where panel replacement takes place, provided the adjusted tie bars meet the tolerances below.

Placement Tolerances		
	Dowel Bars	**Tie Bars**
Vertical: Center of Bar to Center of Slab Depth	± 1.00 inch max	± 1.00 inch max
Dowel Bar Centered Over the Transverse Joint	± 1.00 inch max	N/A
Tie Bar Centered Over the Longitudinal Joint	N/A	± 1.00 inch max
Parallel to Centerline Over the Length of the Dowel Bar	± 0.50 inch max	N/A
Perpendicular to Longitudinal Joint Over the Length of the Tie Bar	N/A	± 1.00 inch max
Parallel to Roadway Surface Over the Length of the Bar	± 0.50 inch max	± 1.00 inch max

Dowel bars and tie bars shall be placed according to the Standard Plan when multiple panels are placed. Panels shall be cast separately from the bridge approach slab.

Dowel bars to be drilled into existing concrete or at a new transverse contraction joint shall have a parting compound, such as curing compound, grease, or other Engineer accepted equal, applied to them prior to placement.

Clean the drilled holes in accordance with the epoxy or grout manufacturer's instructions. Holes shall be clean and dry at the time of placing the epoxy, or grout and tie bars. Completely fill the void between the tie bar and the outer limits of the drilled hole with epoxy or grout. Use retention rings to prevent leakage of the epoxy or grout and support the tie bar to prevent movement until the epoxy or grout has cured the minimum time recommended by the manufacturer.

5-01.3(4)D Foundation Preparation

The Contractor shall smooth the surfacing below the removed panel and compact it to the satisfaction of the Engineer. Crushed surfacing base course, or hot mix asphalt may be needed to bring the surfacing to grade prior to placing the new concrete.

If the material under the removed panel is uncompactable and the Engineer requires it, the Contractor shall excavate the Subgrade 2 feet, place a soil stabilization construction geotextile meeting the requirements of Section 9-33, and backfill with crushed surfacing base course. This Work may include:

1. Furnishing and hauling crushed surfacing base course to the project site.
2. Excavating uncompactable material.

3. Furnishing and placing a soil stabilization construction geotextile.
4. Backfilling and compacting crushed surfacing base course.
5. Removing, hauling and restocking any unused crushed surfacing base course.

5-01.3(4)E Concrete Finishing

Grade control shall be the responsibility of the Contractor.

All panels shall be struck off level with the adjacent panels and floated to a smooth surface.

Final finish texturing shall meet the requirements of Section 5-05.3(11).

In areas where the Plans do not require grinding, the surface smoothness will be measured with a 10-foot straightedge by the Engineer in accordance with Section 5-05.3(12). If the replacement panel is located in an area that will be ground as part of concrete pavement grinding in accordance with Section 5-01.3(9), the surface smoothness shall be measured, by the Contractor, in conjunction with the smoothness measurement done in accordance with Section 5-01.3(10).

5-01.3(4)F Joints

All transverse and longitudinal joints shall be sawed and sealed in accordance with Section 5-05.3(8). The Contractor may use a hand pushed single blade saw for sawing joints.

5-01.3(4)G Cracked Panels

Replacement panels that crack shall be repaired as specified in Section 5-05.3(22) at no cost to the Contracting Agency. When repairing replacement panels that have cracked, epoxy-coated dowel bars meeting the requirements of Section 9-07.5(1) may be substituted for the corrosion resistant dowel bars specified.

5-01.3(4)H Opening to Traffic

Opening to traffic shall meet the requirements of Section 5-05.3(17).

5-01.3(5) Partial Depth Spall Repair

Removal of the existing pavement shall not damage any pavement to be left in place. Any existing pavement that is to remain that has been damaged shall be repaired at the Contractor's expense. If jackhammers are used for removing pavement, they shall not weigh more than 30 pounds, and chipping hammers shall not weigh more than 15 pounds. All power driven hand tools used for the removal of pavement shall be operated at angles less than 45 degrees as measured from the surface of the pavement to the tool. The patch limits shall extend beyond the spalled area a minimum of 3 inches. Repair areas shall be kept square, rectangular or circular. Repair areas that are within 12 inches of another repair area shall be combined.

A vertical cut shall be made to a minimum depth of 2 inches around the area using a saw or core drill to be patched as marked by the Engineer. The Contractor shall remove material within the perimeter of the saw cut to a depth of 2 inches, or to sound concrete as determined by the Engineer.

The surface patch area shall be sand blasted and all loose material removed. All sandblasting residue shall be removed.

Spall repair shall not be done in areas where dowel bars are encountered.

When a partial depth repair is placed directly against an adjacent longitudinal joint, a bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer shall be placed between the existing concrete and the area to be patched.

Patches that abut working transverse joints or cracks require placement of a compressible insert. The new joint or crack shall be formed to the same width as the existing joint or crack. The compressible joint material shall be placed into the existing joint 1 inch below the depth of repair. The compressible insert shall extend at least 3 inches beyond each end of the patch boundaries.

Patches that abut the lane/Shoulder joint require placement of a formed edge, along the slab edge, even with the surface.

The patching material shall be mixed, placed, consolidated, finished, and cured according to manufacturer's recommendations. Slab/patch interfaces that will not receive pavement grinding shall be sealed (painted) with a 1:1 cement-water grout along the patch perimeter.

The Contractor shall reseal all joints in accordance with Section 5-03.3(3)C.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

5-01.3(6) Dowel Bar Retrofit

Dowel bars shall be installed in the existing concrete pavement joints and transverse cracks where shown in the Plans or as marked by the Engineer.

Saw cut slots will be required in the pavement to place the center of the dowel at mid-depth in the concrete slab. The completed slot shall provide a level, secure surface for the feet of the dowel bar chairs. Slots that intersect longitudinal or random cracks shall not be retrofitted. When gang saws are used, slots that are not used shall be cleaned and sealed with either Type I or IV epoxy resin as specified in Section 9-26. The transverse joint between cement concrete pavement and a Bridge approach slab shall not be retrofitted.

Saw cut slots shall be prepared such that dowel bars can be placed at the mid depth of the concrete slab, centered over the transverse joint, and parallel to the centerline and to the Roadway surface.

Placement Tolerances for Dowel Bars

1. ± 1 inch of the middle of the concrete slab depth.
2. ± 1 inch of being centered over the transverse joint.
3. ± ½ inch from parallel to the centerline.
4. ± ½ inch from parallel to the Roadway surface.

If jackhammers are used to break loose the concrete they shall weigh less than 30 pounds.

All slot surfaces shall be cleaned to bare concrete by sand blasting. The cleaning shall remove all slurry, parting compound, and other foreign materials prior to installation of the dowel. Any damage to the concrete shall be repaired by the Contractor at no cost to the Contracting Agency. Traffic shall not be allowed on slots where concrete has been removed.

Prior to placement, the dowel bars shall be lightly coated with a parting compound and placed on a chair that will provide a minimum of ½-inch clearance between the bottom of the dowel and the bottom of the slot.

The chair design shall hold the dowel bar tightly in place during placement of the concrete patching material. If the transverse joint or crack is open ¼ inch or more, the Contractor shall caulk the transverse joint or crack at the bottom and sides of the slot as shown in the Plans immediately prior to placement of the dowel bar and concrete patching material. The caulking filler shall not be placed any farther than ½ inch outside either side of the joint or crack. The transverse joint or crack shall be caulked sufficiently to satisfy the above requirements and to prevent any of the patching material from entering the joint/crack at the bottom or sides of the slot.

A ⅜-inch-thick foam insert shall be placed at the middle of the dowel to maintain the transverse joint. The foam insert shall fit tightly around the dowel and to the bottom and edges of the slot and extend to the top of the existing pavement surface. The foam insert shall be capable of remaining in a vertical position and held tightly to all edges during placement of the patch. If for any reason the foam insert shifts during placement of the patch the Work shall be rejected and redone at the Contractor's expense.

Patching material shall be consolidated by using a 1-inch or less diameter vibrator as approved by the Engineer. The Contractor shall not overwork the patching material during the patch consolidation process.

The patching material on the surface of the dowel bar slots shall not be overworked, causing segregation and leaving the fine material on the surface. The patching material shall be left ⅛ to ¼ inch high and not finished flush with the existing concrete surface.

The joint shall be maintained by saw cutting the surface with a hand pushed single blade saw. The cut width shall be 3⁄16 to 5⁄16 inch and the depth 1½ inches. The cut length shall be 2¼ feet long centered over the three retrofit dowel bars and shall be sawed within 24 hours after placement of the concrete patching material.

5-01.3(7) Sealing Existing Concrete Random Cracks

Sealing existing random cracks shall be in accordance with Section 5-03.

5-01.3(8) Sealing Existing Longitudinal and Transverse Joint

Sealing existing longitudinal and transverse joints shall be in accordance with Section 5-03.

5-01.3(9) Cement Concrete Pavement Grinding

Pavement grinding shall begin within 10 working days of placing dowel bar retrofit patching materials. Once the grinding operation has started it shall be continuous until completed. If new cement concrete pavement, in accordance with Section 5-05, is to be placed next to rehabilitated cement concrete pavement, grind one pass along the edge of the rehabilitated cement concrete pavement adjacent to where the new cement concrete pavement is to be placed before the new cement concrete pavement is placed.

The pavement shall be ground in a longitudinal direction beginning and ending at lines normal to the pavement centerline. Ninety-five percent of the surface area of the pavement to be ground shall have a minimum of ⅛ inch removed by grinding.

Bridge decks, bridge approach slabs, and bridge overlay insets shall not be ground. The ground pavement shall be feathered to match the elevation of the above features.

5-01.3(9)A Surface Finish

The final surface texture shall be uniform in appearance with longitudinal corduroy type texture. The grooves shall be between 3/32 and 5/32 inches wide, and no deeper than 1/16 inch. The land area between the grooves shall be between 1/16 and ⅛ inches wide.

5-01.3(10) Pavement Smoothness

Pavement surface smoothness for cement concrete pavement grinding on this project will include International Roughness Index (IRI) testing. Ride quality will be evaluated using the Mean Roughness Index (MRI) calculated by averaging the IRI data for the left and right wheel path within the section.

Smoothness Testing Equipment and Operator Certification

Use an inertial profiler and operator that meet the requirements of Section 5-05.3(3)E.

Surface Smoothness

Operate the inertial profiler in accordance with AASHTO R 57. Collect two longitudinal traces, one in each wheel path. Collect the control profile at locations designated in Table 2 prior to any pavement rehabilitation Work on the areas to be tested. Collect an acceptance profile at locations designated in Table 2 after completion of all cement concrete pavement grinding on the project. Profiles shall be collected in a continuous pass including areas excluded from pay adjustments. Provide notice to the Engineer a minimum of seven calendar days prior to testing.

Table 2 Locations Requiring MRI Testing

Travel lanes where cement concrete grinding is shown in the plans	Control profile
Additional locations designated by the Engineer	Control profile
Travel lanes with completed cement concrete pavement grinding	Acceptance profile
Bridges, approach panels and 0.02 miles before and after bridges and approach panels and other excluded areas within lanes requiring testing	Control and acceptance profile
Ramps, Shoulders and Tapers	Do not test

Within 30 calendar days after the Contractor's testing, the Engineer may perform verification testing. If the verification testing shows a difference in MRI greater than the 10 percent, the following resolution process will be followed:

1. The profiles, equipment and procedures will be evaluated to determine the cause of the difference.
2. If the cause of the discrepancy cannot be resolved the pavement shall be retested with both profilers at a mutually agreed time. The two profilers will test the section within 30 minutes of each other. If the retest shows a difference in MRI equal or greater than the percentages shown in Table 2 of AASHTO R 54 the Engineer's test results will be used for pavement smoothness acceptance.

The Contractor shall evaluate profiles for acceptance or corrective action using the current version of ProVAL and provide the results including the profile data in unfiltered electronic Engineering Research Division (ERD) file format to the Engineer within 3 calendar days of completing each days profile testing. If the profile data files are created using an export option in the manufacturer's software where filter settings can be specified, use the filter settings that were used to create data files for certification.

Analyze the entire profile. Exclude areas listed in Table 3.

Table 3 Areas Excluded from MRI Acceptance Requirements

Location	Exclude
Beginning and end of grinding	Pavement within 0.02 mile
Bridges and approach slabs	The bridge and approach slab and 0.02 mile from the ends of the bridge or approach slab
Defects in the existing roadway identified by the Contractor that adversely affect the MRI such as dips, depressions and wheel path longitudinal joints.[1]	0.01-mile section containing the defect and the 0.01-mile section following the section with the defect.

[1] The presence of defects is subject to verification by the Engineer

Report the MRI results in inches per mile for each 0.01-mile section and each 0.10-mile section. Do not truncate 0.10-mile sections for areas excluded from MRI acceptance requirements. MRI requirements will not apply to 0.10-mile sections with more than three 0.01 mile-sections excluded. MRI requirements for the individual 0.01-mile sections shall still apply. The Engineer will verify the analysis.

The MRI for each 0.10 mile of ground lane will comply with the following:

Control Profile per 0.10 Mile	Maximum MRI of Acceptance Profile per 0.10 Mile
≤130 inches/mile	78 inches/mile
>130 inches/mile	0.6 x Control Profile MRI

The MRI for each 0.01 mile of the completed cement concrete grinding shall not exceed 160 inches/mile.

All Work is subject to parallel and transverse 10-foot straightedge requirements, corrective work and disincentive adjustments.

Surface smoothness of travel lanes including areas subject to MRI testing shall not vary more than ⅛ inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline.

The smoothness perpendicular to the centerline will be measured with a 10-foot straightedge within the lanes. There shall be not vertical elevation difference of more than a ¼ inch between lanes.

Pavement that does not meet these requirements will be subject to corrective Work. All corrective Work shall be completed at no additional expense, including traffic control, to the Contracting Agency. Pavement shall be repaired by one or more of the following methods:

1. Diamond grinding.
2. By other method accepted by the Engineer.

Repair areas shall be re-profiled to ensure they no longer require corrective Work. With concurrence of the Engineer, a 10-foot straight edge may be used in place of the inertial profiler.

If correction of the roadway as listed above either will not or does not produce satisfactory results as to smoothness or serviceability the Engineer may accept the completed pavement and a credit will be calculated in accordance with Section 5-01.5. Under these circumstances, the decision whether to accept the completed pavement or to require corrective work as described above shall be vested entirely in the Engineer.

5-01.3(11) Concrete Slurry and Grinding Residue

All concrete slurry and grinding residue shall be removed from the pavement surface on a continual basis immediately behind the grinding or cutting operations. Slurry shall not be allowed to drain into an area open to traffic, off of the paved surface, into any drainage structure, water of the state, or wetlands.

The Contractor shall collect the concrete slurry and grinding residue from the pavement surface and dispose of it in accordance with Section 2-03.3(7)C. The Contractor shall submit copies of all disposal tickets to the Engineer within 5 calendar days.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

5-01.4 Measurement

Replacement cement concrete panels will be measured by the square yard, based on the actual width and length of the surface area placed.

Retrofit dowel bars will be measured per each for the actual number of bars used in the completed Work.

Cement concrete pavement grinding will be measured by the square yard, based on the actual width and length of area ground. Extra passes to meet the Specifications or overlaps will not be measured.

5-01.5 Payment

Payment will be made for each of the following Bid items that are included in the Proposal:

"Replace Cement Concrete Panel", per square yard.

The unit Contract price per square yard shall be full payment for all costs to complete the Work as specified, including saw cutting full depth, removal and disposal of the existing panels off of the Contracting Agency's Right of Way, preparing the surfacing below the new panel, provide, place and compact the crushed surfacing or hot mix asphalt, furnishing and placing polyethylene film or building paper, furnishing and placing the cement concrete, drilling the holes, providing and anchoring the dowel bars and tie bars, and for all incidentals required to complete the Work as specified.

"Retrofit Dowel Bars", per each.

The unit Contract price per each shall be full payment for all costs to complete the Work as specified, including furnishing and installing parting compound, dowel bar expansion caps, caulking filler, foam core insert material, cement patch where pavement is removed for dowel bar retrofit and for all incidentals required to complete the Work as specified.

"Partial Depth Spall Repair", by force account as provided in Section 1-09.6.

To provide a common Proposal for all Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the total Bid by the Contractor.

"Grinding Smoothness Compliance Adjustment", by calculation.

Grinding Smoothness Compliance Adjustments will be based on the requirements in Section 5-01.3(10) and the following calculations:

A smoothness compliance adjustment will be calculated in the sum of minus $100 for each and every section of single traffic lane 0.01 mile in length and $1,000 for each and every section of single traffic lane 0.10 mile in length that does not meet the requirements in Section 5-01.3(10) after corrective Work.

"Cement Concrete Pavement Grinding", per square yard.

The unit Contract price per square yard for "Cement Concrete Pavement Grinding", when multiplied by the number of units measured, shall be full payment for all costs to complete the Work as specified. The costs of any additional pavement grinding and profiling required to complete the Work as specified is also included in this payment.

"Replace Uncompactable Material", by force account as provided in Section 1-09.6.

Payment for "Replace Uncompactable Material" will be by force account as provided in Section 1-09.6 and will be full payment for all work required to replace uncompactable material and provide base for the Concrete panel. This will include, but not be limited to, excavating the subgrade, placement of a soil stabilization construction geotextile, and backfilling with crushed surfacing base course, as well as the work detailed in items 1 through 5 noted in Section 5-01.3(4). For the purpose of providing a common Proposal for Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the total Bid by the Contractor.

All costs associated with the containment, collection and disposal of concrete slurry and grinding residue shall be included in the applicable concrete grinding or cutting items of Work.

5-02 Bituminous Surface Treatment

5-02.1 Description

This Work shall consist of constructing a single or multiple course bituminous surface treatment (BST) in accordance with these Specifications and in conformity with the lines and cross-sections shown in the Plans or as designated by the Engineer.

5-02.1(1) New Construction

This method of treatment requires two applications of emulsified asphalt and three applications of aggregate. The first application of emulsified asphalt is applied to an untreated Roadway that is followed with an application of aggregate. The second application of emulsified asphalt is followed with two additional applications of aggregate.

5-02.1(2) Seal Coats

This method requires the placing of one application of emulsified asphalt and one or more sizes of aggregate as specified to an existing pavement to seal and rejuvenate the surface and to produce a uniform Roadway surface with acceptable nonskid characteristics.

5-02.1(3) Pavement Sealers – Fog Seal

This method of treatment requires an application of emulsified asphalt over an existing or newly constructed pavement as specified.

5-02.2 Materials

Materials shall meet the requirements of the following sections:

Cationic Emulsified Asphalt	9-02.1(6)
Aggregates for Bituminous Surface Treatment	9-03.4

Each source of aggregate for bituminous surface treatment shall be evaluated separately for acceptance in accordance with Section 3-04.

5-02.3 Construction Requirements

5-02.3(1) Equipment

The equipment used by the Contractor shall be subject to approval by the Engineer before its use.

The distributor shall be capable of uniformly applying emulsified asphalt at the required application temperature and rate. A temperature measuring device shall be capable of reporting the temperature of emulsified asphalt in the tank. A tachometer shall be required to accurately control the application of emulsified asphalt. Distributors shall be equipped with an adjustable spray bar with pressure pump and gauge. The power for operating the pressure pump shall be supplied by a power unit which will provide a uniform spray from each of the nozzles across the spray bar and extensions. The distributor truck shall have a volume control gauge. All reading devices and gauges shall be easily accessible by Inspectors from the ground.

Rollers for seal coats shall be self-propelled pneumatic tired rollers. Rollers for new construction shall be a combination of self-propelled pneumatic tired rollers and smooth-wheeled rollers. Each roller shall not weigh less than 12 tons and shall be capable of providing constant contact pressure. Operation of the roller shall be in accordance with the manufacturer's recommendations.

Aggregate spreading equipment shall be self-propelled, supported on at least four pneumatic tires, with an approved device for accurately metering and distributing the aggregate uniformly over the Roadway surface. Spreading equipment shall be so equipped that the operator has positive width control. This control shall allow the operator to adjust the spreading width of aggregates in 6-inch increments without stopping the machine.

Brooms shall be motorized and capable of controlling vertical pressure.

Other equipment necessary to satisfactorily perform the Work as specified herein or as designated by the Engineer shall be subject to approval by the Engineer before its use in the Work.

Additional units shall be used in the Work when, in the opinion of the Engineer, it is considered necessary in order to fulfill the requirements of these Specifications, or to complete the Work within the time specified.

5-02.3(2) Preparation of Roadway Surface

5-02.3(2)A New Construction

The existing Roadway surface shall be shaped to a uniform grade and cross-section as shown in the Plans, or as designated by the Engineer.

The Roadway shall be dampened, bladed and rolled until the entire Roadway surface shows a uniform grading and conforms to the line, grade, and cross-section shown in the Plans, or as staked. During the operation of blading and rolling, water shall be applied, if necessary, in the amount and at the locations designated by the Engineer.

The entire surface shall be rolled with a smooth-wheeled or pneumatic-tired roller, or both, as designated by the Engineer, except that the final rolling shall be accomplished with a smooth-wheeled roller as specified in Section 5-02.3(1). Rolling shall continue until the entire Roadway presents a firm, damp and unyielding surface.

Immediately before the first application of emulsified asphalt, the Roadway surface shall be in the following condition: firm and unyielding, damp, free from irregularities and material segregation, and true to line, grade, and cross-section.

No traffic will be allowed on the prepared surface until the first application of emulsified asphalt and aggregate has been completed.

5-02.3(2)B Seal Coats

The existing bituminous surface shall be swept with a power broom until it is free from dirt or other foreign matter. Hand push brooms shall be used to clean omissions of the power broom. In addition to power and hand brooms, the use of other equipment may be necessary to thoroughly clean the Roadway prior to the application of emulsified asphalt. Berms created by the removal of dirt or other foreign matter shall be evenly distributed over the fore slope.

Repair of existing pavement shall be done in accordance with Section 5-04. The HMA in repaired areas shall be fog sealed. HMA repaired areas may require a second fog seal depending on surface texture as required by the Engineer. The pavement surface shall be dry prior to fog sealing.

5-02.3(2)C Pavement Sealing – Fog Seal

Where shown in the Plans or directed by the Engineer, the Contractor shall apply a fog seal. Before application of the fog seal, all surfaces shall be thoroughly cleaned of dust, soil, pavement grindings, and other foreign matter. The existing pavement surface shall be dry.

5-02.3(2)D Soil Residual Herbicide

Where shown in the Plans, soil residual herbicide shall be applied in accordance with Section 5-04. Application of the BST shall begin within 24 hours after application of the herbicide.

5-02.3(2)E Crack Sealing

Crack sealing shall be in accordance with Section 5-03.

5-02.3(3) Application of Emulsified Asphalt and Aggregate

Upon the properly prepared Roadway surface, emulsified asphalt of the grade specified in the Special Provisions shall be uniformly applied with distributors and specified aggregates spread at the following rates:

Application Rate			
	Undiluted Emulsified Asphalt (gal. per sq. yd.) Applied	**Aggregate Size**	**Aggregate Application Rate (lbs. per sq. yd.)**
New Construction			
First Application	0.35-0.65	½ inch - No. 4 or ¾ inch - ½ inch	25-45
Second Application	0.35-0.60	½ inch - No. 4	25-40
Choke Stone	N/A	No. 4 - 0	4-6
Seal Coats			
⅝ inch – No. 4 Choke Stone	0.40-0.65	⅝ inch - No. 4 No. 4 - 0	25-45 4-6
½ inch – No. 4 Choke Stone	0.35-0.55	½ inch - No. 4 No. 4 - 0	20-35 4-6
⅜ inch – No. 4	0.35-0.55	⅜ inch - No. 4	20-30
Choke Stone	N/A	No. 4 - 0	4-6

The Engineer will determine the application rates. The second application of emulsified asphalt shall be applied the next day, or as approved by the Engineer.

Longitudinal joints will be allowed at only the centerline of the Roadway, the center of the driving lanes, or the edge of the driving lanes.

To ensure uniform distribution of emulsified asphalt and that the distributor is correctly calibrated, the Contractor shall provide a minimum 1,000-foot test strip when beginning a BST section.

To avoid gaps and ridges at transverse junctions of separate applications of emulsified asphalt and aggregate, the Contractor shall spread sufficient building paper over the treated surface to ensure that the distributor will be functioning normally when the untreated surface is reached. If ordered by the Engineer, the joints shall be cut back to a neat edge prior to placing the building paper.

Should ridges, overlaps, or gaps occur at transverse joints, the Contractor shall repair the defects to the satisfaction of the Engineer. In lieu of repair the Engineer may elect to accept the completed joints and will deduct from monies due or that may become due the Contractor, the sum of $200 for each joint where the deviations described above are found. Should longitudinal joints occur outside the centerline of the Roadway, the center of the driving lanes, or the edge of the driving lanes, the Contractor shall repair the defects to the satisfaction of the Engineer.

All costs involved in making the corrections to defects described above shall be borne by the Contractor and no payment will be made for this Work.

Omissions (skips) by the distributor or tire marks on the uncovered emulsified asphalt shall be immediately covered by hand patching with the same grade of emulsified asphalt and aggregate used on the project.

The area covered by any one spread of emulsified asphalt shall be no more than can be covered with aggregate within 1 minute from the time of application upon any part of the spread. If field conditions warrant, this time may be increased as designated by the Engineer.

Unless otherwise designated by the Engineer, emulsified asphalt shall be spread toward the source of aggregate to avoid injury to the freshly treated surface.

Before application to the Roadway, emulsified asphalt shall be heated to the following temperatures or that recommended by the manufacturer:

Type and Grade of Emulsified Asphalt	Distributor Temperature	
	Min. °F	Max. °F
New Construction and Seal Coats		
CRS-1, CRS-2, CRS-2P	125	195
CMS-2, CMS-2S, CMS-2h	125	185
Fog Seal		
CSS-1, CSS-1h	70	140

Before application of the fog seal, all surfaces shall be thoroughly cleaned of dust, soil, pavement grindings, and other foreign matter. The fog seal emulsified asphalt shall be CSS-1 or CSS-1h diluted with water at a rate of one part water to one part emulsified asphalt unless otherwise approved by the Engineer. The fog seal shall be uniformly applied to the pavement at a diluted rate of 0.10 – 0.18 gal/sy. The finished application shall be free of streaks and bare spots.

Fog sealing shall be applied no sooner than 3 days, but no later than 14 days after new construction or seal coat. If required, newly placed aggregates shall be swept prior to the fog seal application. Rebrooming for fog seal applications shall be paid under “Additional Brooming”, per hour as specified in Section 5-02.5.

5-02.3(4) Vacant

5-02.3(5) Application of Aggregates

All aggregate stockpiles shall be watered down to provide aggregates that are uniformly damp at the time of placement on the Roadway.

After the emulsified asphalt has been spread evenly over the Roadway surface, aggregates of the type specified shall be evenly applied to the Roadway surface by spreader equipment.

The aggregate shall be spread in one operation in such a manner that an 8-inch strip of emulsified asphalt is left exposed along the longitudinal joint to form a lap for the succeeding applications of emulsified asphalt. If necessary, thin or bare spots in the spread of aggregate shall be corrected immediately by re-spreading with the chip spreader or by hand spreading the aggregate.

A minimum of three pneumatic tired rollers providing a minimum of two complete coverages to the Roadway immediately behind the spreading equipment for the coarse aggregate shall be required.

The maximum rate of roller travel shall be limited to 8 mph.

The Contractor shall apply choke stone to the Roadway with additional spreading equipment immediately following the initial rolling of the coarse aggregate unless otherwise specified in the Contract documents or specified by the Engineer. Excess aggregate shall be removed from the Roadway. A minimum of one pass with a pneumatic roller shall be made across the entire width of the applied choke stone.

The operation of trucks hauling aggregate from the stockpile shall be so regulated that no damage, as determined by the Engineer, will result to the Highway or the freshly applied asphalt surface.

The completed surface shall be allowed to cure and then broomed as soon as practical.

If brooming causes rock to be turned or if the Engineer determines that additional cure is needed, the Contractor shall broom the Roadway when directed by the Engineer. If, after completion of the initial brooming, the Engineer determines the need to remobilize for additional brooming, the Contractor shall rebroom the areas designated by the Engineer. The Contractor shall apply water for dust control during brooming operations when safety or environmental concerns arise, or as otherwise determined by the Engineer.

The Contractor shall be held responsible for protecting all surface waters, riparian habitats, or other sensitive areas that may be encroached upon by brooming operations. Materials such as dirt, foreign material, or aggregates removed from these areas shall become the property of the Contractor and shall be disposed of in accordance with Section 2-03.3(7).

The Contractor shall use a pickup broom in all curbed areas, on all bridges, within city limits, within sensitive areas, and where shown in the Plans both before the application of emulsified asphalt and during the final brooming operation. When the pickup broom does not satisfactorily pickup the aggregate, manual methods shall be used. Materials collected by the pick up broom shall become the property of the Contractor and shall be disposed of in accordance with Section 2-03.3(7).

Aggregates accumulated in intersections and driveways due to brooming operations shall become the property of the Contractor and shall be disposed of in accordance with Section 2-03.3(7).

The Contractor shall notify the Engineer when the brooming for each section is considered complete. The Engineer will indicate acceptance or inform the Contractor of deficiencies within 24 hours of notification.

5-02.3(6) Additional Emulsified Asphalt and Aggregate

If the application of emulsified asphalt or aggregate, or both, is insufficient or excessive for the required results, the Engineer may require the Contractor to make an additional application of one or both materials in accordance with these Specifications, or at the direction of the Engineer. Additional emulsified asphalt or aggregate used will be paid for at the unit Contract prices for the materials used.

5-02.3(7) Patching and Correction of Defects

Omissions by the distributor or damage to the treated surface of any coat shall be immediately covered by hand patching with emulsified asphalt in adequate quantities. Holes which develop in the surface shall be patched in the same manner as specified in Section 5-02.3(2)A. All costs incurred by the Contractor, in coating omissions and patching, shall be included in the unit Contract prices for the materials used.

Defects such as raveling, lack of uniformity, or other imperfections caused by faulty workmanship shall be corrected and new Work shall not be started until such defects have been remedied.

All improper workmanship and defective materials resulting from overheating, improper handling or application, shall be removed from the Roadway by the Contractor and be replaced with approved materials and workmanship at no expense to the Contracting Agency.

If the Engineer determines a fog seal is necessary at any time during the life of the Contract, the Contractor shall apply a fog seal. The CSS-1 or CSS-1h emulsified asphalt may be diluted with water at a rate of one part water to one part emulsified asphalt unless otherwise specified by the Engineer.

5-02.3(8) Progress of Work

The Contractor shall organize the Work so that no longitudinal joints shall remain open overnight.

5-02.3(9) Protection of Structures

The Contractor shall be responsible for protecting monument covers, sewer lids, manhole covers, water valve covers, drainage grates, inlets, railroad tracks, bridge handrails and expansion joints, guardrails, curbs, road signs, guide posts, or other facilities from the application of emulsified asphalt and aggregates. This protective effort is to include uncovering these items the same working day that the completed BST or seal coat construction has passed the protected locations. If needed, drainage inlets shall be cleaned out immediately after final brooming is completed. All costs incurred by the Contractor in necessary protective measures shall be included in the unit Contract prices for the various Bid items of Work involved.

5-02.3(10) Unfavorable Weather

Emulsified asphalt shall not be applied to a wet Roadway. Subject to the determination of the Engineer, emulsified asphalt shall not be applied during rainfall, sand or dust storms, or before any imminent storms that might damage the construction. The Engineer will have the discretion as to whether the surface and materials are dry enough to proceed with construction.

The application of any emulsified asphalt to the Roadway shall be restricted to the following conditions:

1. The Roadway surface temperature shall be at least 55°F. The air temperature shall be at least 60°F and rising. The air temperature shall be not less than 70°F when falling and the wind shall be less than 10 mph as estimated by the Engineer.
2. The surface temperature shall be not more than 130° F or as otherwise determined by the Engineer.
3. No emulsified asphalt shall be applied which cannot be covered 1 hour before darkness. The Engineer may require the Contractor to delay application of emulsified asphalt until the atmospheric and Roadway conditions are satisfactory.
4. Construction of bituminous surface treatments shall not be carried out before May 1 or after August 31 of any year except upon written order of the Engineer.

5-02.3(11) Temporary Pavement Markings

During bituminous surface treatment paving operations, temporary pavement markings shall be maintained throughout the project. Temporary pavement markings shall be installed on the Roadway that was paved that day. Temporary pavement markings shall be in accordance with Section 8-23.

5-02.4 Measurement

Processing and finishing will be measured by the mile to the nearest 0.01 mile along the main line Roadway. All related supplemental Roadways and irregular shaped areas will be incidental.

Emulsified asphalt of the grade or grades specified will be measured by the ton in accordance with Section 1-09.

Asphalt for fog seal will be measured by the ton, before dilution, in accordance with Section 1-09.

Aggregate from stockpile for BST will be measured by the cubic yard in trucks at the point of delivery on the Roadway.

Furnishing and placing crushed aggregate will be measured by the cubic yard in trucks at the point of delivery on the Roadway, or by the ton in accordance with Section 1-09.1.

Additional brooming will be measured by the hour.

Water will be measured in accordance with Section 2-07.

5-02.5 Payment

Payment will be made for each of the following Bid items that are included in the Proposal:

"Processing and Finishing", per mile.

The unit Contract price per mile for "Processing and Finishing" shall be full pay for all costs to perform the specified Work including blading, scarifying, processing, leveling, finishing, and the manipulation of aggregates as required. In the event the Proposal does not include a Bid item for "Processing and Finishing" then all costs for processing and finishing shall be included in other related items of Work.

"Emulsified Asphalt (_____)", per ton.

The unit Contract price per ton for "Emulsified Asphalt (_____) shall be full pay for all costs to perform the specified Work including furnishing, heating, hauling, and spreading the emulsified asphalt on the Roadway.

"Asphalt for Fog Seal", per ton.

The unit Contract price per ton for "Asphalt for Fog Seal" shall be full pay for all costs to perform the specified Work for fog seal.

"Agg. from Stockpile for BST", per cubic yard.

The unit Contract price per cubic yard for "Aggregate from Stockpile for BST" shall be full pay for all costs to perform the specified Work including loading, transporting, and placing the material in the finished Work.

"Furnishing and Placing Crushed (_____)", per cubic yard.

"Furnishing and Placing Crushed (_____)", per ton.

The unit Contract price per cubic yard or per ton for "Furnishing and Placing Crushed (_____) shall be full pay for all costs to perform the specified Work including furnishing, transporting, and placing the material in the finished Work.

"Additional Brooming", per hour.

The unit Contract price per hour for "Additional Brooming" shall be full pay for all costs to perform the specified Work including rebrooming the Roadway.

"Water", per M gal.

Payment for "Water" shall be in accordance with Section 2-07.5.

If the Proposal does not include a Bid item for water, the Contractor shall dampen stockpiled or furnished aggregate as required, and the cost thereof shall be included in other related items of the Work.

Any incidental Work required to complete the bituminous surface treatment that is not specifically mentioned as included with the Bid items above shall be performed by the Contractor and shall be included in the unit Contract prices of the various related Bid items.

5-03 Crack and Joint Sealing

5-03.1 Description

This Work consists of preparing and sealing cracks and joints in pavement.

5-03.2 Materials

Materials shall meet the requirements of the following sections:

Cationic Emulsified Asphalt	9-02.1(6)
Hot Poured Sealant for Cement Concrete Pavement	9-04.2(1)A1
Hot Poured Sealant for Bituminous Pavement	9-04.2(1)A2
Sand Slurry for Bituminous Pavement	9-04.2(1)B
Polymer Modified Asphalt Mastic	9-04.2(1)C
Closed Cell Foam Backer Rod	9-04.2(3)A

5-03.3 Construction Materials

5-03.3(1) General Requirements

5-03.3(1)A Weather Limitations

The Contractor shall follow the weather limitations recommended by the manufacturer.

Sand Slurry, or in the absence of manufacturer recommendations Hot Poured Sealant or Polymer Modified Asphalt Mastic shall not be placed when the pavement temperature is less than 40°F, or during any precipitation.

5-03.3(1)B Cleaning, Drying and Debris Removal

The Contractor shall ensure that cracks and joints are thoroughly clean, dry and free of all loose and foreign material immediately prior to filling with sealant material.

For bituminous pavements when the pavement temperature is less than 50°F, or there is any moisture in the cracks or joint the Contractor shall use a hot compressed air lance to dry and warm the pavement surfaces within the crack or joint immediately prior to filling with sealant. The pavement shall not be overheated. Direct flame dryers shall not be used.

Routing cracks in bituminous pavements is not required unless required by the manufacturer's installation instructions.

5-03.3(1)C Polymer Modified Asphalt Mastic

The Contractor shall furnish a Type 2 working drawing of the manufacturer's product information and recommendations to the Engineer prior to the start of work. The manufacturer's recommendations shall include the heating time and temperatures, allowable storage time and temperatures after initial heating, allowable reheating criteria, and application temperature range. The polymer modified asphalt mastic shall be confined within the crack. Any overflow of polymer modified asphalt mastic shall be cleaned from the pavement surface. If, in the opinion of the Engineer, the Contractor's method results in an excessive amount of polymer modified asphalt mastic on the pavement surface, the operation shall be stopped and corrected to eliminate the excess. BST or HMA shall not be placed over polymer modified asphalt mastic until a minimum of 14 calendar days have elapsed following application.

5-03.3(1)D Sand Slurry

The sand slurry components shall be thoroughly mixed and the mixture shall be poured into the cracks until full. Additional CSS-1 cationic emulsified asphalt may be added to the sand slurry as needed for workability to ensure the mixture will completely fill the cracks. The Contractor shall strike off the sand slurry flush with the existing pavement surface and allow the mixture to cure. Cracks that were not completely filled shall be topped off with additional sand slurry. Placement of the HMA overlay shall not commence until the slurry has fully cured.

5-03.3(1)E Hot Poured Sealant

The Contractor shall furnish a Type 2 working drawing of the manufacturer's product information and recommendations to the Engineer prior to the start of work. The manufacturer's recommendations shall include the heating time and temperatures, allowable storage time and temperatures after initial heating, allowable reheating criteria, and application temperature range. The sealant material shall be confined within the crack or joint. Any overflow of sealant shall be cleaned from the pavement surface. If, in the opinion of the Engineer, the Contractor's method results in an excessive amount of sealant on the pavement surface, the operation shall be stopped and corrected to eliminate the excess. BST or HMA shall not be placed over hot poured sealant until a minimum of 14 calendar days have elapsed following application.

5-03.3(2) Sealing Bituminous Pavement

Where shown in the Plans all cracks ¼ inch in width and greater or joints in HMA or BST pavement shall be sealed.

5-03.3(2)A Material Selection

The material to be used for crack or joint sealing shall be selected from the following table based on the width of the cracks and the nature of the material that will be placed over the crack sealing material.

Crack or Joint Seal Material Selection			
	Material to be Placed Over the Sealed Crack or Joint		
Crack or Joint to be Sealed	HMA	BST	Areas not Paved under the Contract
Cracks with widths form ¼ inch to 1 inch	Sand Slurry	Hot Poured Sealant	Hot Poured Sealant
Cracks with widths greater than 1 inch	Polymer Modified Asphalt Mastic	Polymer Modified Asphalt Mastic	Polymer Modified Asphalt Mastic
All Joints	Hot Poured Sealant		

5-03.3(2)B Longitudinal Joint Seal

When HMA is placed adjacent to cement concrete pavement, the Contractor shall construct longitudinal joints between the HMA and the cement concrete pavement. The joint shall be sawed to the dimensions shown on Standard Plan A-40.10 and filled with joint sealant meeting the requirements of Section 9-04.2(1)A2.

5-03.3(2)C Bridge Paving Joint Seals

5-03.3(2)C1 HMA Sawcut and Seal

Prior to placing HMA on the bridge deck sawcut alignment points shall be established at both ends of the bridge paving joint seals to be placed at the bridge ends, and at interior joints within the bridge deck when and where shown in the Plans. The sawcut alignment points shall be established in a manner that they remain functional for use in aligning the sawcut after placing the HMA overlay.

The Contractor shall construct the bridge paving joint seal as specified in the Plans and in accordance with the detail shown in the Standard Plans. The sawed joint shall be constructed in accordance with Section 5-05.3(8) and filled with joint sealant meeting the requirements of Section 9-04.2(1)A2.

5-03.3(2)C2 Paved Panel Joint Seal

The Contractor shall construct the paved panel joint seal in accordance with the requirements specified in Section 5-03.3(2)C1 and the following requirement:

1. The existing joint between concrete panels shall be cleaned and sealed in accordance with Section 5-03.3(3)B and the details shown in the Standard Plans.

5-03.3(3) Sealing Cement Concrete Pavement

5-03.3(3)A Sealing Existing Concrete Random Crack

The Contractor shall route, clean and seal existing concrete random cracks in existing cement concrete pavement where indicated by the Engineer. Cracks smaller than 5/16 inch in width shall be routed to 5/16 inch wide by 1 inch deep prior to placing the sealant. Cracks over 5/16 inch in width shall be cleaned and sealed.

All incompressible material shall be completely removed from the existing random crack to a depth of ¾ inch. Immediately prior to sealing, the cracks shall be clean.

The top surface of the sealant shall be at least ¼ inch below the surface of the pavement.

5-03.3(3)B Sealing Existing Transverse and Longitudinal Joint

The Contractor shall clean and seal existing longitudinal and transverse joints in cement concrete pavement where shown in the Plans or as marked by the Engineer.

Old sealant and incompressible material shall be completely removed from the joint to the depth of the new reservoir with a diamond blade saw in accordance with the detail shown in the Standard Plans. The removed sealant shall become the property of the Contractor and be removed from the jobsite.

Removal of the old sealant for the entire depth of the joint is not required if the depth of the new reservoir is less than the depth of the existing joint.

Joints constructed with joint tape do not require cleaning and sealing.

If shown in the Plans, a backer rod shall be placed at the base of the sawn reservoir. The joints shall be completely dry before the sealing installation may begin. Immediately following the cleaning and backer rod replacement, if required, the sealant material shall be installed in conformance to manufacturer's recommendations and in accordance with Section 5-03.3(3)C.

The top surface of the sealant shall be at least ¼ inch below the surface of the pavement.

5-03.3(3)C Sealing Sawed Contraction Joints

Sawed contraction joints shall be filled with a joint sealant conforming to the requirements of Section 9-04.2(1)A1. Care shall be taken to avoid air pockets. The joint sealant shall be applied in two or more layers, if necessary. The joint sealant shall be applied under sufficient pressure to fill the groove from bottom to top and the cured joint sealant shall be between ¼ and ⅝ inch below the top surface of the concrete.

5-03.3(3)D Construction Joints

All transverse and longitudinal construction joints, including the joint between new and existing pavement when widened, shall be sawed and sealed with joint sealant conforming to the requirements of Sections 5-03.3(3)C and 9-04.2(1)A1.

5-03.4 Measurement

"Crack Sealing ¼ inch to 1 inch in width - LF" will be measured by the linear foot along the line of the cracks.

"Crack Sealing greater than 1 inch in width - LF" will be measured by the linear foot along the line of the cracks.

"Crack Sealing-CM" will be measured by the centerline mile. Measurement will begin and end at the stations indicated in the Plans. Shoulders, road approaches, gores and irregular shaped areas will be incidental and not measures separately for payment.

"Crack Sealing-LF" will be measured by the linear foot along the line of the cracks that have been completed as required by Section 5-03.

Sealing existing concrete random cracks will be measured by the linear foot, measured along the crack sealed.

Sealing existing longitudinal and transverse joint will be measured by the linear foot, measured along the line of the completed joint.

Longitudinal joint seals between the HMA and cement concrete pavement will be measured by the linear foot along the line and slope of the completed joint seal.

HMA sawcut and seal, and paved panel joint seal, will be measured by the linear foot along the line and slope of the completed joint seal.

5-03.5 Payment

Payment will be made for each of the following Bid items that are included in the Proposal:

"Crack Sealing-FA", by force account.

"Crack Sealing-FA" will be paid for by force account as specified in Section 1-09.6. For the purpose of providing a common Proposal for all Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the total Bid by the Contractor.

"Crack Sealing ¼ inch to 1 inch in width - LF", per linear foot.

The unit Contract price per linear foot for "Crack Sealing ¼ inch to 1 inch in width - LF" shall be full payment for all costs incurred to perform the Work required in Section 5-03 related to cracks that are ¼ inch to 1 inch in width.

"Crack Sealing greater than 1 inch in width - LF", per linear foot.

The unit Contract price per linear foot for "Crack Sealing greater than 1 inch in width - LF" shall be full payment for all costs incurred to perform the Work required in Section 5-03 related to cracks that are greater than 1 inch in width.

"Crack Sealing-CM", per centerline mile.

The unit contract price per lane mile for "Crack Sealing-CM", shall be full payment for all costs incurred to perform the Work described in Section 5-03 including all lanes, paved shoulders, road approaches, gores and irregular shaped areas.

"Crack Sealing-LF", per linear foot.

The unit contract price per linear foot for "Crack Sealing-LF" shall be full payment for all costs incurred to perform the Work described in Section 5-03.

"Sealing Existing Concrete Random Crack", per linear foot.

The unit Contract price per linear foot for "Sealing Existing Concrete Random Crack" shall be full payment for all costs to complete the Work as specified, including removing incompressible material, preparing and sealing existing random cracks where existing random cracks are cleaned and for all incidentals required to complete the Work as specified.

"Sealing Existing Longitudinal and Transverse Joint", per linear foot.

The unit Contract price per linear foot for "Sealing Existing Longitudinal and Transverse Joint", shall be full payment for all costs to complete the Work as specified, including removing incompressible material, preparing and sealing existing transverse and longitudinal joints where existing transverse and longitudinal joints are cleaned and for all incidentals required to complete the Work as specified.

"Longitudinal Joint Seal", per linear foot.

The unit Contract price per linear foot for "Longitudinal Joint Seal" shall be full payment for all costs incurred to construct the longitudinal joint between HMA and cement concrete pavement, as described in Section 5-03.

"HMA Sawcut And Seal", per linear foot.

The unit Contract price per linear foot for "HMA Sawcut And Seal" shall be full payment for all costs incurred to perform the Work described in Section 5-03.3(2)C1.

"Paved Panel Joint Seal", per linear foot.

The unit Contract price per linear foot for "Paved Panel Joint Seal" shall be full payment for all costs incurred to perform the Work described in Section 5-03.3(2)C2.

Sealing Sawed Contraction Joints and Construction Joints shall be included in the cost of "Cement Concrete Pavement".

5-04 Hot Mix Asphalt

This Section 5-04 is written in a style which, unless otherwise indicated, shall be interpreted as direction to the Contractor.

5-04.1 Description

This Work consists of providing and placing one or more layers of plant-mixed hot mix asphalt (HMA) on a prepared foundation or base, in accordance with these Specifications and the lines, grades, thicknesses, and typical cross-sections shown in the Plans. The manufacture of HMA may include additives or processes that reduce the optimum mixing temperature (Warm Mix Asphalt) or serve as a compaction aid in accordance with these Specifications.

HMA shall be composed of asphalt binder and mineral materials as required, and may include reclaimed asphalt pavement (RAP) or reclaimed asphalt shingles (RAS), mixed in the proportions specified to provide a homogeneous, stable, and workable mix.

5-04.2 Materials

Provide materials as specified in these sections:

Asphalt Binder	9-02.1(4)
Cationic Emulsified Asphalt	9-02.1(6)
Anti-Stripping Additive	9-02.4
HMA Additive	9-02.5
Aggregates	9-03.8
Reclaimed Asphalt Pavement (RAP)	9-03.8(3)B, 9-03.21
Reclaimed Asphalt Shingles (RAS)	9-03.8(3)B, 9-03.21
Mineral Filler	9-03.8(5)
Recycled Material	9-03.21

5-04.2(1) How to Get an HMA Mix Design on the QPL

Comply with each of the following:

- Develop the mix design in accordance with WSDOT SOP 732.
- Develop a mix design that complies with Sections 9-03.8(2) and 9-03.8(6).
- Develop a mix design no more than 6 months prior to submitting it for QPL evaluation.
- Submit mix designs to the WSDOT State Materials Laboratory in Tumwater, including WSDOT Form 350-042.
- Include representative samples of the materials that are to be used in the HMA production as part of the mix design submittal.
- Identify the brand, type, and percentage of anti-stripping additive in the mix design submittal.
- Include with the mix design submittal a certification from the asphalt binder supplier that the anti-stripping additive is compatible with the crude source and the formulation of asphalt binder proposed for use in the mix design.

- Do not include HMA additives that reduce the optimum mixing temperature or serve as a compaction aid when developing a mix design or submitting a mix design for QPL evaluation. The use of HMA additives is not part of the process for obtaining approval for listing a mix design on the QPL. Refer to Section 5-04.2(2)B.

The Contracting Agency's basis for approving, testing, and evaluating HMA mix designs for approval on the QPL is dependent on the contractual basis for acceptance of the HMA mixture, as shown in Table 1.

Table 1 Basis for Contracting Agency Evaluation of HMA Mix Designs for Approval on the QPL

Contractual Basis for Acceptance of HMA Mixture [see Section 5-04.3(9)]	Basis for Contracting Agency Approval of Mix Design for Placement on QPL	Contracting Agency Materials Testing for Evaluation of the Mix Design
Statistical Evaluation	WSDOT Standard Practice QC-8 located in the WSDOT *Materials Manual* M 46-01	The Contracting Agency will test the mix design materials for compliance with Sections 9-03.8(2) and 9-03.8(6).
Visual Evaluation	Review of Form 350-042 for compliance with Sections 9-03.8(2) and 9-03.8(6))	The Contracting Agency may elect to test the mix design materials, or evaluate in accordance with WSDOT Standard Practice QC-8, at its sole discretion.

If the Contracting Agency approves the mix design, it will be listed on the QPL for 12 consecutive months. The Contracting Agency may extend the 12 month listing provided the Contractor submits a certification letter to the Qualified Products Engineer verifying that the aggregate source and job mix formula (JMF) gradation, and asphalt binder crude source and formulation have not changed. The Contractor may submit the certification no sooner than three months prior to expiration of the initial 12 month mix design approval. Within 7 calendar days of receipt of the Contractor's certification, the Contracting Agency will update the QPL. The maximum duration for approval of a mix design and listing on the QPL will be 24 months from the date of initial approval or as approved by the Engineer.

5-04.2(1)A Mix Designs Containing RAP and/or RAS

Mix designs are classified by the RAP and/or RAS content as shown in Table 2.

Table 2 Mix Design Classification Based on RAP/RAS Content

RAP/RAS Classification	RAP/RAS Content[1]
Low RAP/No RAS	0% ≤ RAP% ≤ 20% and RAS% = 0%
High RAP/Any RAS	20% < RAP% ≤ Maximum Allowable RAP[2] and/or 0% < RAS% ≤ Maximum Allowable RAS[2]

[1]Percentages in this table are by total weight of HMA.

[2]See Table 4 in Section 5-04.2(1)A2 to determine the limits on the maximum amount RAP and/or RAS.

5-04.2(1)A1 Low RAP/No RAS – Mix Design Submittals for Placement on QPL

For Low RAP/No RAS mix designs, comply with the following additional requirements:

1. Develop the mix design with or without the inclusion of RAP.
2. The asphalt binder grade shall be the grade indicated in the Bid item name or as otherwise required by the Contract.
3. Submit samples of RAP if used in development of the mix design.
4. Testing RAP or RAS stockpiles is not required for obtaining approval for placing these mix designs on the QPL.

5-04.2(1)A2 High RAP/Any RAS – Mix Design Submittals for Placement on QPL

For High RAP/Any RAS mix designs, comply with the following additional requirements:

1. For mix designs with any RAS, test the RAS stockpile (and RAP stockpile if any RAP is in the mix design) in accordance with Table 3.
2. For High RAP mix designs with no RAS, test the RAP stockpile in accordance with Table 3.
3. For mix designs with High RAP/Any RAS, construct a single stockpile for RAP and a single stockpile for RAS and isolate (sequester) these stockpiles from further stockpiling before beginning development of the mix design. Test the RAP and RAS during stockpile construction as required by item 1 and 2 above. Use the test data in developing the mix design, and report the test data to The Contracting Agency on WSDOT Form 350-042 as part of the mix design submittal for approval on the QPL. Account for the reduction in asphalt binder contributed from RAS in accordance with AASHTO PP 78. Do not add to these stockpiles after starting the mix design process.

Table 3 Test Frequency of RAP/RAS During RAP/RAS Stockpile Construction for Approving a High RAP/Any RAS Mix Design for Placement on the QPL

Test Frequency[1]	Test for	Test Method
• 1/1000 tons of RAP (minimum of 10 per mix design) and • 1/100 tons of RAS (minimum of 10 per mix design)	Asphalt Binder Content and Sieve Analysis of Fine and Coarse Aggregate	FOP for AASHTO T 308 and FOP for AASHTO T 30/T 11
• 1/500 tons of RAS (minimum of 3 per mix design)	Asbestos Containing Material (ACM)	See Section 9-03.21(1)A

[1]"tons", in this table, refers to tons of the reclaimed material before being incorporated into HMA.

4. Limit the amount of RAP and/or RAS used in a High RAP/Any RAS mix design by the amount of binder contributed by the RAP and/or RAS, in accordance with Table 4.

Table 4 Maximum Amount of RAP and/or RAS in HMA Mixture

Maximum Amount of Binder Contributed from:	
RAP	**RAS**
40%[1] minus contribution of binder from RAS	20%[2]

[1] Calculated as the weight of asphalt binder contributed from the RAP as a percentage of the total weight of asphalt binder in the mixture.

[2] Calculated as the weight of asphalt binder contributed from the RAS as a percentage of the total weight of asphalt binder in the mixture.

5. Develop the mix design including RAP, RAS, recycling agent, and new binder.
6. Extract, recover, and test the asphalt residue from the RAP and RAS stockpiles to determine the percent of recycling agent and/or grade of new asphalt binder needed to meet but not exceed the performance grade (PG) of asphalt binder required by the Contract.
    a. Perform the asphalt extraction in accordance with AASHTO T 164 or ASTM D 2172 using reagent grade solvent.
    b. Perform the asphalt recovery in accordance with AASHTO R 59 or ASTM D 1856.
    c. Test the recovered asphalt residue in accordance with AASHTO R 29 to determine the asphalt binder grade in accordance with Section 9-02.1(4).
    d. After determining the recovered asphalt binder grade, determine the percent of recycling agent and/or grade of new asphalt binder in accordance with ASTM D 4887.
    e. Test the final blend of recycling agent, binder recovered from the RAP and RAS, and new asphalt binder in accordance with AASHTO R 29. The final blended binder shall meet but not exceed the performance grade of asphalt binder required by the Contract and comply with the requirements of Section 9-02.1(4).
7. Include the following test data with the mix design submittal:
    a. All test data from RAP and RAS stockpile construction.
    b. All data from testing the recovered and blended asphalt binder.
8. Include representative samples of the following with the mix design submittal:
    a. RAP and RAS.
    b. 150 grams of recovered asphalt residue from the RAP and RAS that are to be used in the HMA production.

5-04.2(1)B Commercial HMA – Mix Design Submittal for Placement on QPL

For HMA used in the Bid item Commercial HMA, in addition to the requirements of Section 5-04.2(1) identify the following in the submittal:

1. Commercial HMA
2. Class of HMA
3. Performance grade of binder
4. Equivalent Single Axle Load (ESAL)

The Contracting Agency may elect to approve Commercial HMA mix designs without evaluation.

5-04.2(1)C Mix Design Resubmittal for QPL Approval

Develop a new mix design and resubmit for approval on the QPL when any of the following changes occur. When these occur, discontinue using the mix design until after it is reapproved on the QPL.

1. Change in the source of crude petroleum used in the asphalt binder.
2. Changes in the asphalt binder refining process.
3. Changes in modifiers used in the asphalt binder.
4. Changes in the anti-strip additive, brand, type or quantity.
5. Changes to the source of material for aggregate.
6. Changes to the job mix formula that exceed the amounts as described in item 2 of Section 9-03.8(7), unless otherwise approved by the Engineer.
7. Changes in the percentage of material from a stockpile, when such changes exceed 5 percent of the total aggregate weight.
    a. For Low RAP/No RAS mix designs developed without RAP, changes to the percentage of material from a stockpile will be calculated based on the total aggregate weight not including the weight of RAP.
    b. For Low RAP/No RAS mix designs developed with RAP, changes to the percentage of material from a stockpile will be calculated based on the total aggregate weight including the weight of RAP.
    c. For High RAP/Any RAS mix designs, changes in the percentage of material from a stockpile will be based on total aggregate weight including the weight of RAP (and/or RAS when included in the mixture).

Prior to making any change in the amount of RAS in an approved mix design, notify the Engineer for determination of whether a new mix design is required, and obtain the Engineer's approval prior to implementing such changes.

5-04.2(2) Mix Design – Obtaining Project Approval

Use only mix designs listed on the Qualified Products List (QPL). Submit WSDOT Form 350-041 to the Engineer to request approval to use a mix design from the QPL. Changes to the job mix formula (JMF) that have been approved on other contracts may be included. The Engineer may reject a request to use a mix design if production of HMA using that mix design on any contract is not in compliance with Section 5-04.3(11)D, E, F, and G for mixture or compaction.

5-04.2(2)A Changes to the Job Mix Formula

The approved mix design obtained from the QPL will be considered the starting job mix formula (JMF) and shall be used as the initial basis for acceptance of HMA mixture, as detailed in Section 5-04.3(9).

During production the Contractor may request to adjust the JMF. Any adjustments to the JMF will require approval of the Engineer and shall be made in accordance with item 2 of Section 9-03.8(7). After approval by the Engineer, such adjusted JMFs shall constitute the basis for acceptance of the HMA mixture.

5-04.2(2)B Using HMA Additives

The Contractor may, at the Contractor's discretion, elect to use additives that reduce the optimum mixing temperature or serve as a compaction aid for producing HMA. Additives include organic additives, chemical additives, and foaming processes. The use of Additives is subject to the following:

- Do not use additives that reduce the mixing temperature in accordance with Section 5-04.3(6) in the production of High RAP/Any RAS mixtures.
- Before using additives, obtain the Engineer's approval using WSDOT Form 350-076 to describe the proposed additive and process.

5-04.3 Construction Requirements

5-04.3(1) Weather Limitations

Do not place HMA for wearing course on any Traveled Way beginning October 1st through March 31st of the following year, without written concurrence from the Engineer.

Do not place HMA on any wet surface, or when the average surface temperatures are less than those specified in Table 5, or when weather conditions otherwise prevent the proper handling or finishing of the HMA.

Table 5 Minimum Surface Temperature for Paving

Compacted Thickness (Feet)	Wearing Course	Other Courses
Less than 0.10	55°F	45°F
0.10 to 0.20	45°F	35°F
More than 0.20	35°F	35°F

5-04.3(2) Paving Under Traffic

These requirements apply when the Roadway being paved is open to traffic.

In hot weather, the Engineer may require the application of water to the pavement to accelerate the finish rolling of the pavement and to shorten the time required before reopening to traffic.

During paving operations, maintain temporary pavement markings throughout the project. Install temporary pavement markings on the Roadway prior to opening to traffic. Temporary pavement markings shall comply with Section 8-23.

5-04.3(3) Equipment

5-04.3(3)A Mixing Plant

Equip mixing plants as follows:

1. **Use tanks for storage and preparation of asphalt binder which:**
   - Heat the contents by means that do not allow flame to contact the contents or the tank, such as by steam or electricity.
   - Heat and hold contents at the required temperatures.
   - Continuously circulate contents to provide uniform temperature and consistency during the operating period.
   - Provide an asphalt binder sampling valve, in either the storage tank or the supply line to the mixer.
2. **Provide thermometric equipment:**
   - In the asphalt binder feed line near the charging valve at the mixer unit, capable of detecting temperature ranges expected in the HMA and in a location convenient and safe for access by Inspectors.
   - At the discharge chute of the drier to automatically register or indicate the temperature of the heated aggregates, and situated in full view of the plant operator.
3. **When heating asphalt binder:**
   - Do not exceed the maximum temperature of the asphalt binder recommended by the asphalt binder supplier.
   - Avoid local variations in heating.
   - Provide a continuous supply of asphalt binder to the mixer at a uniform average temperature with no individual variations exceeding 25°F.
4. **Provide a mechanical sampler for sampling mineral materials that:**
   - Meets the crushing or screening requirements of Section 1-05.6.
5. **Provide HMA sampling equipment that complies with FOP for AASHTO T 168:**
   - Use a mechanical sampling device accepted by the Engineer, or
   - Platforms or devices to enable sampling from the truck transport without entering the truck transport for sampling HMA.

6. **Provide for setup and operation of the Contracting Agency's field testing:**
   - As required in Section 3-01.2(2).
7. **Provide screens or a lump breaker:**
   - When using any RAP or any RAS, to eliminate oversize RAP or RAS particles from entering the pug mill or drum mixer.
8. Hydrated Lime Marination Treatment:
   - Wet cure the coarse aggregates with lime at a minimum rate of 1.00% of the mass of the dry aggregate. Wet cure the fine aggregate with lime at a minimum rate of 2.00% of the mass of the dry aggregate. Marinate (wet cure) the aggregate in stockpiles for a minimum of 48 hours. Fine aggregate stockpiles shall be defined as to have a minimum of 50% passing the No. 4 sieve. All other stockpiles shall be defined as coarse aggregate. Marinate stockpiles individually. Do not use the marination treatment process to combine stockpiles. Use the wet cured aggregate in stockpiles within 60 days. Protect stockpiles from weather events such as, but not limited to; rain, wind, and other weather events that will compromise the activated lime coating.
   - Before the introduction of the lime, add sufficient moisture by way of spray bars at the aggregate bins to bring the aggregate moisture content where enough free surface moisture is available to thoroughly wet the aggregate and activate the lime.
   - After the addition of water and lime, mix aggregate using horizontal twin-shaft pugmill with a minimum effective length of five feet.
   - Use mixing paddles which are adjustable for angular position on the shaft to permit altering of the mixing pattern or retarding the flow to insure that the aggregate is thoroughly coated with lime.
   - Do not extend the volume of material in the pugmill above the vertical position of the blade tips. Retard the flow of material through the pugmill by reversing a minimum of the last two rows of paddles or providing a material dam.
   - Draw lime from a storage facility in which the lime is agitated by air or other means to keep it in a uniform free flowing condition. Deliver the lime to the mixer from a positive weighing device which is interlocked, (actuate electric driven feeders from the same circuit) to the flow of each aggregate feed. Equip the lime feeder to provide a continuous uniform flow to within 5% of the required amount.
   - Calibrate the lime feeder at two different speeds (the lowest and highest speed of the anticipated operation) in relation to the speed of the aggregate feed. Use a target 1% lime for low speed tons per hour and 2% lime for high speed tons per hour. Provide an approved calibrated scale or weigh metering device to determine the actual mass of lime for each test. Furnish a test box having a sufficient capacity to perform the calibration testing. Calibrate the lime feed so the masses show on the metering device are within ± 5% of the weighed mass.

5-04.3(3)B Hauling Equipment

Provide HMA hauling equipment with tight, clean, smooth metal beds and a cover of canvas or other suitable material of sufficient size to protect the HMA from adverse weather. Securely attach the cover to protect the HMA whenever the weather conditions during the work shift include, or are forecast to include, precipitation or an air temperature less than 45°F.

Prevent HMA from adhering to the hauling equipment. Spray metal beds with an environmentally benign release agent. Drain excess release agent prior to filling hauling equipment with HMA. Do not use petroleum derivatives or other coating material that contaminate or alter the characteristics of the HMA. For hopper trucks, operate the conveyer during the process of applying the release agent.

5-04.3(3)C Pavers

Use self-contained, power-propelled pavers provided with an internally heated vibratory screed that is capable of spreading and finishing courses of HMA in lane widths required by the paving section shown in the Plans.

When requested by the Engineer, provide written certification that the paver is equipped with the most current equipment available from the manufacturer for the prevention of segregation of the coarse aggregate particles. The certification shall list the make, model, and year of the paver and any equipment that has been retrofitted to the paver.

Operate the screed in accordance with the manufacturer's recommendations and in a manner to produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the mixture. Provide a copy of the manufacturer's recommendations upon request by the Contracting Agency. Extensions to the screed will be allowed provided they produce the same results, including ride, density, and surface texture as obtained by the primary screed. In the Traveled Way do not use extensions without both augers and an internally heated vibratory screed.

Equip the paver with automatic screed controls and sensors for either or both sides of the paver. The controls shall be capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing automatic signals that operate the screed to maintain the desired grade and transverse slope. Construct the sensor so it will operate from a reference line or a mat referencing device. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

Equip the paver with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

Manual operation of the screed is permitted in the construction of irregularly shaped and minor areas. These areas include, but are not limited to, gore areas, road approaches, tapers and left-turn channelizations.

When specified in the Contract, provide reference lines for vertical control. Place reference lines on both outer edges of the Traveled Way of each Roadway. Horizontal

control utilizing the reference line is permitted. Automatically control the grade and slope of intermediate lanes by means of reference lines or a mat referencing device and a slope control device. When the finish of the grade prepared for paving is superior to the established tolerances and when, in the opinion of the Engineer, further improvement to the line, grade, cross-section, and smoothness can best be achieved without the use of the reference line, a mat referencing device may be substituted for the reference line. Substitution of the device will be subject to the continued approval of the Engineer. A joint matcher may be used subject to the approval of the Engineer. The reference line may be removed after completion of the first course of HMA when approved by the Engineer. Whenever the Engineer determines that any of these methods are failing to provide the necessary vertical control, the reference lines will be reinstalled by the Contractor.

Furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment.

If the paving machine in use is not providing the required finish, the Engineer may suspend Work as allowed by Section 1-08.6.

5-04.3(3)D Material Transfer Device or Material Transfer Vehicle

Use a material transfer device (MTD) or material transfer vehicle (MTV) to deliver the HMA from the hauling equipment to the paving machine for any lift in (or partially in) the top 0.30 feet of the pavement section used in traffic lanes. However, an MTD/V is not required for HMA placed in irregularly shaped and minor areas such as tapers and turn lanes, or for HMA mixture that is accepted by Visual Evaluation. At the Contractor's request the Engineer may approve paving without an MTD/V; the Engineer will determine if an equitable adjustment in cost or time is due. If a windrow elevator is used, the Engineer may limit the length of the windrow in urban areas or through intersections.

To be approved for use, an MTV:

1. Shall be self-propelled vehicle, separate from the hauling vehicle or paver.
2. Shall not be connected to the hauling vehicle or paver.
3. May accept HMA directly from the haul vehicle or pick up HMA from a windrow.
4. Shall mix the HMA after delivery by the hauling equipment and prior to placement into the paving machine.
5. Shall mix the HMA sufficiently to obtain a uniform temperature throughout the mixture.

To be approved for use, an MTD:

1. Shall be positively connected to the paver.
2. May accept HMA directly from the haul vehicle or pick up HMA from a windrow.
3. Shall mix the HMA after delivery by the hauling equipment and prior to placement into the paving machine.
4. Shall mix the HMA sufficiently to obtain a uniform temperature throughout the mixture.

5-04.3(3)E Rollers

Operate rollers in accordance with the manufacturer's recommendations. When requested by the Engineer, provide a Type 1 Working Drawing of the manufacturer's recommendation for the use of any roller planned for use on the project. Do not use rollers that crush aggregate, produce pickup or washboard, unevenly compact the surface, displace the mix, or produce other undesirable results.

5-04.3(4) Preparation of Existing Paved Surfaces

Before constructing HMA on an existing paved surface, the entire surface of the pavement shall be clean. Entirely remove all fatty asphalt patches, grease drippings, and other deleterious substances from the existing pavement to the satisfaction of the Engineer. Thoroughly clean all pavements or bituminous surfaces of dust, soil, pavement grindings, and other foreign matter. Thoroughly remove any cleaning or solvent type liquids used to clean equipment spilled on the pavement before paving proceeds. Fill all holes and small depressions with an appropriate class of HMA. Level and thoroughly compact the surface of the patched area.

Apply a uniform coat of asphalt (tack coat) to all paved surfaces on which any course of HMA is to be placed or abutted. Apply tack coat to cover the cleaned existing pavement with a thin film of residual asphalt free of streaks and bare spots. Apply a heavy application of tack coat to all joints. For Roadways open to traffic, limit the application of tack coat to surfaces that will be paved during the same working shift. Equip the spreading equipment with a thermometer to indicate the temperature of the tack coat material.

Do not operate equipment on tacked surfaces until the tack has broken and cured. Repair tack coat damaged by the Contractor's operation, prior to placement of the HMA.

Unless otherwise allowed by the Engineer, use cationic emulsified asphalt CSS-1, CSS-1h, or Performance Graded (PG) asphalt for tack coat. The CSS-1 and CSS-1h may be diluted with water at a rate not to exceed one part water to one part emulsified asphalt. Do not allow the tack coat material to exceed the maximum temperature recommended by the asphalt supplier.

When shown in the Plans, prelevel uneven or broken surfaces over which HMA is to be placed by using an asphalt paver, a motor patrol grader, or by hand raking, as approved by the Engineer.

5-04.3(4)A Crack Sealing

Crack sealing shall be in accordance with Section 5-03.

5-04.3(4)B Soil Residual Herbicide

Where shown in the Plans, apply one application of an approved soil residual herbicide. Comply with Section 8-02.3(3)B. Complete paving within 48 hours of applying the herbicide.

Use herbicide registered with the Washington State Department of Agriculture for use under pavement. Before use, obtain the Engineer's approval of the herbicide and the proposed rate of application. Include the following information in the request for approval of the material:

1. Brand Name of the Material,
2. Manufacturer,
3. Environmental Protection Agency (EPA) Registration Number,
4. Material Safety Data Sheet, and
5. Proposed Rate of Application.

5-04.3(4)C Pavement Repair

Excavate pavement repair areas and backfill these with HMA in accordance with the details shown in the Plans and as staked. Conduct the excavation operations in a manner that will protect the pavement that is to remain. Repair pavement not designated to be removed that is damaged as a result of the Contractor's operations to the satisfaction of the Engineer at no cost to the Contracting Agency. Excavate only within one lane at a time unless approved otherwise by the Engineer. Do not excavate more area than can be completely backfilled and compacted during the same shift.

Unless otherwise shown in the Plans or determined by the Engineer, excavate to a depth of 1.0 feet. The Engineer will make the final determination of the excavation depth required.

The minimum width of any pavement repair area shall be 40 inches unless shown otherwise in the Plans. Before any excavation, sawcut the perimeter of the pavement area to be removed unless the pavement in the pavement repair area is to be removed by a pavement grinder.

Excavated materials shall be the property of the Contractor and shall be disposed of in a Contractor-provided site off the Right of Way or used in accordance with Sections 2-02.3(3) or 9-03.21.

Apply a heavy application of tack coat to all surfaces of existing pavement in the pavement repair area, in accordance with Section 5-04.3(4).

Place the HMA backfill in lifts not to exceed 0.35-foot compacted depth. Thoroughly compact each lift by a mechanical tamper or a roller.

5-04.3(5) Producing/Stockpiling Aggregates, RAP, & RAS

Produce aggregate in compliance with Section 3-01. Comply with Section 3-02 for preparing stockpile sites, stockpiling, and removing from stockpile each of the following: aggregates, RAP, and RAS. Provide sufficient storage space for each size of aggregate, RAP and RAS. Fine aggregate or RAP may be uniformly blended with the RAS as a method of preventing the agglomeration of RAS particles. Remove the aggregates, RAP and RAS from stockpile(s) in a manner that ensures minimal segregation when being moved to the HMA plant for processing into the final mixture. Keep different aggregate sizes separated until they have been delivered to the HMA plant.

When hydrated lime is required by use of the marination treatment, the aggregates shall be stockpiled in accordance with Section 5-04.3(3)A.

5-04.3(5)A Stockpiling RAP or RAS for High RAP/Any RAS Mixes

Do not place any RAP or RAS into a stockpile which has been sequestered for a High RAP/Any RAS mix design. Do not incorporate any RAP or RAS into a High RAP/Any RAS mixture from any source other than the stockpile which was sequestered for approval of that particular High RAP/Any RAS mix design.

RAP that is used in a Low RAP/No RAS mix is not required to come from a sequestered stockpile.

5-04.3(6) Mixing

The asphalt supplier shall introduce recycling agent and anti-stripping additive, in the amount designated on the QPL for the mix design, into the asphalt binder prior to shipment to the asphalt mixing plant.

Anti-strip is not required for temporary work that will be removed prior to Physical Completion.

Use asphalt binder of the grade, and from the supplier, in the approved mix design.

Prior to introducing reclaimed materials into the asphalt plant, remove wire, nails, and other foreign material. Discontinue use of the reclaimed material if the Engineer, in their sole discretion, determines the wire, nails, or other foreign material to be excessive.

Size RAP and RAS prior to entering the mixer to provide uniform and thoroughly mixed HMA. If there is evidence of the RAP or RAS not breaking down during the heating and mixing of the HMA, immediately suspend the use of the RAP or RAS until changes have been approved by the Engineer.

After the required amount of mineral materials, RAP, RAS, new asphalt binder and recycling agent have been introduced into the mixer, mix the HMA until complete and uniform coating of the particles and thorough distribution of the asphalt binder throughout the mineral materials, RAP and RAS is ensured.

Upon discharge from the mixer, ensure that the temperature of the HMA does not exceed the optimum mixing temperature shown on the accepted Mix Design Report by more

than 25°F, or as allowed by the Engineer. When an additive is included in the manufacture of HMA, do not heat the additive (at any stage of production including in binder storage tanks) to a temperature higher than the maximum recommended by the manufacturer of the additive.

A maximum water content of 2 percent in the mix, at discharge, will be allowed providing the water causes no problems with handling, stripping, or flushing. If the water in the HMA causes any of these problems, reduce the moisture content.

During the daily operation, HMA may be temporarily held in approved storage facilities. Do not incorporate HMA into the Work that has been held for more than 24 hours after mixing. Provide an easily readable, low bin-level indicator on the storage facility that indicates the amount of material in storage. Waste the HMA in storage when the top level of HMA drops below the top of the cone of the storage facility, except as the storage facility is being emptied at the end of the working shift. Dispose of rejected or waste HMA at no expense to the Contracting Agency.

5-04.3(7) Spreading and Finishing

Do not exceed the maximum nominal compacted depth of any layer in any course, as shown in Table 6, unless approved by the Engineer:

Table 6 Maximum Nominal Compacted Depth of Any Layer

HMA Class	Wearing Course	Other than Wearing Course
1 inch	0.35 feet	0.35 feet
¾ and ½ inch	0.30 feet	0.35 feet
⅜ inch	0.25 feet	0.30 feet

Use HMA pavers complying with Section 5-04.3(3) to distribute the mix. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other equipment or by hand.

When more than one JMF is being utilized to produce HMA, place the material produced for each JMF with separate spreading and compacting equipment. Do not intermingle HMA produced from more than one JMF. Each strip of HMA placed during a work shift shall conform to a single JMF established for the class of HMA specified unless there is a need to make an adjustment in the JMF.

5-04.3(8) Aggregate Acceptance Prior to Incorporation in HMA

Sample aggregate for meeting the requirements of Section 3-04 prior to being incorporated into HMA. (The acceptance data generated for the Section 3-04 acceptance analysis will not be commingled with the acceptance data generated for the Section 5-04.3(9) acceptance analysis.) Aggregate acceptance samples shall be taken as described in Section 3-04. Aggregate acceptance testing will be performed by the Contracting Agency. Aggregate contributed from RAP and/or RAS will not be evaluated under Section 3-04.

The Contracting Agency's combined aggregate bulk specific gravity (Gsb) blend as shown on the HMA Mix Design will be used for VMA calculations until the Contractor submits a written request for a Gsb test. The new Gsb will be used in the VMA calculations for HMA from the date the Project Engineer receives the written request for a Gsb retest. The Contractor may request aggregate specific gravity (Gsb) testing be performed by the Contracting Agency twice per project. The Gsb blend of the combined stockpiles will be used to calculate voids in mineral aggregate (VMA) of any HMA produced after the new Gsb is determined.

For aggregate that will be used in HMA mixture which will be accepted by Statistical Evaluation, the Contracting Agency's acceptance of the aggregate will be based on:

1. Samples taken prior to mixing with asphalt binder, RAP, or RAS;
2. Testing for the materials properties of fracture, uncompacted void content, and sand equivalent;
3. Evaluation by the Contracting Agency in accordance with Section 3-04, including price adjustments as described therein.

For aggregate that will be used in HMA which will be accepted by Visual Evaluation, evaluation in accordance with items 1, 2, and 3 above is at the discretion of the Engineer.

5-04.3(9) HMA Mixture Acceptance

The Contracting Agency will evaluate HMA mixture for acceptance by one of two methods as determined from the criteria in Table 7.

Table 7 Basis of Acceptance for HMA Mixture

	Visual Evaluation	Statistical Evaluation
Criteria for Selecting the Evaluation Method	• HMA and Commercial HMA placed in the following locations: – sidewalks – road approaches – ditches – slopes – paths – trails – gores – prelevel – temporary pavement[1] – pavement repair	• All HMA mixture other than that accepted by Visual Evaluation

[1] Temporary pavement is HMA that will be removed before Physical Completion of the Contract.

5-04.3(9)A Test Sections

This section applies to HMA mixture accepted by Statistical Evaluation. A test section is not allowed for HMA accepted by Visual Evaluation.

The purpose of a test section is to determine whether or not the Contractor's mix design and production processes will produce HMA meeting the Contract requirements related to mixture. Construct HMA mixture test sections at the beginning of paving, using at least 600 tons and a maximum of 1,000 tons or as specified by the Engineer. Each test section shall be constructed in one continuous operation.

5-04.3(9)A1 Test Section – When Required, When to Stop

Use Tables 8 and 9 to determine when a test section is required, optional, or not allowed, and to determine when performing test sections may end. Each mix design will be evaluated independently for the test section requirements.

If more than one test section is required, each test section shall be evaluated separately by the criteria in Tables 8 and 9.

Table 8 Criteria for Conducting and Evaluating HMA Mixture Test Sections (For HMA Mixture Accepted by Statistical Evaluation)

	High RAP/Any RAS	Low RAP/No RAS
Is Mixture Test Section Optional or Mandatory?	Mandatory[1]	At Contractor's Option
Waiting period after paving the test section.	4 calendar days[2]	4 calendar days[2]
What Must Happen to Stop Performing Test Sections?	Meet "Results Required to Stop Performing Test Sections" in Table 9 for High RAP/Any RAS.	Provide samples and respond to WSDOT test results required by Table 9 for Low RAP/No RAS.

[1] If a mix design has produced an acceptable test section on a previous contract (paved in the same calendar year, from the same plant, using the same JMF) the test section may be waived if approved by the Engineer.

[2] This is to provide time needed by the Contracting Agency to complete testing and the Contractor to adjust the mixture in response to those test results. Paving may resume when this is done.

Table 9 Results Required to Stop Performing HMA Mixture Test Sections[1] (For HMA Mixture Accepted by Statistical Evaluation)

Test Property	Type of HMA	
	High RAP/Any RAS	Low RAP/No RAS
Gradation	Minimum PF_i of 0.95 based on the criteria in Section 5-04.3(9)B4[2]	None[4]
Asphalt Binder	Minimum PF_i of 0.95 based on the criteria in Section 5-04.3(9)B4[2]	None[4]
VMA	Minimum PF_i of 0.95 based on the criteria in Section 5-04.3(9)B4[2]	None[4]
V_a	Minimum PF_i of 0.95 based on the criteria in Section 5-04.3(9)B4[2]	None[4]
Hamburg Wheel Track Indirect Tensile Strength	Meet requirements of Section 9-03.8(2)[2]	These tests will not be done as part of Test Section.
Aggregates Sand Equivalent Uncompacted Void Content Fracture	Nonstatistical Evaluation in accordance with the requirements of Section 3-04[3]	None[3]

[1] In addition to the requirements of this table, acceptance of the HMA mixture used in each test section is subject to the acceptance criteria and price adjustments for Statistical Evaluation (see Table 9a in Section 5-04.3(9)A2).

[2] Divide the test section lot into three sublots, approximately equal in size. Take one sample from each sublot, and test each sample for the properties in the first column.

[3] Take one sample for each test section lot. Test the sample for the property in the first column.

[4] Divide the test section lot into three sublots, approximately equal in size. Take one sample from each sublot, and test each sample for the property in the first column. There are no criteria for discontinuing test sections for these mixes; however, the contractor must comply with Section 5-04.3(11)F before resuming paving.

5-04.3(9)A2 Test Section – Evaluating the HMA Mixture in a Test Section

The Engineer will evaluate the HMA mixture in each test section for rejection, acceptance, and price adjustments based on the criteria in Table 9a using the data generated from the testing required by Table 9 in Section 5-04.3(9)A1. Each test section shall be considered a separate lot.

Table 9a Acceptance Criteria for HMA Mixture Placed in a Test Section (For HMA Mixture Accepted by Statistical Evaluation)

Test Property	Type of HMA	
	High RAP/Any RAS	Low RAP/No RAS
Gradation, Asphalt Binder, VMA and V_a	Statistical Evaluation	Statistical Evaluation
Hamburg Wheel Track Indirect Tensile Strength	Pass/Fail for the requirements of Section 9-03.8(2)[1]	N/A
Aggregates Sand Equivalent Uncompacted Void Content Fracture	Nonstatistical Evaluation in accordance with the requirements of Section 3-04	Nonstatistical Evaluation in accordance with the requirements of Section 3-04

[1]Failure to meet the specifications for Hamburg and/or IDT will cause the mixture in the test section to be rejected.
Refer to Section 5-04.3(11).

5-04.3(9)B Mixture Acceptance – Statistical Evaluation

5-04.3(9)B1 Mixture Statistical Evaluation – Lots and Sublots

HMA mixture which is accepted by Statistical Evaluation will be evaluated by the Contracting Agency dividing that HMA tonnage into mixture lots, and each mixture lot will be evaluated using stratified random sampling by the Contracting Agency sub-dividing each mixture lot into mixture sublots. All mixture in a mixture lot shall be of the same mix design. The mixture sublots will be numbered in the order in which the mixture (of a particular mix design) is paved.

Each mixture lot comprises a maximum of 15 mixture sublots, except:

- The final mixture lot of each mix design on the Contract will comprise a maximum of 25 sublots.
- A mixture lot for a test section will consist of three sublots.

Each mixture sublot shall be approximately uniform in size with the maximum mixture sublot size as specified in Table 10. The quantity of material represented by the final mixture sublot of the project, for each mix design on the project, may be increased to a maximum of two times the mixture sublot quantity calculated.

Table 10 Maximum HMA Mixture Sublot Size For HMA Accepted by Statistical Evaluation

HMA Original Plan Quantity (tons)[1]	Maximum Sublot Size (tons)[2]
< 20,000	1,000
20,000 to 30,000	1,500
>30,000	2,000

[1]"Plan quantity" means the plan quantity of all HMA of the same class and binder grade which is accepted by Statistical Evaluation.

[2]The maximum sublot size for each combination of HMA class and binder grade shall be calculated separately.

- For a mixture lot in progress with a mixture CPF less than 0.75, a new mixture lot will begin at the Contractor's request after the Engineer is satisfied that material conforming to the Specifications can be produced. See also Section 5-04.3(11)F.
- If, before completing a mixture lot, the Contractor requests a change to the JMF which is approved by the Engineer, the mixture produced in that lot after the approved change will be evaluated on the basis of the changed JMF, and the mixture produced in that lot before the approved change will be evaluated on the basis of the unchanged JMF; however, the mixture before and after the change will be evaluated in the same lot. Acceptance of subsequent mixture lots will be evaluated on the basis of the changed JMF.

5-04.3(9)B2 Mixture Statistical Evaluation – Sampling

Comply with Section 1-06.2(1).

Samples of HMA mixture which is accepted by Statistical Evaluation will be randomly selected from within each sublot, with one sample per sublot. The Engineer will determine the random sample location using WSDOT Test Method T 716. The Contractor shall obtain the sample when ordered by the Engineer. The Contractor shall sample the HMA mixture in the presence of the Engineer and in accordance with FOP for AASHTO 168.

5-04.3(9)B3 Mixture Statistical Evaluation – Acceptance Testing

Comply with Section 1-06.2(1).

The Contracting Agency will test the mixture sample from each sublot (including sublots in a test section) for the properties shown in Table 11.

Table 11 Testing Required for each HMA Mixture Sublot

Test	Procedure	Performed by
VMA and V_a	WSDOT SOP 731	Engineer
Asphalt Binder Content	FOP for AASHTO T 308	Engineer
Gradation: percent Passing 1½″, 1″, ¾″, ½″, ⅜″, No. 4, No. 8, No. 200	FOP for AASHTO T 30/T 11	Engineer

The mixture samples and tests taken for the purpose of determining acceptance of the test section (as described in Section 5-04.3(9)A) shall also be used as the test results for acceptance of the mixture described in Sections 5-04.3(9)B3, 5-04.3(9)B4, 5-04.3(9)B5, and 5-04.3(9)B6.

5-04.3(9)B4 Mixture Statistical Evaluation – Pay Factors

Comply with Section 1-06.2(2).

The Contracting Agency will determine a pay factor (PF_i) for each of the properties in Table 11 of Section 5-04.3(9)B3, for each mixture lot, using the quality level analysis in Section 1-06.2(2)D. For Gradation, a pay factor will be calculated for each of the sieve sizes listed in Table 11 of Section 5-04.3(9)B3, which is equal to or smaller than the maximum allowable aggregate size (100 percent passing sieve) of the HMA mixture. The USL and LSL shall be calculated using the Job Mix Formula Tolerances (for Statistical Evaluation) in Section 9-03.8(7).

If a constituent is not measured in accordance with these Specifications, its individual pay factor will be considered 1.00 in calculating the Composite Pay Factor (CPF).

5-04.3(9)B5 Mixture Statistical Evaluation – Composite Pay Factors (CPF)

Comply with Section 1-06.2(2).

In accordance with Section 1-06.2(2)D4, the Contracting Agency will determine a Composite Pay Factor (CPF) for each mixture lot from the pay factors calculated in Section 5-04.3(9)B4, using the price adjustment factors in Table 12. Unless otherwise specified, the maximum CPF for HMA mixture shall be 1.05.

Table 12 HMA Mixture Price Adjustment Factors

Constituent	Factor "f"
All aggregate passing: 1½″, 1″, ¾″, ½″, ⅜″ and No.4 sieves	2
All aggregate passing No. 8 sieve	15
All aggregate passing No. 200 sieve	20
Asphalt binder	40
Voids in Mineral Aggregate (VMA)	10
Air Voids (V_a)	20

5-04.3(9)B6 Mixture Statistical Evaluation – Price Adjustments

For each HMA mixture lot, a Job Mix Compliance Price Adjustment will be determined and applied, as follows:

$$JMCPA = [0.60 \times (CPF - 1.00)] \times Q \times UP$$

Where

JMCPA = Job Mix Compliance Price Adjustment for a given lot of mixture ($)
CPF = Composite Pay Factor for a given lot of mixture (maximum is 1.05)
Q = Quantity in a given lot of mixture (tons)
UP = Unit price of the HMA in a given lot of mixture ($/ton)

5-04.3(9)B7 Mixture Statistical Evaluation – Retests

The Contractor may request that a mixture sublot be retested. To request a retest, submit a written request to the Contracting Agency within 7 calendar days after the specific test results have been posted to the website or emailed to the Contractor, whichever occurs first. The Contracting Agency will send a split of the original acceptance sample for testing by the Contracting Agency to either the Region Materials Laboratory or the State Materials Laboratory as determined by the Engineer. The Contracting Agency will not test the split of the sample with the same equipment or by the same tester that ran the original acceptance test. The sample will be tested for a complete gradation analysis, asphalt binder content, VMA and V_a, and the results of the retest will be used for the acceptance of the HMA mixture in place of the original mixture sublot sample test results. The cost of testing will be deducted from any monies due or that may come due the Contractor under the Contract at the rate of $250 per sample.

5-04.3(9)C Vacant

5-04.3(9)D Mixture Acceptance – Visual Evaluation

Visual Evaluation of HMA mixture will be by visual inspection by the Engineer or, in the sole discretion of the Engineer, the Engineer may sample and test the mixture.

5-04.3(9)D1 Mixture Visual Evaluation – Lots, Sampling, Testing, Price Adjustments

HMA mixture accepted by Visual Evaluation will not be broken into lots unless the Engineer determines that testing is required. When that occurs, the Engineer will identify the limits of the questionable HMA mixture, and that questionable HMA mixture shall constitute a lot. Then, the Contractor will take samples from the truck, or the Engineer will take core samples from the roadway at a minimum of three random locations from within the lot, selected in accordance with WSDOT Test Method T 716, taken from the roadway in accordance with WSDOT SOP 734, and tested in accordance with WSDOT SOP 737. The Engineer will test one of the samples for all constituents in Section 5-04.3(9)B3. If all constituents from that test fall within the Job Mix Formula Tolerances (for Visual Evaluation) in Section 9-03.8(7), the lot will be accepted at the unit Contract price with no further evaluation.

When one or more constituents fall outside those tolerance limits, the other samples will be tested for all constituents in Section 5-04.3(9)B3, and a Job Mix Compliance Price Adjustment will be calculated in accordance with Table 13.

Table 13 Visual Evaluation – Out of Tolerance Procedures

Comply with the Following[1]	
Pay Factors[1]	Section 5-04.3(9)B4
Composite Pay Factors[2]	Section 5-04.3(9)B5
Price Adjustments	Section 5-04.3(9)B6

[1]The Visual Evaluation tolerance limits in Section 9-03.8(7) will be used in the calculation of the PF_i.

[2]The maximum CPF shall be 1.00.

5-04.3(9)E Mixture Acceptance – Notification of Acceptance Test Results

The results of all mixture acceptance testing and the Composite Pay Factor (CPF) of the lot after three sublots have been tested will be available to the Contractor through the Contracting Agency's website.

The Contracting Agency will endeavor to provide written notification (via email to the Contractor's designee) of acceptance test results through its web-based materials testing system Statistical Analysis of Materials (SAM) within 24 hours of the sample being made available to the Contracting Agency. However, the Contractor agrees:

1. Quality control, defined as the system used by the Contractor to monitor, assess, and adjust its production processes to ensure that the final HMA mixture will meet the specified level of quality, is the sole responsibility of the Contractor.
2. The Contractor has no right to rely on any testing performed by the Contracting Agency, nor does the Contractor have any right to rely on timely notification by the Contracting Agency of the Contracting Agency's test results (or statistical analysis thereof), for any part of quality control and/or for making changes or correction to any aspect of the HMA mixture.
3. The Contractor shall make no claim for untimely notification by the Contracting Agency of the Contracting Agency's test results or statistical analysis.

5-04.3(10) HMA Compaction Acceptance

For all HMA, the Contractor shall comply with the General Compaction Requirements in Section 5-04.3(10)A. The Contracting Agency will evaluate all HMA for compaction compliance with one of the following - Statistical Evaluation, Visual Evaluation, or Test Point Evaluation - determined by the criteria in Table 14:

Table 14 Criteria for Determining Method of Evaluation for HMA Compaction[1]

Statistical Evaluation of HMA Compaction is Required For:	Visual Evaluation of HMA Compaction is Required For:	Test Point Evaluation of HMA Compaction is Required For:
• Any HMA for which the specified course thickness is greater than 0.10 feet, and the HMA is in: – traffic lanes, including but not limited to: • ramp lanes • truck climbing lanes • weaving lanes • speed change lanes	• "HMA for Preleveling…" • "HMA for Pavement Repair…"	• Any HMA not meeting the criteria for Statistical Evaluation or Visual Evaluation

[1] This table applies to all HMA, and shall be the sole basis for determining the acceptance method for compaction.

The Contracting Agency may, at its sole discretion, evaluate any HMA for compliance with the Cyclic Density requirements of Section 5-04.3(10)B.

5-04.3(10)A HMA Compaction – General Compaction Requirements

Immediately after the HMA has been spread and struck off, and after surface irregularities have been adjusted, thoroughly and uniformly compact the mix. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, and irregularities and shall conform to the line, grade, and cross-section shown in the Plans. If necessary, alter the JMF in accordance with Section 9-03.8(7) to achieve desired results.

Compact the mix when it is in the proper condition so that no undue displacement, cracking, or shoving occurs. Compact areas inaccessible to large compaction equipment by mechanical or hand tampers. Remove HMA that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way defective. Replace the removed material with new HMA, and compact it immediately to conform to the surrounding area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided the specified densities are attained. An exception shall be that pneumatic tired rollers shall be used for compaction of the wearing course beginning October 1st of any year through March 31st of the following year. Coverage with a steel wheel roller may precede pneumatic tired rolling. Unless otherwise approved by the Engineer, operate rollers in the static mode when the internal temperature of the mix is less than 175°F. Regardless of mix temperature, do not operate a roller in a mode that results in checking or cracking of the mat.

On bridge decks and on roadway approaches within five feet of a bridge/back of pavement seat, rollers shall not be operated in a vibratory mode, defined as a mode in which the drum vibrates vertically. However, unless otherwise noted on the plans, rollers may be operated in an oscillatory mode, defined as a mode in which the drum vibrates in the horizontal direction only.

5-04.3(10)B HMA Compaction – Cyclic Density

Low cyclic density areas are defined as spots or streaks in the pavement that are less than 90 percent of the theoretical maximum density. At the Engineer's discretion, the Engineer may evaluate the HMA pavement for low cyclic density, and when doing so will follow WSDOT SOP 733. A $500 Cyclic Density Price Adjustment will be assessed for any 500-foot section with two or more density readings below 90 percent of the theoretical maximum density.

5-04.3(10)C HMA Compaction Acceptance – Statistical Evaluation

HMA compaction which is accepted by Statistical Evaluation will be based on acceptance testing performed by the Contracting Agency, and statistical analysis of those acceptance tests results. This will result in a Compaction Price Adjustment.

5-04.3(10)C1 HMA Compaction Statistical Evaluation – Lots and Sublots

HMA compaction which is accepted by Statistical Evaluation will be evaluated by the Contracting Agency dividing the project into compaction lots, and each compaction lot will be evaluated using stratified random sampling by the Contracting Agency sub-dividing each compaction lot into compaction sublots. All mixture in any individual compaction lot shall be of the same mix design. The compaction sublots will be numbered in the order in which the mixture (of a particular mix design) is paved.

Each compaction lot comprises a maximum of 15 compaction sublots, except for the final compaction lot of each mix design on the Contract, which comprises a maximum of 25 sublots.

Each compaction sublot shall be uniform in size as shown in Table 15, except that the last compaction sublot of each day may be increased to a maximum of two times the compaction sublot quantity calculated. Minor variations in the size of any sublot shall not be cause to invalidate the associated test result.

Table 15 HMA Compaction Sublot Size

HMA Original Plan Quantity (tons)[1]	Compaction Sublot Size (tons)
<20,000	100
20,000 to 30,000	150
>30,000	200

[1]In determining the plan quantity tonnage, do not include any tons accepted by test point evaluation.

The following will cause one compaction lot to end prematurely and a new compaction lot to begin:

- For a compaction lot in progress with a compaction CPF less than 0.75 using an LSL = 91.5, a new compaction lot will begin at the Contractor's request after the Engineer is satisfied that material conforming to the Specifications can be produced. See also Section 5-04.3(11)F.

All HMA which is paved on a bridge and accepted for compaction by Statistical Evaluation will compose a bridge compaction lot. If the contract includes such HMA on more than one bridge, compaction will be evaluated on each bridge individually, as separate bridge compaction lots.

Bridge compaction sublots will be determined by the Engineer subject to the following:

- All sublots on a given bridge will be approximately the same size.
- Sublots will be stratified from the lot.
- In no case will there be less than 3 sublots in each bridge compaction lot.
- No sublot will exceed 50 tons.
- Compaction test locations will be determined by the Engineer in accordance with WSDOT Test Method T 716.

5-04.3(10)C2 HMA Compaction Statistical Evaluation – Acceptance Testing

Comply with Section 1-06.2(1).

The location of HMA compaction acceptance tests will be randomly selected by the Contracting Agency from within each sublot, with one test per sublot. The Contracting Agency will determine the random sample location using WSDOT Test Method T 716.

Use Table 16 to determine compaction acceptance test procedures and to allocate compaction acceptance sampling and testing responsibilities between the Contractor and the Contracting Agency. HMA cores shall be taken or nuclear density testing shall occur after completion of the finish rolling, prior to opening to traffic, and on the same day that the mix is placed.

Table 16 HMA Compaction Acceptance Testing Procedures and Responsibilities

	When Contract Includes Bid Item "HMA Core – Roadway" or "HMA Core – Bridge"[4]	When Contract Does Not Include Bid Item "HMA Core – Roadway" or "HMA Core – Bridge"[4]	
Basis for Test:	Cores	Cores[3]	Nuclear Density Gauge[3]
In-Place Density Determined by:	Contractor shall take cores[1] using WSDOT SOP 734[2] ——— Contracting Agency will determine core density using FOP for AASHTO T 166	Contracting Agency will take cores[1] using WSDOT SOP 734 ——— Contracting Agency will determine core density using FOP for AASHTO T 166	Contracting Agency, using FOP for AASHTO T 355
Theoretical Maximum Density Determined by:	Contracting Agency, using FOP for AASHTO T 209		
Rolling Average of Theoretical Maximum Densities Determined by:	Contracting Agency, using WSDOT SOP 729		
Percent Compaction in Each Sublot Determined by:	Contracting Agency, using WSDOT SOP 736	Contracting Agency, using WSDOT SOP 736	Contracting Agency, using FOP for AASHTO T 355

[1] The core diameter shall be 4-inches unless otherwise approved by the Engineer.

[2] The Contractor shall take the core samples in the presence of the Engineer, at locations designated by the Engineer, and deliver the core samples to the Contracting Agency.

[3] The Contracting Agency will determine, in its sole discretion, whether it will take cores or use the nuclear density gauge to determine in-place density. Exclusive reliance on cores for density acceptance is generally intended for small paving projects and is not intended as a replacement for nuclear gauge density testing on typical projects.

[4] The basis for test of all compaction sublots in a bridge compaction lot shall be cores. These cores shall be taken by the Contractor when the Proposal includes the bid item "HMA Cores – Bridge". When there is no bid item for "HMA Cores – Bridge", the Engineer will be responsible for taking HMA cores for all compaction sublots in a bridge compaction lot. In either case, the Engineer will determine core location, in-place density of the core, theoretical maximum density, rolling average of theoretical maximum density, and percent compaction using the procedure called for in this section.

When using the nuclear density gauge for acceptance testing of pavement density, the Engineer will follow WSDOT SOP 730 for correlating the nuclear gauge with HMA cores. When cores are required for the correlation, coring and testing will be by the Contracting Agency. When a core is taken for gauge correlation at the location of a sublot, the relative density of the core will be used for the sublot test result and is exempt from retesting.

5-04.3(10)C3 HMA Statistical Compaction – Price Adjustments

For each HMA compaction lot (that is accepted by Statistical Evaluation) which has less than three compaction sublots, for which all compaction sublots attain a minimum of 92 percent compaction determined in accordance with FOP for AASHTO T 355 (or WSDOT SOP 736 when provided by the Contract), the HMA will be accepted at the unit Contract price with no further evaluation.

For each HMA compaction lot (that is accepted by Statistical Evaluation) which does not meet the criteria in the preceding paragraph, the compaction lot shall be evaluated in accordance with Section 1-06.2(2)D5 to determine the appropriate Composite Pay Factor (CPF). All of the test results obtained from the acceptance samples from a given compaction lot shall be evaluated collectively. Additional testing by either a nuclear density gauge or cores will be completed as required to provide a minimum of three tests for evaluation.

For the statistical analysis in Section 1-06.2, use the following values:

x = percent compaction for each sublot
USL = 100
LSL = 92

Determine the Compaction Price Adjustment (CPA) from the table below, selecting the equation for CPA that corresponds to the value of CPF determined above.

Calculating HMA Compaction Price Adjustment (CPA)

Value of CPF	Equation for Calculating CPA
When CPF > 1.00	CPA = [1.00 x (CPF – 1.00)] x Q x UP
When CPF = 1.00	CPA = $0
When CPF < 1.0	CPA = [0.40 x (CPF – 1.00)] x Q x UP

Where

CPA = Compaction Price Adjustment for the compaction lot ($)
CPF = Composite Pay Factor for the compaction lot (maximum is 1.05)
Q = Quantity in the compaction lot (tons)
UP = Unit price of the HMA in the compaction lot ($/ton)

5-04.3(10)C4 HMA Statistical Compaction – Requests for Retesting

For a compaction sublot that has been tested with a nuclear density gauge that did not meet the minimum of 92.0 percent of the theoretical maximum density in a compaction lot with a CPF below 1.00 and thus subject to a price reduction or rejection, the Contractor may request that a core, taken at the same location as the nuclear density test, be used for determination of the relative density of the compaction sublot. The relative density of the core will replace the relative density determined by the nuclear density gauge for the compaction sublot and will be used for calculation of the CPF and acceptance of HMA compaction lot. When cores are taken by the Contracting Agency at the request of the Contractor, they shall be requested by noon of the next workday after the test results for the compaction sublot have been provided or made available to

the Contractor. Traffic control shall be provided by the Contractor as requested by the Engineer. Failure by the Contractor to provide the requested traffic control will result in forfeiture of the request for retesting. When the CPF for the compaction lot based on the results of the cores is less than 1.00, the Contracting Agency will deduct the cost for the coring from any monies due or that may become due the Contractor under the Contract at the rate of $200 per core and the Contractor shall pay for the cost of the traffic control.

5-04.3(10)D HMA Compaction – Visual Evaluation

Visual Evaluation will be the basis of acceptance for compaction of the Bid items "HMA for Pavement Repair Cl. ___ PG ___" and "HMA for Prelevelling Class___ PG___". This HMA shall be thoroughly compacted to the satisfaction of the Engineer. HMA that is used to prelevel wheel ruts shall be compacted with a pneumatic tire roller.

5-04.3(10)E HMA Compaction – Test Point Evaluation

When compaction acceptance is by Test Point Evaluation, compact HMA based on a test point evaluation of the compaction train. Perform the test point evaluation in accordance with instructions from the Engineer. The number of passes with an approved compaction train, required to attain the maximum test point density, shall be used on all subsequent paving.

5-04.3(10)F HMA Compaction Acceptance – Notification of Acceptance Test Results

The obligations and responsibilities for notifying the Contractor of compaction acceptance test results are the same as for mixture acceptance test results. See Section 5-04.3(9)E.

5-04.3(11) Reject Work

This section applies to HMA and all requirements related to HMA (except aggregates prior to being incorporated into HMA). For rejection of aggregate prior to its incorporation into HMA refer to Section 3-04.

5-04.3(11)A Reject Work – General

Work that is defective or does not conform to Contract requirements shall be rejected. The Contractor may propose, in writing, alternatives to removal and replacement of rejected material. Acceptability of such alternative proposals will be determined at the sole discretion of the Engineer.

5-04.3(11)B Rejection by Contractor

The Contractor may, prior to acceptance sampling and testing, elect to remove any defective material and replace it with new material. Any such new material will be sampled, tested, and evaluated for acceptance.

5-04.3(11)C Rejection Without Testing (Mixture or Compaction)

The Engineer may, without sampling, reject any batch, load, or section of Roadway that appears defective. Material rejected before placement shall not be incorporated into the pavement.

No payment will be made for the rejected materials or the removal of the materials unless the Contractor requests the rejected material to be tested. If the Contractor requests testing, acceptance will be by Statistical Evaluation, and a minimum of three samples will be obtained and tested. When uncompacted material is required for testing but not available, the Engineer will determine random sample locations on the roadway in accordance with WSDOT Test Method T 716, take cores in accordance with WSDOT SOP 734, and test the cores in accordance with WSDOT SOP 737.

If the CPF for the rejected material is less than 0.75, no payment will be made for the rejected material; in addition, the cost of sampling and testing shall be borne by the Contractor. If the CPF is greater than or equal to 0.75, the cost of sampling and testing will be borne by the Contracting Agency. If the material is rejected before placement and the CPF is greater than or equal to 0.75, compensation for the rejected material will be at a CPF of 0.75. If rejection occurs after placement and the CPF is greater than or equal to 0.75, compensation for the rejected material will be at the calculated CPF with an addition of 25 percent of the unit Contract price added for the cost of removal and disposal.

5-04.3(11)D Rejection – A Partial Sublot (Mixture or Compaction)

In addition to the random acceptance sampling and testing, the Engineer may also isolate from a mixture or compaction sublot any material that is suspected of being defective in relative density, gradation or asphalt binder content. Such isolated material will not include an original sample location. The Contracting Agency will obtain a minimum of three random samples of the suspect material and perform the testing. When uncompacted material is required for testing but is not available, the Engineer will select random sample locations on the roadway in accordance with WSDOT Test Method T 716, take cores samples in accordance with WSDOT SOP 734, and test the material in accordance with WSDOT SOP 737. The material will then be statistically evaluated as an independent lot in accordance with Section 1-06.2(2).

5-04.3(11)E Rejection – An Entire Sublot (Mixture or Compaction)

An entire mixture or compaction sublot that is suspected of being defective may be rejected. When this occurs, a minimum of two additional random samples from this sublot will be obtained. When uncompacted material is required for the additional samples but the material has been compacted, the Contracting Agency will take and test cores from the roadway as described in Section 5-04.3(11)D. The additional samples and the original sublot will be evaluated as an independent lot in accordance with Section 1-06.2(2).

5-04.3(11)F Rejection - A Lot in Progress (Mixture or Compaction)

The Contractor shall shut down operations and shall not resume HMA placement until such time as the Engineer is satisfied that material conforming to the Specifications can be produced when:

1. the Composite Pay Factor (CPF) of a mixture or compaction lot in progress drops below 1.00 and the Contractor is taking no corrective action, or
2. the Pay Factor (PF_i) for any constituent of a mixture or compaction lot in progress drops below 0.95 and the Contractor is taking no corrective action, or
3. either the PF_i for any constituent (or the CPF) of a mixture or compaction lot in progress is less than 0.75.

5-04.3(11)G Rejection – An Entire Lot (Mixture or Compaction)

An entire lot with a CPF of less than 0.75 will be rejected.

5-04.3(12) Joints

5-04.3(12)A HMA Joints

5-04.3(12)A1 Transverse Joints

Conduct operations such that the placement of the top or wearing course is a continuous operation or as close to continuous as possible. Unscheduled transverse joints will be allowed, but the roller may pass over the unprotected end of the freshly laid HMA only when the placement of the course is discontinued for such a length of time that the HMA will cool below compaction temperature. When the Work is resumed, cut back the previously compacted HMA to produce a slightly beveled edge for the full thickness of the course.

Construct a temporary wedge of HMA on a 50H:1V where a transverse joint as a result of paving or planing is open to traffic. Separate the HMA in the temporary wedge from the permanent HMA upon which it is placed by strips of heavy wrapping paper or other methods approved by the Engineer. Remove the wrapping paper and trim the joint to a slightly beveled edge for the full thickness of the course prior to resumption of paving.

Waste the material that is cut away and place new HMA against the cut. Use rollers or tamping irons to seal the joint.

5-04.3(12)A2 Longitudinal Joints

Offset the longitudinal joint in any one course from the course immediately below by not more than 6 inches nor less than 2 inches. Locate all longitudinal joints constructed in the wearing course at a lane line or an edge line of the Traveled Way. Construct a notched wedge joint along all longitudinal joints in the wearing surface of new HMA unless otherwise approved by the Engineer. The notched wedge joint shall have a vertical edge of not less than the maximum aggregate size nor more than ½ of the compacted lift thickness, and then taper down on a slope not steeper than 4H:1V. Uniformly compact the sloped portion of the HMA notched wedge joint.

On one-lane ramps a longitudinal joint may be constructed at the center of the traffic lane, subject to approval by the Engineer, if:

1. The ramp must remain open to traffic, or
2. The ramp is closed to traffic and a hot-lap joint is constructed.
    a. Two paving machines shall be used to construct the hot-lap joint.
    b. The pavement within 6 inches of the hot-lap joint will not be excluded from random location selection for compaction testing.
    c. Construction equipment other than rollers shall not operate on any uncompacted HMA.

When HMA is placed adjacent to cement concrete pavement comply with Section 5-03.

5-04.3(12)B Bridge Paving Joint Seals

Bridge Paving Joint Seals shall be in accordance with Section 5-03.

5-04.3(13) Surface Smoothness

The completed surface of all courses shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds. The completed surface of the wearing course shall not vary more than ⅛ inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline. The transverse slope of the completed surface of the wearing course shall vary not more than ¼ inch in 10 feet from the rate of transverse slope shown in the Plans.

When deviations in excess of the above tolerances are found that result from a high place in the HMA, correct the pavement surface by one of the following methods:

1. Remove material from high places by grinding with an approved grinding machine, or
2. Remove and replace the wearing course of HMA, or
3. By other method approved by the Engineer.

Correct defects until there are no deviations anywhere greater than the allowable tolerances.

Deviations in excess of the above tolerances that result from a low place in the HMA and deviations resulting from a high place where corrective action, in the opinion of the Engineer, will not produce satisfactory results will be accepted with a price adjustment. The Engineer shall deduct from monies due or that may become due to the Contractor the sum of $500.00 for each and every section of single traffic lane 100 feet in length in which any excessive deviations described above are found.

When concrete pavement is to be placed on HMA, the surface tolerance of the HMA shall be such that no surface elevation lies above the Plan grade minus the specified Plan depth of concrete pavement. Prior to placing the concrete pavement, bring any such irregularities to the required tolerance by grinding or other means allowed by the Engineer.

When utility appurtenances such as manhole covers and valve boxes are located in the Traveled Way, pave the Roadway before the utility appurtenances are adjusted to the finished grade.

5-04.3(14) Planing Bituminous Pavement

Plane in such a manner that the underlying pavement is not torn, broken, or otherwise damaged by the planing operation. Delamination or raveling of the underlying pavement will not be construed as damage due to the Contractor's operations. Pavement outside the limits shown in the Plans or designated by the Engineer that is damaged by the Contractor's operations shall be repaired to the satisfaction of the Engineer at no additional cost to the Contracting Agency.

For mainline planing operations, use equipment with automatic controls and with sensors for either or both sides of the equipment. The controls shall be capable of sensing the grade from an outside reference line, or a mat-referencing device. The automatic controls shall have a transverse slope controller capable of maintaining the mandrel at the desired transverse slope (expressed as a percentage) within plus or minus 0.1 percent.

Remove all loose debris from the planed surface before opening the planed surface to traffic. The planings and other debris resulting from the planing operation shall become the property of the Contractor and be disposed of in accordance with Section 2-03.3(7)C, or as otherwise allowed by the Contract.

5-04.3(15) Sealing Pavement Surfaces

Apply a fog seal where shown in the Plans. Construct the fog seal in accordance with Section 5-02.3. Unless otherwise approved by the Engineer, apply the fog seal prior to opening to traffic.

5-04.3(16) HMA Road Approaches

Construct HMA approaches at the locations shown in the Plans or where staked by the Engineer, in accordance with Section 5-04.

5-04.4 Measurement

HMA Cl. ___ PG ___, HMA for ___ Cl. ___ PG ___, and Commercial HMA will be measured by the ton in accordance with Section 1-09.2, with no deduction being made for the weight of asphalt binder, mineral filler, or any other component of the HMA. If the Contractor elects to remove and replace HMA as allowed by Section 5-04.3(11), the material removed will not be measured.

Roadway cores will be measured per each for the number of cores taken.

Soil residual herbicide will be measured by the mile for the stated width to the nearest 0.01 mile or by the square yard, whichever is designated in the Proposal.

Pavement repair excavation will be measured by the square yard of surface marked prior to excavation.

Asphalt for fog seal will be measured by the ton, as provided in Section 5-02.4.

Planing bituminous pavement will be measured by the square yard.

Temporary pavement marking will be measured by the linear foot as provided in Section 8-23.4.

Water will be measured by the M gallon as provided in Section 2-07.4.

5-04.5 Payment

Payment will be made for each of the following Bid items that are included in the Proposal:

"HMA Cl. ___ PG ___", per ton.

"HMA for Approach Cl. ___ PG ___", per ton.

"HMA for Preleveling Cl. ___ PG ___", per ton.

"HMA for Pavement Repair Cl. ___ PG ___", per ton.

"Commercial HMA", per ton.

The unit Contract price per ton for "HMA Cl. ___ PG ___", "HMA for Approach Cl. ___ PG ___", "HMA for Preleveling Cl. ___ PG ___", "HMA for Pavement Repair Cl. ___ PG ___", and "Commercial HMA" shall be full compensation for all costs, including anti-stripping additive, incurred to carry out the requirements of Section 5-04 except for those costs included in other items which are included in this Subsection and which are included in the Proposal.

"Soil Residual Herbicide ____ ft. Wide", per mile, or

"Soil Residual Herbicide", per square yard.

The unit Contract price per mile or per square yard for "Soil Residual Herbicide" shall be full payment for all costs incurred to obtain, provide and install herbicide in accordance with Section 5-04.3(4)B.

"Pavement Repair Excavation Incl. Haul", per square yard.

The unit Contract price per square yard for "Pavement Repair Excavation Incl. Haul" shall be full payment for all costs incurred to perform the Work described in Section 5-04.3(4)C with the exception, however, that all costs involved in the placement of HMA shall be included in the unit Contract price per ton for "HMA for Pavement Repair Cl. ___ PG ___", per ton.

"Asphalt for Fog Seal", per ton.

Payment for "Asphalt for Fog Seal" is described in Section 5-02.5.

"Planing Bituminous Pavement", per square yard.

The unit Contract price per square yard for "Planing Bituminous Pavement" shall be full payment for all costs incurred to perform the Work described in Section 5-04.3(14).

"Temporary Pavement Marking", per linear foot.

Payment for "Temporary Pavement Marking" is described in Section 8-23.5.

"Water", per M gallon.

Payment for "Water" is described in Section 2-07.5.

"Job Mix Compliance Price Adjustment", by calculation.

"Job Mix Compliance Price Adjustment" will be calculated and paid for as described in Section 5-04.3(9)B6 and 5-04.3(9)D1.

"Compaction Price Adjustment", by calculation.

"Compaction Price Adjustment" will be calculated and paid for as described in Section 5-04.3(10)C3.

"HMA Core – Bridge", per each.

The unit Contract price per each for "HMA Core – Bridge" shall be full payment for all costs, including traffic control, associated with taking HMA density cores in pavement that is on a bridge deck.

"HMA Core – Roadway", per each.

The unit Contract price per each for "HMA Core – Roadway" shall be full payment for all costs, including traffic control, associated with taking HMA density cores in pavement that is not on a bridge deck.

"Cyclic Density Price Adjustment", by calculation.

"Cyclic Density Price Adjustment" will be calculated and paid for as described in Section 5-04.3(10)B.

5-05 Cement Concrete Pavement

5-05.1 Description

This Work shall consist of constructing a pavement composed of cement concrete on a prepared Subgrade or base in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or established by the Engineer.

5-05.2 Materials

Materials shall meet the requirements of the following sections:

Cement	9-01
Fine Aggregate	9-03
Coarse Aggregate	9-03
Combined Aggregate	9-03
Joint Filler	9-04.1
Joint Sealants	9-04.2
Corrosion Resistant Dowel Bars	9-07.5(2)
Tie Bars	9-07.6
Concrete Patching Material	9-20.1
Curing Materials and Admixtures	9-23
Water	9-25
Epoxy Resins	9-26

Cementitious materials are considered to be the following: portland cement, blended hydraulic cement, fly ash, ground granulated blast furnace slag, and microsilica fume.

5-05.3 Construction Requirements

5-05.3(1) Concrete Mix Design for Paving

The Contractor shall provide a concrete mix design for each design of concrete specified in the Contract. The Contractor shall use ACI 211.1 as a guide to determine proportions. Concrete strength, placement, and workability shall be the responsibility of the Contractor. Following approval of the Contractor's proposal, all other requirements of Section 5-05 shall apply.

1. **Materials** – Materials shall conform to Section 5-05.2. Fine aggregate shall conform to Section 9-03.1(2), Class 1. Coarse aggregate shall conform to Section 9-03.1(4), AASHTO grading No. 467. An alternate combined gradation conforming to Section 9-03.1(5) may be proposed, that has a nominal maximum aggregate size equal to or greater than a 1½-inch sieve.

   Fly ash, if used, shall not exceed 35 percent by weight of the total cementitious material, shall conform to Section 9-23.9 and shall be limited to Class F with a maximum CaO content of 15 percent by weight.

Ground granulated blast furnace slag, if used, shall not exceed 30 percent by weight of the total cementitious material and shall conform to Section 9-23.10. When both ground granulated blast furnace slag and fly ash are included in the concrete mix, the total weight of both these materials is limited to 35 percent by weight of the total cementitious material. As an alternative to the use of fly ash, ground granulated blast furnace slag and cement as separate components, a blended hydraulic cement that meets the requirements of Section 9-01.2(1)B Blended Hydraulic Cements may be used.

The water/cement ratio shall be calculated on the total weight of cementitious material. Cementitious materials are those listed in Section 5-05.2. The minimum cementitious material for any mix design shall be 564 pounds per cubic yard.

2. **Submittals** – The Contractor's submittal shall include the mix proportions per cubic yard, test results from beams and cylinders, and the proposed sources for all ingredients including the fly ash. The mix shall be capable of providing a minimum flexural strength of 650 psi at 14 days. Evaluation of strength shall be based on statistically analyzed results of five beam specimens made according to WSDOT T 808 and tested according to WSDOT T 802 that demonstrate a quality level of not less than 80 percent analyzed in accordance with Section 1-06.2(2)D. In addition the Contractor shall fabricate, cure, and test five sets of cylinders, for evaluation of 28-day strengths, according to FOP for AASHTO T 22 and FOP for AASHTO T 23 using the same mix design as used in fabrication of the beams.

   Mix designs submitted by the Contractor shall provide a unique identification for each proposal and shall include test data confirming that concrete made in accordance with the proposed design will meet the requirements of these Specifications and the 28-day compressive strength result. Test data shall be from an independent testing lab or from a commercial concrete producer's lab. If the test data is developed at a producer's lab, the Engineer or a representative may witness all testing.

3. **Mix Design Modifications** – The Contractor may initiate adjustments to the aggregate proportions of the approved mix design. An adjustment in both the fine and coarse aggregate batch target weights of plus or minus 200 pounds per cubic yard will be allowed without resubmittal of the mix design. The adjusted aggregate weights shall become the new batch target weights for the mix design.

4. **Conformance to Mix Design** – Cement and coarse and fine aggregate weights shall be within the following tolerances of the batch target weights of the mix design:

Concrete Batch Weights		
Cement	+5%	-1%
Coarse Aggregate	+ 2%	- 2%
Fine Aggregate	+ 2%	- 2%

If the total cementitious material weight is made up of different components, these component weights shall be within the following tolerances:

a. Cement weight plus 5 percent or minus 1 percent of that specified in the mix design.

b. Fly ash and ground granulated blast furnace slag weight plus or minus 5 percent of that specified in the mix design.

c. Microsilica weight plus or minus 10 percent of that specified in the mix design.

Water shall not exceed the maximum water specified in the mix design.

The Contractor may initiate minor adjustments to the approved mix proportions within the tolerances noted above without resubmitting the mix design.

The Contractor shall notify the Engineer in writing of any proposed modification. A new mix design will designate a new lot.

5-05.3(2) Consistency

The materials shall be mixed with sufficient water to produce a stiff concrete which will hold its shape when deposited upon the Subgrade. Concrete placed during wet weather must be mixed with sufficient water to produce a very stiff mixture. The consistency shall be such that separation of the mortar from the coarse aggregate will not occur in handling.

The water/cementitious material ratio, by weight, shall not exceed 0.44. When slip-form paving equipment is used, the Contractor shall further control concrete consistency to ensure that edge slump conforms to the requirements of Section 5-05.3(11).

5-05.3(3) Equipment

Equipment necessary for handling materials and performing all parts of the Work shall conform to the following requirements:

5-05.3(3)A Batching Plant and Equipment

1. **General** – The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a suitable batch counter that cannot be reset, which will correctly indicate the number of batches proportioned.

2. **Bins and Hoppers** – Bins with adequate separate compartments for fine aggregate and for each size of the coarse aggregate shall be provided in the batching plant.

5-05.3(3)B Mixing Equipment

1. **General** – Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

2. **Batching Plant** – Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform weight within the specified mixing period.

   Mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum shall be repaired or replaced when they are worn down ¾ inch or more. The Contractor shall have available at the jobsite a copy of the manufacturer's design, showing dimensions and arrangements of the blades in reference to original height and depth, or provide permanent marks on blades to show points of ¾ inch wear from new conditions. Drilled holes ¼ inch in diameter near each end and at midpoint of each blade are recommended.

3. **Truck Mixers and Truck Agitators** – Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, shall conform to the requirements of Section 6-02.3(4)A.

4. **Nonagitator Trucks** – Bodies of nonagitating hauling equipment for concrete shall be smooth, mortar-tight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection. Plant-mixed concrete may be transported in nonagitated vehicles provided that concrete is in a workable condition when placed and:

   a. discharge is completed within 45 minutes after the introduction of mixing water to the cement and aggregates, or

   b. discharge is completed within 60 minutes after the introduction of mixing water to the cement and aggregates, provided the concrete mix temperature is 70°F or below during placement, or

   c. discharge is completed within 60 minutes after the introduction of mixing water to the cement and aggregates, provided the mix contains an approved set retarder at the manufacturer's minimum dosage rate.

5-05.3(3)C Finishing Equipment

The standard method of constructing concrete pavement on State Highways shall be with approved slip-form paving equipment designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine so a dense and homogeneous pavement is achieved with a minimum of hand finishing. On other roads and on WSDOT projects requiring less than 1,000 square yards of cement concrete pavement or requiring individual placement areas of less than 1,000 square yards, irregular areas, intersections, and at locations inaccessible to slip-form paving equipment, cement concrete pavement may be placed with approved placement and finishing equipment utilizing stationary side forms. Hand screeding and float finishing of cement concrete pavement may only be utilized on small irregular areas as allowed by the Engineer.

5-05.3(3)D Joint Sawing Equipment

The Contractor shall provide approved power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously upon call by the Engineer on a 24-hour basis, including Saturdays, Sundays, and holidays.

5-05.3(3)E Smoothness Testing Equipment

Inertial profilers shall meet all requirements of AASHTO M 328 and be certified in accordance with AASHTO R 56 within the preceding 12 months.

The inertial profiler operator shall be certified as required by AASHTO R 56 within three years preceding profile measurement.

Equipment or operator certification by other states or a profiler certification facility will be accepted provided the certification meets the requirements of AASHTO R 56. Documentation verifying certification by another state shall be submitted to the Engineer a minimum of 14 calendar days prior to profile measurement. Equipment certification documentation shall include the information required by part 8.5 and 8.6 of AASHTO R 56. Operator documentation shall include a statement from the certifying state that indicates the operator is certified to operate the inertial profiler to be used on the project. The decision whether another state's certification meets the requirements of AASHTO R 56 shall be vested entirely in the Engineer.

5-05.3(4) Measuring and Batching Materials

The batch plant site, layout, equipment, and provisions for transporting material shall ensure a continuous supply of material to the Work.

1. **Measuring Materials**

   a. **Aggregates** – The fine aggregate and each size of coarse aggregate shall be measured by weighing, the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of material shall be a separate and distinct operation.

      Corrections shall be made for variations in weight of materials due to the moisture content.

      The equipment for weighing aggregates shall conform to the requirements of Section 1-09.2.

   b. **Cement** – Cement shall be weighed on scales meeting the requirements of Section 1-09.2. Adequate provision shall be made to prevent loss of cement between the batch box and the mixer.

   c. **Water** – Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1 percent.

2. **Batching Materials** – On all projects requiring more than 2,500 cubic yards of concrete for paving, the batching plant shall be equipped to proportion aggregates and cement by weight by means of automatic and interlocked proportioning devices of accepted type.

5-05.3(4)A Acceptance of Portland Cement or Blended Hydraulic Cement Concrete Pavement

Acceptance of portland cement or blended hydraulic cement concrete pavement shall be as provided under statistical or nonstatistical acceptance. Determination of statistical or nonstatistical shall be based on Proposal quantities and shall consider the total of all Bid items involving of a specific class.

Statistical acceptance will apply only to Contracts advertised, Awarded and administered by WSDOT, unless specifically provided otherwise in the Special Provisions. Contracting agencies other than WSDOT must specifically invoke statistical acceptance in their Special Provisions if it is desired.

Statistical Acceptance, (1) applies only to WSDOT projects, (2) is administered under the provisions of Section 5-05.5, and (3) will be used for a class of mix when the Proposal quantities for that class of mix is 1,500 cubic yards or greater.

Nonstatistical Acceptance will be used (1) for a class of mix when the Proposal quantities for that class of mix is less than 1,500 cubic yards and (2) all contracts advertised, Awarded and administered by agencies other than WSDOT.

The point of acceptance will be in accordance with FOP for WAQTC TM 2 or at the point of discharge when a pump is used.

Acceptance of Concrete. The concrete producer shall provide a certificate of compliance for each truckload of concrete in accordance with Section 6-02.3(5)B.

For the purpose of acceptance sampling and testing, a lot is defined as having a maximum of 15 sublots that was produced for the same class of mix. The final lot may be increased to 25 sublots. All of the test results obtained from the same lot shall be evaluated collectively. The quantity represented by each sample will constitute a sublot. Sampling and testing shall be performed on a random basis at the frequency of one sample per sublot. Sublot size shall be determined to the nearest 10 cubic yards to provide not less than three uniform sized sublots with a maximum sublot size of 500 cubic yards.

Acceptance testing for compliance of air content and 28-day compressive strength shall be conducted from samples prepared according to FOP for WAQTC TM 2. Air content shall be determined by conducting FOP for AASHTO T 152. Compressive strength shall be determined by FOP for AASHTO T 23 and FOP for AASHTO T 22.

The Contractor shall provide cure boxes in accordance with Section 6-02.3(5)H, and protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period in accordance with Section 6-02.3(6)D. Payment for cure boxes shall be in accordance with Section 6-02.5.

Rejection of Concrete

1. **Rejection by the Contractor** – The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the Contracting Agency. Any such new material will be sampled, tested, and evaluated for acceptance.
2. **Rejection Without Testing** – The Engineer may reject any load that appears defective prior to placement. Material rejected before placement shall not be incorporated into the pavement. No payment will be made for the rejected materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected materials tested, a sample will be taken and both the air content and strength shall be tested by WSDOT.

Payment for rejected material will be based on the results of the one sample, which was taken and tested. If the rejected material fails either test, no payment will be made for the rejected material; in addition, the cost of sampling and testing at the rate of $250.00 per sample shall be borne by the Contractor. If the rejected material passes both tests, the mix will be compensated at a CPF of 1.00 and the cost of the sampling and testing will borne by the Contracting Agency.

Statistical Acceptance

The results of all acceptance testing performed in the field and the Composite Pay Factor (CPF) of the lot after three sublots have been tested will be available to the contractor through WSDOT's website.

The Specification limits as defined in Section 1-06.2(2)D shall be as follows. The lower Specification limit for Air Content shall be 3 percent, and the upper Specification limit for Air Content shall be 7 percent. The lower Specification limit for compressive strength shall be 4,000 psi.

The price adjustment factor (f_i) defined in Section 1-06.2(2)D shall be six for compressive strength and four for air content.

If either the air content or compressive strength is not measured in accordance with this section its individual pay factor will be considered to be 1.00 in calculating the Composite Pay Factor.

For each lot of cement concrete pavement a Cement Concrete Compliance Adjustment will be determined and applied, as follows:

$$CCCA = (CPF - 1.00) \times Q \times UP$$

Where

CCCA	=	Cement Concrete Compliance Adjustment for a given lot of mixture ($)
CPF	=	Composite Pay Factor for a given lot of cement concrete pavement (maximum is 1.05)
Q	=	Quantity in a given lot cement concrete pavement (cubic yards) as calculated in accordance with Section 5-04.
UP	=	Unit price of the cement concrete pavement in a given lot ($/cubic yard)

Non-Statistical Acceptance

Concrete will be accepted based on conformance to the requirement for air content and the compressive strength at 28 days for sublots as tested and determined by the Contracting Agency. The lower Specification limit for air content shall be 3 percent, and the upper Specification limit for air content shall be 7 percent. The lower Specification limit for compressive strength shall be 4,000 psi.

Each sublot will be deemed to have met the specified compressive strength requirement when both of the following conditions are met:

1. Individual strength tests do not fall below the lower specification limit for strength by more than 12½ percent, or 500 psi, whichever is least.
2. An individual strength test averaged with the two preceding individual strength tests meets or exceeds the lower specification limit for strength.

When compressive strengths fail to satisfy one or both of the above requirements, the Contractor may request acceptance of in-place concrete strength based on core results. This method will not be used if the Engineer determines coring would be harmful to the integrity of the Structure. Cores, if allowed, will be obtained by the Contractor in

accordance with FOP for AASHTO T 24 and delivered to the Contracting Agency for testing in accordance with AASHTO T 22. If the concrete in the Structure will be dry under service conditions, the core will be air-dried at a temperature of between 60°F and 80°F and at a relative humidity of less than 60 percent for 7 days before testing, and will be tested air dry.

Acceptance for each sublot by the core method requires that the average compressive strength of three cores be at least 85 percent of the specified strength with no one core less than 75 percent of the specified strength. When the Contractor requests strength analysis by coring, the results obtained will be accepted by both parties as conclusive and supersede all other strength data for the concrete sublot.

If the Contractor elects to core, cores shall be obtained no later than 50 days after initial concrete placement. The Engineer will concur in the locations to be cored. Repair of cored areas shall be the responsibility of the Contractor. The cost incurred in coring and testing these cores, including repair of core locations, shall be borne by the Contractor.

5-05.3(5) Mixing Concrete

The concrete may be mixed in a batching plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of Sections 6-02.3(4), 6-02.3(4)A, and 6-02.3(4)B.

When mixed in a batching plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's nameplate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at no expense to the Contracting Agency. The volume of concrete mixed per batch shall not exceed the mixer's rated capacity, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine shall be equipped with a device for counting automatically the number of batches mixed during the day's operation.

Retempering concrete by adding water or by other means will not be permitted.

5-05.3(5)A Limitations of Mixing

Concrete shall not be mixed, placed, or finished when the natural light is inadequate, as determined by the Engineer, unless an adequate and approved artificial lighting system is operated.

Mixing and placing concrete shall be discontinued when a descending air temperature in the shade away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F unless authorized in writing by the Engineer.

When mixing and placing is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used

shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50°F and not more than 90°F at the time of discharge into the hauling conveyance. No concrete shall be mixed with frozen aggregates.

5-05.3(6) Surface Preparation

The Subgrade surface shall be prepared and compacted a minimum of 3 feet beyond each edge of the area which is to receive concrete pavement in order to accommodate the slip-form equipment.

Concrete shall not be placed during a heavy rainfall. Prior to placing concrete:

1. The surface shall be moist;
2. Excess water (e.g., standing, pooling or flowing) shall be removed from the surface.
3. The surface shall be clean and free of any deleterious materials.
4. The surface temperature shall not exceed 120°F or be frozen.

5-05.3(7) Placing, Spreading, and Compacting Concrete

5-05.3(7)A Slip-Form Construction

The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose, or by an electronic control system capable of controlling the line and grade within required tolerances. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit shall not exceed 9 inches. The spacing of internal units shall be uniform and not exceed 18 inches.

The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be not less than 7,500 cycles per minute, and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1 foot. The frequency of vibration or amplitude shall be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

5-05.3(7)B Stationary Side Form Construction

Side form sections shall be straight, free from warps, bends, indentations, or other defects. Defective forms shall be removed from the Work. Metal side forms shall be used unless other forms are approved by the Engineer.

Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such buildup is attached to the top of metal forms, the buildup shall be of metal.

Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with adjoining forms, that springing will not occur under the weight of grading and paving equipment or from the pressure of concrete. The Contractor shall provide sufficient forms so that there will be no delay in placing the concrete due to lack of forms.

Before placing side forms, the underlying material shall be at the proper grade. Side forms shall be placed to the required grade and alignment of the edge of the finished pavement. Wood wedges may be used to adjust the form elevation provided they do not extend into the concrete. The forms shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.

Immediately in advance of placing concrete and after all Subgrade operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing concrete.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms are removed.

Side forms shall be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.

Concrete shall be spread, screeded, shaped, and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that completed pavement will conform to required cross section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the Work required at a rate equal to that of concrete delivery.

Concrete for the full paving width shall be effectively consolidated by means of surface vibrators, in combination with internal vibrators, or by some other method of consolidation that produces equivalent results without segregation.

When vibrators are used to consolidate concrete, the rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and shall be not less than 7,000 cycles per minute for internal vibrators. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than 1 foot from the vibrating element. The Contractor shall furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

5-05.3(8) Joints

Joints in cement concrete pavement will be designated as longitudinal and transverse contraction joints, longitudinal and transverse construction joints, or isolation joints, and shall be constructed as shown in the Plans and in accordance with the following provisions:

All contraction joints shall be constructed at the locations, intervals, and depths shown in the *Standard Plans*. The faces of all joints shall be constructed perpendicular to the surface of the cement concrete pavement.

5-05.3(8)A Contraction Joints

All transverse and longitudinal contraction joints shall be formed with suitable power-driven concrete saws. The Contractor shall provide sufficient sawing equipment capable of completing the sawing to the required dimensions and at the required rate to control cracking. The Contractor shall provide adequate artificial lighting facilities for night sawing. Joints shall not vary from the specified or indicated line by more than ¾ inch.

Commencement of sawing transverse contraction joints will be dependent upon the setting time of the concrete and shall be done at the earliest possible time following placement of the concrete without tearing or raveling the adjacent concrete excessively.

Longitudinal contraction joints shall be sawed as required to control cracking and as soon as practical after the initial control transverse contraction joints are completed.

Any damage to the curing material during the sawing operations shall be repaired immediately after the sawing is completed.

When cement concrete pavement is placed adjacent to existing cement concrete pavement, the vertical face of all existing working joints shall be covered with a bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer.

5-05.3(8)B Sealing Sawed Contraction Joints

Sealing sawed contraction joints shall be in accordance with Section 5-03.

5-05.3(8)C Construction Joints

When placing of concrete is discontinued for more than 45 minutes, a transverse construction joint shall be installed. Construction joints shall be as shown in the *Standard Plans*.

Transverse construction joints shall be constructed between cement concrete pavement and reinforced concrete bridge approach slabs.

All transverse and longitudinal construction joints, including the joint between new and existing pavement when widened, shall be sawed and sealed in accordance with Section 5-03.3(3)C.

5-05.3(8)D Isolation Joints

Premolded joint filler in accordance with Section 9-04.1(2) shall be placed as detailed in the Plans through the full depth of concrete pavement when drainage features are placed within the concrete pavement.

5-05.3(9) Vacant

5-05.3(10) Tie Bars and Corrosion Resistant Dowel Bars

Tie bars shall be placed at all longitudinal contraction and construction joints, in accordance with the requirements shown in the *Standard Plans*. In addition, tie bars shall be installed when concrete Shoulders are placed as a separate operation or when widening existing pavement.

Tie bars shall be placed at longitudinal construction joints between lanes in a manner that the individual bars are located at the required elevation and spaced as shown in the *Standard Plans* and in a manner that the vertical edge of the concrete is not deformed or otherwise damaged during placement of the bars.

Placement tolerances for tie bars shall be within 1 inch of the middle of the concrete slab, within 1 inch of being centered over the joint and placed parallel or perpendicular to centerline within 1 inch of the vertical and horizontal plane.

Corrosion resistant dowel bars will be required for the construction joint at the end of paving operations each day and they shall be placed in accordance with the *Standard Plans*. Corrosion resistant dowel bars shall be placed at all transverse contraction joints as shown in the Contract or in accordance with the *Standard Plans*. All dowel bars shall have a parting compound, such as curing compound, grease or other Engineer approved

equal applied to them prior to placement. Any dowel bar delivered to the project that displays rust/oxidation, pinholes, questionable blemishes, or deviates from the round shall be rejected.

The Contractor shall furnish a Manufacturer's Certificate of Compliance in accordance with Section 1-06.3, including mill test report verifying conformance to the requirements of Section 9-07.5(2) as well as written certification identifying the patching material, when applicable, used at cut dowel bar ends.

Only one type of corrosion resistant dowel bars will be allowed per contract; intermixing of different corrosion resistant dowel bar types will not be allowed.

Placement tolerances for dowel bars shall be within 1 inch of the middle of the concrete slab, within 1 inch of being centered over the transverse joint and parallel to centerline within ½ inch of the vertical and the horizontal plane.

Cutting of stiffeners within the dowel bar cage is not allowed.

When fresh concrete pavement is to be placed against pre-project existing cement concrete pavement, tie bars shall be drilled and set into the existing pavement with an epoxy bonding agent in accordance with the *Standard Plans* and specified tolerances for placement of tie bars. The epoxy-bonding agent shall be either Type I or IV epoxy resin as specified in Section 9-26. The Contractor may use any method for drilling the holes, provided the method selected does not damage the existing concrete. Any damage caused by the Contractor's operations shall be repaired by the Contractor at no cost to the Contracting Agency in accordance with Section 1-07.13.

The tie bar holes shall be clean before grouting. The bar shall be centered in the hole for the full length of embedment before grouting. The grout shall then be pumped into the hole around the bar in a manner that the back of the hole will be filled first. Blocking or shimming shall not impede the flow of the grout into the hole. Dams, if needed, shall be placed at the front of the holes to confine the grout. The dams shall permit the escape of air without leaking grout and shall not be removed until grout has cured in the hole.

5-05.3(11) Finishing

After the concrete has been given a preliminary finish by means of finishing devices incorporated in the slip-form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge device not less than 10 feet in length. High areas indicated by the straightedge device shall be removed by the hand-float method. Each successive check with the straightedge device shall lap the previous check path by at least ½ of the length of the straightedge. The requirements of this paragraph may be waived if it is successfully demonstrated that other means will consistently produce a surface with a satisfactory profile index and meeting the 10-foot straightedge requirement specified in Section 5-05.3(12).

Any edge slump of the pavement, exclusive of specified edging, in excess of ¼ inch shall be corrected before the concrete has hardened. If edge slump on any 1 foot or greater length of hardened concrete exceeds 1 inch, the concrete shall be repaired as provided in Section 5-05.3(22).

The standard method of surface finish shall be longitudinal tining. In advance of curing operations, where longitudinal tining is required, the pavement shall be given an initial and a final texturing. Initial texturing shall be performed with a burlap drag or broom device that will produce striations parallel with the centerline. Final texturing shall be performed with a wire comb tine device that will produce grooves parallel with the centerline. The wire comb tine device shall be operated within 5 inches, but not closer than 3 inches, of pavement edges.

Burlap drags, brooms, and tine devices shall be installed on self-propelled equipment having external alignment control. The installation shall be such that, when texturing, the area of burlap in contact with the pavement surface shall be maintained constant at all times. Broom and tine devices shall be provided with positive elevation control. Downward pressure on pavement surface shall be maintained at all times during texturing so as to achieve uniform texturing without measurable variations in pavement profile. Self-propelled texturing machines shall be operated so that travel speed when texturing is maintained constant. Failure of equipment to conform to all provisions in this paragraph shall constitute cause for stopping placement of concrete until the equipment deficiency or malfunction is corrected. The wire comb of the final texturing device shall be rectangular in cross section, 3/32 to 1/8 inch wide, on 3/4-inch centers, ± 1/8-inch, and of sufficient length, thickness, and resilience to form grooves approximately 1/8 inch deep in the fresh concrete surface. Final texture shall be uniform in appearance with substantially all of the grooves having a depth between 1/16 and 3/16 inch.

On projects requiring less than 1,000 square yards of cement concrete pavement, for irregular areas or areas not accessible to slip-form pavers, the surface finish may be either longitudinal tined or transverse tined.

Transverse tining shall be done by texturing with a wire comb perpendicular to the centerline of the pavement. The wire comb tines shall be rectangular in cross section, 3/32 to 1/8 inch wide, on 1/2-inch centers ± 1/8 inch, and of sufficient length, thickness, and resilience to form grooves approximately 1/8 inch deep in the fresh concrete surface. Final texture shall be uniform in appearance with substantially all of the grooves having a depth between 1/16 to 3/16 inch. Finishing shall take place with the elements of the wire comb as nearly perpendicular to the concrete surface as is practical, to eliminate dragging the mortar.

If the tining equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment.

Regardless of the surface finish, if the pavement has a raised curb without a formed concrete gutter, the texturing shall end 2 feet from the curb line.

At the beginning and end of paving each day, the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the panel to indicate the date, month, and year of placement.

At approximate 500-foot intervals where designated by the Engineer the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the pavement with the stationing of the Roadway.

5-05.3(12) Surface Smoothness

Pavement surface smoothness for this project will include International Roughness Index (IRI) testing. The Contractor shall perform IRI testing on each through lane, climbing lane, and passing lane, greater than 0.25 mile in length and these lanes will be subject to incentive/disincentive adjustments. Ride quality will be evaluated using the Mean Roughness Index (MRI) calculated by averaging the IRI data for the left and right wheel path within the section.

Ramps, shoulders and tapers will not be included in MRI testing for pavement smoothness and will not be subject to incentive adjustments. All Work is subject to parallel and transverse 10-foot straightedge requirements, corrective work and disincentive adjustments.

Operate the inertial profiler in accordance with AASHTO R 57. Collect two longitudinal traces, one in each wheel path. Collect profile data after completion of all concrete paving on the project in a continuous pass including areas excluded from pay adjustments. Provide notice to the Engineer a minimum of seven calendar days prior to testing.

Within 30 calendar days after the Contractor's testing, the Engineer may perform verification testing. If the verification testing shows a difference in MRI greater than the percentages shown in Table 2 of AASHTO R 54 the following resolution process will be followed:

1. The profiles, equipment and procedures will be evaluated to determine the cause of the difference.
2. If the cause of the discrepancy cannot be resolved the pavement shall be retested with both profilers at a mutually agreed time. The two profilers will test the section within 30 minutes of each other. If the retest shows a difference in MRI equal or greater than the percentages shown in Table 2 of AASHTO R 54 the Engineer's test results will be used to establish pay adjustments.

Surface smoothness of travel lanes not subject to MRI testing will be measured with a 10-foot straightedge no later than 5:00 p.m. of the day following the placing of the concrete. The completed surface of the wearing course shall not vary more than ⅛ inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline.

Smoothness perpendicular to the centerline will be measured with a 10-foot straightedge across all lanes with the same cross slope, including shoulders when composed of cement concrete pavement. The overlapping 10-foot straightedge measurement shall be discontinued at a point 6 inches from the most extreme outside edge of the finished cement concrete pavement. The completed surface of the wearing course shall not vary more than ¼ inch from the lower edge of a 10-foot straightedge placed on the surface perpendicular to the centerline. Any deviations in excess of the above tolerances shall be corrected.

The Contractor shall evaluate profiles for acceptance, incentive payments, disincentive payments, or corrective action using the current version of ProVAL and provide the results including the profile data in unfiltered electronic Engineering Research Division (ERD) file format to the Engineer within 2 calendar days of completing testing each section of pavement. If the profile data files are created using an export option in the manufacturer's software where filter settings can be specified, use the filter settings that were used to create data files for certification. Analyze the entire profile. Exclude any areas specifically identified in the Contract. Exclude from the analysis the first 100 feet after the start of the paving operations and last 100 feet prior to the end of the paving operation, the first 100 feet on either side of bridge Structures and bridge approach slab. Report the MRI results in inches per mile for each 52.8 foot section and horizontal distance measurements in project stationing to the nearest foot. Include pay adjustments in the results. The Engineer will verify the analysis.

Corrective work for pavement smoothness may be taken by the Contractor prior to MRI testing. After completion of the MRI testing the Contractor shall measure the smoothness of each 52.8-foot section with an MRI greater than 125 inches per mile with a 10-foot straightedge within 14 calendar days or as allowed by the Engineer. The Contractor shall identify all locations that require corrective work and provide the straight edge measurements at each location that exceeds the allowable limit to the Engineer. If all measurements in a 52.8-foot section comply with smoothness requirements, the Contractor shall provide the maximum measurement to the Engineer and a statement that corrective work is not required. Unless allowed by the Engineer, corrective work shall be taken by the Contractor for pavement identified by the Contractor or Engineer that does not meet the following requirements:

1. The completed surface shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds.
2. The completed surface shall not vary more than ⅛ inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline.
3. The completed surface shall vary not more than ¼ inch in 10 feet from the rate of transverse slope shown in the Plans.

All corrective work shall be completed at no additional expense, including traffic control, to the Contracting Agency. Corrective work shall not begin until the concrete has reached its design strength unless allowed by the Engineer. Pavement shall be repaired by one or more of the following methods:

1. Diamond grinding; repairs shall not reduce pavement thickness by more than ¼ inch less than the thickness shown in the Plans. When required by the Engineer, the Contractor shall verify the thickness of the concrete pavement by coring. Thickness reduction due to corrective work will not be included in thickness measurements for calculating the Thickness Deficiency in Section 5-05.5(1)A.
2. Removal and replacement of the cement concrete pavement.
3. By other method allowed by the Engineer.

For repairs following MRI testing the repaired area shall be checked by the Contractor with a 10-foot straightedge to ensure it no longer requires corrective work. With concurrence of the Engineer an inertial profiler may be used in place of the 10-foot straight edge.

If correction of the roadway as listed above either will not or does not produce satisfactory results as to smoothness or serviceability the Engineer may accept the completed pavement and a credit will be calculated in accordance with Section 5-05.5. The credit will be in addition to the price adjustment for MRI. Under these circumstances, the decision whether to accept the completed pavement or to require corrective work as described above shall be vested entirely in the Engineer.

5-05.3(13) Curing

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with one of the following methods the Contractor may elect.

5-05.3(13)A Curing Compound

Liquid membrane-forming concrete curing compound Type 2 meeting the requirements of Section 9-23.2 shall be applied to the entire area of the exposed surface of the concrete with an approved mechanical spray machine. The spray fog shall be protected from the wind with an adequate shield. It shall be applied uniformly at the rate of one gallon to not more than 150-square feet.

The compound shall be applied with equipment of the pressure tank or pump type equipped with a feed tank agitator which ensures continuous agitation of the compound during spraying operations. The nozzle shall be of the two-line type with sufficient air to properly atomize the compound.

The curing compound shall not be applied during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it shall be covered with polyethylene sheeting, which shall remain in place until weather conditions are favorable for the application of the curing compound.

In the event that rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or in the event of damage to the film from any cause, the Contractor shall apply a new coat of curing compound in one or two applications to the affected area at the rate which, in the opinion of the Engineer, will result in a film of curing value equal to that specified in the original coat.

Before placing the curing compound in the spray tank, it shall be thoroughly agitated as recommended by the Manufacturer. The compound shall not be diluted by the addition of solvents nor be altered in any manner. If the compound has become chilled to the extent that it is too viscous for proper stirring or application or if portions of the vehicle have been precipitated from solution, it shall be heated to restore proper fluidity but it shall not be heated above 100°F. All curing compound shall have approval prior to placing in the spray tanks.

The curing compound shall be applied immediately after the concrete has been finished and after any bleed water that has collected on the surface has disappeared, or at a time designated by the Engineer. If hair checking develops in the pavement before finishing is completed, the Engineer may order the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations shall be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it shall be obtained ahead of the spraying operations. All areas cut by finishing tools subsequent to the application of the curing compound shall immediately be given new applications at the rate specified above.

The curing compound, after application, shall be protected by the Contractor from injury until the pavement has reached a minimum compressive strength of 2,500 psi. All traffic, either by foot or otherwise, shall be considered as injurious to the film of the applied compound.

The Contractor shall provide on the job a sufficient quantity of white polyethylene sheeting to cover all the pavement laid in 3 hours of maximum operation. This sheeting shall be reserved exclusively for the protection of the pavement in case of rain or breakdown of the spray equipment used for applying the curing compound. The protective sheeting shall be placed over the pavement when ordered, and in the manner specified by the Engineer.

Areas from which it is impossible to exclude traffic shall be protected by a covering of sand or earth not less than 1 foot in thickness or by other suitable and effective means. The protective covering shall be placed no earlier than 24 hours after application of the compound.

The Contractor shall assume all liabilities for and protect the Contracting Agency from any damages or claims arising from the use of materials or processes described herein.

5-05.3(13)B White Polyethylene Sheeting

The sheeting shall be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting shall be laid so that individual sheets overlap at least 2 feet, and the lapped areas shall be held in close contact with the pavement by weighting with earth or boards to prevent movement by the wind. The sheeting shall extend downward to cover the edges of the pavement and shall be secured to the Subgrade with a continuous bank of earth or surfacing material. Any holes occurring in the sheeting shall be patched immediately to the satisfaction of the Engineer. The sheeting shall be maintained against injury and remain in place until the pavement has reached a minimum compressive strength of 2,500 psi.

5-05.3(13)C Wet Curing

Wet curing shall be accomplished by applying a continuous fog or mist spray to the entire pavement surface until it has reached a minimum compressive strength of 2,500 psi. If water runoff is not a concern, continuous sprinkling is acceptable. Sprinkling shall not begin until the concrete has achieved initial set as determined by AASHTO T 197 or other approved method.

5-05.3(14) Cold Weather Work

When the air temperature is expected to reach the freezing point during the day or night and the pavement has not reached 50 percent of its design strength or 2,500 psi which ever is greater the concrete shall be protected from freezing. The Contractor shall, at no expense to the Contracting Agency, provide a sufficient supply of straw, hay, grass, earth, blankets, or other suitable blanketing material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The Contractor shall be responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing shall be removed and replaced at the Contractor's expense in accordance with these Specifications.

5-05.3(15) Concrete Pavement Construction in Adjacent Lanes

Unless otherwise shown in the Plans or in the Special Provisions, the pavement shall be constructed in multiple lanes; that is, two or more adjacent lanes paved in a single operation. Longitudinal contraction joints shall be used between adjacent lanes that are paved concurrently, and construction joints shall be used when lanes are paved separately. Tie bars shall be installed during initial lane construction.

The Contractor shall replace, at no expense to the Contracting Agency, any panels on the new pavement that are cracked or broken as a result of the Contractor's operations.

5-05.3(16) Protection of Pavement

The Contractor shall protect the pavement and its appurtenances from any damage. Protection shall include personnel to direct traffic and the erection and maintenance of warning signs, lights, barricades, temporary take-down bridges across the pavement with adequate approaches, and whatever other means may be necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as determined by the Engineer.

The operation of construction equipment on the new pavement will not be allowed until the pavement has developed a compressive strength of 2,500 psi as determined from cylinders, made at the time of placement, cured under comparable conditions, and tested in accordance with FOP for AASHTO T 22. Exceptions would be one track from a slip-form paving machine when paving adjacent lanes or light vehicles required for sawing operations or taking cores.

Placement of Shoulder material may commence when the pavement has developed a compressive strength of 1,800 psi as determined from cylinders made at the time of placement, cured under comparable conditions, and tested in accordance with AASHTO T22 as long as construction equipment is not operated on the new pavement.

A continuous barrier of the design shown in the Plans shall be constructed and maintained along the edge of the pavement being constructed and adjacent to the portion of the Roadway used for traffic. The barriers shall be left in place until the new pavement is ready to be opened to traffic and shall then be removed by the Contractor.

Any damage to the pavement occurring prior to final acceptance shall be replaced or repaired in accordance with Section 5-05.3(22).

5-05.3(17) Opening to Traffic

The pavement may be opened to traffic when the concrete has developed a compressive strength of 2,500 psi as determined from cylinders, made at the time of placement, cured under comparable conditions, and tested in accordance with FOP for AASHTO T 22.

Fabrication, curing, and testing of cylinders to measure early strength shall be the responsibility of the Contractor. The Contractor shall obtain the services of an independent Laboratory to perform these activities and these laboratories shall be approved by the Engineer. At the Contractor's option, the time for opening pavement may be determined through the use of the maturity test in accordance with ASTM C1074. The Contractor shall develop the maturity-strength relationship and provide maturity curves along with supporting data for approval by the Engineer. The Contractor shall furnish all equipment, including thermal or maturity meter, thermocouples, wire, and qualified personnel to monitor maturity and provide information to the Engineer. Field procedures to monitor maturity shall be submitted to the Engineer for approval prior to use. The pavement shall not be opened to traffic until the maturity-strength relationship shows the pavement has a compressive strength of 2,500 psi and approved by the Engineer.

The pavement shall be cleaned prior to opening to traffic.

All costs associated with early-strength cylinders shall be at the Contractor's expense.

5-05.3(18) Vacant

5-05.3(19) Vacant

5-05.3(20) Vacant

5-05.3(21) Vacant

5-05.3(22) Repair of Defective Pavement Slabs

Broken slabs, slabs with random cracks, nonworking contraction joints near cracks, edge slumping and spalls along joints and cracks shall be replaced or repaired as specified at no expense to the Contracting Agency, and shall be accomplished prior to completion of joint sealing.

Pavement slabs containing more than one crack shall be entirely removed and replaced. Pavement slabs containing a single crack shall be removed and replaced such that the minimum dimension of the removed slab is 6 feet long and full panel width. The portion of the panel to remain in place shall have a minimum dimension of 6 feet in length and full panel width, otherwise entire removal and replacement of the slab is required. There shall be no new joints closer than 3 feet to an existing transverse joints. Saw cutting full pavement depth is required along all longitudinal joints and at transverse locations. Tie bars and dowel bars shall be used in accordance Section 5-05.3(10).

Spalls and edge slumping shall be repaired by making vertical saw cuts at least 3 inches outside the affected area and to a minimum depth of 2 inches. Spall repairs that encounter dowel bars or are within 6 inches of a dowel bar will not be permitted. These spall areas shall be repaired by replacing a half or full panel as permitted by the Engineer. Removal of the existing pavement shall not damage any pavement to be left in place. If jackhammers are used for removing pavement, they shall not weigh more than 30 pounds, and chipping hammers shall not weigh more than 15 pounds. All power-driven hand tools used for the removal of pavement shall be operated at angles less than 45 degrees as measured from the surface of the pavement to the tool. The patch limits shall extend beyond the spalled area a minimum of 3 inches. Repair areas shall be kept square or rectangular. Repair areas that are within 12 inches of another repair area shall be combined.

The Contractor shall remove material within the perimeter of the saw cut to a depth of 2 inches, or to sound concrete as determined by the Engineer. The surface patch area shall be sandblasted and all loose material removed. All sandblasting residue shall be removed.

When a partial depth repair is placed directly against an adjacent longitudinal joint, a bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer shall be placed between the existing concrete and the area to be patched.

Patches that abut working transverse joints or cracks require placement of a compressible insert. The new joint or crack shall be formed to the same width as the existing joint or crack. The compressible joint material shall be placed into the existing joint 1 inch below the depth of repair. The compressible insert shall extend at least 3 inches beyond each end of the patch boundaries.

Patches that abut the lane/shoulder joint require placement of a formed edge, along the slab edge, even with the surface.

The patching material shall be mixed, placed, consolidated, finished, and cured according to manufacturer's recommendations. Slab/patch interfaces that will not receive pavement grinding shall be sealed (painted) with a 1:1 cement-water grout along the patch perimeter.

The Contractor shall reseal all joints in accordance with Section 5-03.3(3)C.

Opening to traffic shall meet the requirements of Section 5-05.3(17).

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 the requirements of Section 9-26.1(1)B for Type II epoxy.

5-05.4 Measurement

Cement concrete pavement will be measured by the cubic yard for the completed pavement. The volume will be determined from measurements taken as listed below.

1. The width measurement will be the width of the pavement shown on the typical cross-section in the Plans, additional widening where called for, or as otherwise specified in writing by the Engineer.
2. The length will be measured along the center of each Roadway or ramp.
3. The depth shall be determined in accordance with Section 5-05.5(1). The depth utilized to calculate the volume shall not exceed the Plan depth plus 0.04 feet.

The volume of cement concrete pavement in each thickness lot shall equal the measured length × width × thickness measurement.

Corrosion resistant dowel bar will be measured per each for the actual number of bars used in the completed Work.

Tie bar with drill hole will be measured per each for the actual number of bars used in the completed Work. Tie bars with drill holes in cement concrete pavement placed under the Contract will not be measured.

5-05.5 Payment

Payment will be made for each of the following Bid items that are included in the Proposal:

"Cement Conc. Pavement", per cubic yard.

The unit Contract price per cubic yard for "Cement Conc. Pavement" shall be full compensation for all costs incurred to carry out the requirements of Section 5-05, except for those costs included in other items, which are included in this Subsection and are included in the Proposal. All costs associated with performing the magnetic pulse induction thickness testing shall be included in the unit Contract price per cubic yard for "Cement Conc. Pavement".

"Corrosion Resistant Dowel Bar", per each.

The unit Contract price per each for "Corrosion Resistant Dowel Bar" shall be full payment for furnishing, and installing corrosion resistant dowel bars and any costs for drilling holes, placing dowel bars with baskets, furnishing and installing parting compound and all other costs associated with completing the installation of corrosion resistant dowel bars.

"Tie Bar with Drill Hole", per each.

The unit Contract price per each, "Tie Bar with Drill Hole" shall be full payment for furnishing, and installing tie bars and any costs for drilling holes, and all other costs associated with installation of tie bars. All costs for tie bars with drill holes in cement concrete pavement placed under the Contract shall be included in the unit Contract price per cubic yard for "Cement Conc. Pavement".

"Ride Smoothness Compliance Adjustment", by calculation.

Smoothness Compliance Adjustments will be based on the requirements in Section 5-05.3(12) and the following calculations:

1. Final MRI acceptance and incentive/disincentive payments for pavement smoothness will be calculated as the average of the ten 52.8-foot sections in each 528 feet in accordance with the price adjustment schedule.
    a. For sections of a lane that are a minimum of 52.8 feet and less than 528 feet, the price adjustment will be calculated using the average of the 52.8 foot MRI values and the price adjustment prorated for the length of the section.
    b. MRI values per 52.8-feet that were measured prior to corrective work will be included in the 528 foot price adjustment for sections with corrective work.
2. In addition to the price adjustment for MRI a smoothness compliance adjustment will be calculated in the sum of minus $1000.00 for each and every section of single traffic lane 52.8 feet in length in that does not meet the 10-foot straight edge requirements in Section 5-05.3(12) after corrective Work.

Price Adjustment Schedule	
MRI for each 528 ft. section in. / mi.	Pay Adjustment Schedule $ / 0.10 mi.
< 30	2400
30	2400
31	2320
32	2240
33	2160
34	2080
35	2000
36	1920
37	1840
38	1760
39	1680
40	1600
41	1520
42	1440
43	1360
44	1280
45	1200
46	1120
47	1040
48	960
49	880
50	800
51	720
52	640
53	560
54	480
55	400
56	320
57	240
58	160
59	80
60	0
61	0
62	0
63	0
64	0
65	0
66	0
67	0
68	0
69	0
70	0
71	0
72	0
73	0
74	0
75	0
76	-80
77	-160

Price Adjustment Schedule	
MRI for each 528 ft. section in. / mi.	Pay Adjustment Schedule $ / 0.10 mi.
78	-240
79	-320
80	-400
81	-480
82	-560
83	-640
84	-720
85	-800
86	-880
87	-960
88	-1040
89	-1120
90	-1200
91	-1280
92	-1360
93	-1440
94	-1520
95	-1600
96	-1680
97	-1760
98	-1840
99	-1920
100	-2000
101	-2080
102	-2160
103	-2240
104	-2320
105	-2400
106	-2480
107	-2560
108	-2640
109	-2720
110	-2800
111	-2880
112	-2960
113	-3040
114	-3120
115	-3200
116	-3280
117	-3360
118	-3440
119	-3520
120	-3600
121	-3680
122	-3760
123	-3840
124	-3920
≥125	-4000

"Cement Concrete Compliance Adjustment", by calculation.

Payment for "Cement Concrete Compliance Adjustment" will be calculated and paid as described in Section 5-05.3(4)A and the Pavement Thickness Deficiency as described in Section 5-05.5(1).

5-05.5(1) Pavement Thickness

Cement concrete pavement shall be constructed in accordance with the thickness requirements in the Plans and Specifications. Tolerances allowed for Subgrade construction and other provisions, which may affect thickness, shall not be construed to modify such thickness requirements.

Thickness measurements in each lane shall comply with the following:

Thickness Testing of Cement Concrete Pavement	
Thickness Lot Size	15 panels maximum
Thickness test location determined by	Engineer will select testing locations in accordance with WSDOT TM 716 method B.
Sample method	AASHTO T 359
Sample preparation performed by	Contractor provides, places, and secures disks in the presence of the Engineer[1]
Measurement method	AASHTO T 359
Thickness measurement performed by	Contractor, in the presence of the Engineer[2]

[1]Reflectors shall be located at within 0.5 feet of the center of the panel. The Contractor shall supply a sufficient number of 300 mm-diameter round reflectors meeting the requirements of AASHTO T 359 to accomplish the required testing.

[2]The Contractor shall provide all equipment and materials needed to perform the testing.

Thickness measurements shall be rounded to the nearest 0.01 foot.

Each thickness test location where the pavement thickness is deficient by more than 0.04 foot, shall be subject to price reduction or corrective action shall be in accordance with the following.

Thickness Deficiency	Price Reduction or Corrective Action
0.04' < Thickness Deficiency ≤ 0.06'	10% Price Reduction
0.06' < Thickness deficiency ≤ 0.08'	25% Price Reduction
Thickness deficiency > 0.08'	Remove and replace the panels or the panels may be accepted with no payment at the discretion of the Engineer.

The price reduction shall be computed by multiplying the percent price reduction in the table above by the unit Contract price by the volume of pavement represented by the thickness test lot.

Additional cores may be taken by the Contractor to determine the limits of an area that has a thickness deficiency greater than 0.04 feet. Cores shall be taken at the approximate center of the panel. Only the panels within the limits of the deficiency area as determined by the cores will be subject to a price reduction or corrective action. The cores shall be taken in the presence of the Engineer in accordance with AASHTO T 24 and delivered to the Engineer for measurement in accordance with AASHTO T 148. All costs for the additional cores including filling the core holes with patching material meeting the requirements of Section 9-20 will be the responsibility of the Contractor.

5-05.5(1)A Vacant

5-05.5(1)B Vacant