

CATEGORY 500 PAVING

SECTION 501 - AGGREGATE BASE COURSES

501.01 DESCRIPTION. This work shall consist of constructing base courses using one of the following as specified in the Contract Documents or as directed by the Engineer:

- (a) Graded aggregate without a stabilizing agent.
- (b) Plant mixed graded aggregate with a portland cement stabilizing agent.
- (c) Bank run gravel.
- (d) Sand aggregate.

501.02 MATERIALS.

Graded Aggregate for Base Course	901
Bank Run Gravel for Base Course	901
Sand Aggregate Base Course	
Coarse Aggregate Portion	901 CA-PCC-57
Fine Aggregate Portion	916 Select Borrow
Portland Cement	902 Type I or IA
Emulsified Asphalt	904.05
Production Plant	915
Water	921.01
Calcium Chloride	921.02

501.03 CONSTRUCTION. At least 30 days prior to the start of constructing the base course, the Contractor shall submit to the Engineer proposed plants, equipment, and material sources.

The Contractor shall protect the subgrade and base against damage from all causes. Any part of the subgrade or base that is damaged shall be re-

paired or replaced by and at the Contractor's expense, in a manner acceptable to the Engineer.

501.03.01 Equipment. All equipment, including the production plant and on-site equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations.

501.03.02 Weather.

- (a) **Temperature and Surface Conditions.** Graded aggregate stabilized with portland cement shall be placed only when the ambient air and surface temperature is at least 40 F (4 C) and rising. Graded aggregate, bank run gravel and sand aggregate base shall be placed only when the ambient air and surface temperature is at least 32 F (0 C) and rising. No material shall be placed on a frozen subgrade.
- (b) **Cold Weather Protection.** The plant mixed graded aggregate stabilized base shall be protected from freezing during the seven day curing period.
- (c) **Precipitation.** Construction shall not take place during precipitation. When precipitation has occurred during the previous 24 hours, the Engineer will determine if the subgrade is sufficiently dry. Any material en route from the plant to the job site may be placed at the Contractor's risk.

501.03.03 Subgrade Preparation. The approved subgrade set to final line and grade shall be completed at least 500 ft (150 m) ahead of the base course or as directed by the Engineer before the base course construction begins. The foundation shall be constructed as specified in Sections 204 and 208, the Contract Documents, and as approved by the Engineer. If traffic, including construction equipment, is allowed to use the subgrade foundation or preceding layer, it shall be distributed over the entire width of the course to aid in obtaining uniform and thorough compaction. If ruts are formed, they shall be removed by reshaping and recompacting the affected area as specified in Section 204.

501.03.04 Stabilized Graded Aggregate Base Mix. The amount of portland cement shall be determined as specified in MSMT 321.

501.03.05 Bank Run Gravel Base Mix. The Contractor will be permitted to mix or blend materials using chemical additives approved by the Engineer.

501.03.06 Sand Aggregate Base Mix. The mixture shall contain 35 to 40 percent coarse material as measured by dry weight of the total mix.

501.03.07 Transportation. Mixed base materials shall be handled and transported in a manner that minimizes segregation and loss of moisture. All loads shall be covered in conformance with State laws unless hauling is off road and is approved by the Engineer. Dumping into piles, hauling over the completed base course, and stockpiling of material on the job site is prohibited unless approved by the Engineer.

501.03.08 Spreading. The base material shall be uniformly spread without segregating the coarse and fine particles, in layers of approximately equal thickness, to provide the specified planned depth. Shoulders or berms not less than 2 ft (0.6 m) wide shall be built up on each side of the base to the top elevation of each uncompacted layer unless the base is placed against concrete curbs or gutters.

501.03.09 Grade or Finished Surface Control. The surface of the base material shall be brought to line and grade and shaped to the specified cross section. Grades shall be set longitudinally and transversely with fixed controls not to exceed 25 ft (8 m) spacing. The surface material shall be compacted and smoothed over its full width using a smooth faced steel wheeled roller or, if rolling is not feasible, by mechanical tampers and vibratory compactors as approved by the Engineer. The finished grade shall not deviate more than 1/2 in. (13 mm) from the established grade.

501.03.10 Finishing. The surface of the base material shall be shaped to the required lines, grades and cross section specified in the Contract Documents.

501.03.11 Compaction. Immediately after placement, the base material

shall be compacted to the required density. During compaction operations, the moisture content of the material shall be maintained within 2 percent of the materials optimum moisture. The optimum moisture content and maximum dry density shall be determined as follows:

Sand Aggregate Base and Bank Run Gravel Base	T 180
Graded Aggregate Base and Graded Stabilized Aggregate Base	MSMT 321

Graded Aggregate for Base, Bank Run Gravel Base, and Sand Aggregate Base shall be compacted to a density not less than 97 percent of the maximum dry density. Graded Stabilized Aggregate Base shall be compacted to a dry density not less than 95 percent of the maximum dry density. In-place density shall be measured as specified in MSMT 350 or 352.

Compaction operations, except on superelevated curves, shall begin at the sides of the course, overlap the shoulder or berm at least 1 ft (0.3 m) and progress toward the center parallel to the center line of the roadway. Superelevated curve compaction shall begin at the low side of the superelevation and progress toward the high side. The compaction operation shall continue until all compaction marks are eliminated.

501.03.12 Graded Stabilized Aggregate Base Protection and Curing. When Graded Stabilized Aggregate Base is used, the spreading, compacting and shaping shall be completed within three hours after the mixing water, cement and aggregate have come in contact. Any section not meeting these requirements shall be reconstructed as directed by the Engineer at the Contractor's expense. The surface of the stabilized aggregate base course shall be maintained in a moist condition until the emulsified asphalt seal coat is applied. The emulsified asphalt shall be applied by distributing equipment as specified in 503.03.01 at the rate of 0.2 gal/yd² (0.9 l/m²). Ponding of the emulsified asphalt shall be avoided. If ponding occurs, the Contractor shall use a sand blotter or an equivalent method as approved by the Engineer.

The stabilized aggregate base course shall be allowed to cure for a period

of seven days. During this period the base course shall be closed to all traffic. Any portion of the base course seal coat that is damaged shall be repaired at the Contractor's expense.

501.03.13 Calcium Chloride. When specified in the Contract Documents or as directed by the Engineer, Calcium Chloride shall be applied to the surface of the graded aggregate base, bank run gravel base, and the sand asphalt base at the rate of 1 lb/yd² (540 g/m²).

501.03.14 Maintenance. During construction and after completion of the base course, the base shall be maintained by the Contractor until the surface course is placed. Unacceptable work that cannot be repaired shall be replaced for the full depth of the base at the Contractor's expense.

On all development projects, the base course and concrete curb and gutter shall be constructed and then maintained for a period of at least 60 days unless otherwise noted on the Plans or directed by the Engineer. After the maintenance period has ended, the base course shall be cleaned of all foreign material and shall be approved by the engineer before the surface course is placed.

The Contractor shall be responsible for the posting and maintenance of signs, and all damage or injury to any person or property during the prosecution of all work under the Contract.

501.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all aggregate, furnishing, hauling, placing, curing, and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

501.04.01 Graded Aggregate Base Course, Graded Aggregate Base Course stabilized with cement, Bank Run Gravel Base Course, and Sand Aggregate Base Course will be measured and paid for at the Contract unit price per square yard.

Surface area measurements will be based on the width of the base as specified in the Contract Documents and the actual length measured along the center line of the base surface.

501.04.02 The Portland Cement stabilizing agent and the emulsified asphalt for seal coat will not be measured but the cost will be incidental to the Contract unit price per square yard for Graded Aggregate Base Course Stabilized with Cement.

501.04.03 Bank Run Gravel Base. Material manipulation or addition of chemical additives will not be measured but the cost will be incidental to the Contract unit price per square yard for Bank Run Gravel Base Course.

501.04.04 Calcium Chloride will be measured and paid for at the Contract unit price per square yard or if specified in the Contract Documents, at the Contract unit price per ton.

501.04.05 The cost of cleaning the base course will be paid for at the contract unit price for this item shown in the Proposal.

SECTION 502 - SOIL-CEMENT BASE COURSE

502.01 DESCRIPTION. This work shall consist of constructing soil cement base course using a combination of soil and portland cement, uniformly mixed, moistened, compacted, shaped and sealed. Unless otherwise specified in the Contract Documents, the soil, cement and water may be mixed in a plant or mixed in-place, at the Contractor's option.

502.02 MATERIALS.

Portland Cement	902
Emulsified Asphalts	904.05
Production Plant	915
Soil	916; Capping shall not contain aggregate retained on a 3 in. (75 mm) sieve, nor more than 45 percent retained on a No. 4 (4.75 mm) sieve
Water	921.01

502.03 CONSTRUCTION. At least 30 days before beginning construction, the Contractor shall submit to the Engineer for approval, proposed production plants, location of plants with respect to project site, equipment, and material sources.

The Contractor shall protect the subgrade and base against damage from all causes. Any part of the subgrade or base that is damaged shall be repaired or replaced by and at the Contractor's expense in a manner acceptable to the Engineer.

502.03.01 Equipment. All equipment, including the production plant and on-site equipment, shall be subject to approval by the Engineer. The production plant shall be ready for inspection by the Engineer at least 48 hours before the start of construction operations.

502.03.02 Weather.

- (a) **Temperature and Surface Conditions.** Soil-cement base course shall be placed only when the ambient air and surface temperature is at least 40 F (4 C) and rising. No material shall be placed on frozen subgrade.
- (b) **Cold Weather Protection.** The completed base shall be protected from freezing during the 7 day curing period.
- (c) **Precipitation.** Construction shall not take place during precipitation. When precipitation has occurred during the previous 24 hours, the Engineer will determine if the subgrade is sufficiently dry. If precipitation occurs during placement, material en route from the plant to the job site may be placed at the Contractor's risk.

502.03.03 Subgrade Preparation. The approved subgrade set to final line and grade shall be completed at least 500 ft (150 m) ahead of the base course or as directed by the Engineer before the base course construction begins. The foundation shall be constructed as specified in Sections 204 and 208, the Contract Documents, and as approved by the Engineer. If traffic, including construction equipment, is allowed to use the subgrade foundation or preceding layer, it shall be distributed over the entire width of

the course to aid in obtaining uniform and thorough compaction. If ruts are formed, they shall be removed by reshaping and recompacting the affected area as specified in Section 204.

502.03.04 Design Mix. At least 45 days prior to the start of constructing the base course, the Contractor shall submit to the Engineer, samples of the soil and portland cement from the proposed material sources. Materials shall be sampled as specified in the Materials Manual Field Procedures. The Engineer shall determine the exact proportions of soil and portland cement, and the optimum moisture content based on these samples. Proportions may be revised during construction to provide for changing conditions as directed by the Engineer. Plant mixed material shall be sampled at the plant. Mixed in place material shall be sampled from a 100 ft (30 m) long control strip constructed on the site by the Contractor.

502.03.05 Transportation. Mixed materials shall be handled and transported to minimize segregation and loss of moisture. All loads shall be covered in conformance with State laws unless hauling is off road and is approved by the Engineer. Dumping into piles, hauling over the completed base course, and stockpiling of mixed material is prohibited unless approved by the Engineer.

502.03.06 Spreading of Plant Mix Material. The approved soil-cement mix shall be uniformly spread over the subgrade, without segregating the coarse and fine particles, in layers of approximately equal thickness, to provide the specified planned depth. Shoulders or berms not less than 2 ft (0.6 m) wide shall be built up on each side of the base to the top elevation of each uncompacted layer unless the base is placed against concrete curbs or gutters.

502.03.07 Mixed In Place Construction. The soil base material shall be pulverized to ensure that, at the completion of moist mixing, 100 percent passes a 1 in. (25 mm) sieve and a minimum of 80 percent passes a No. 4 (4.75 mm) sieve. Moisture content of soil at the time of cement application shall not vary more than 2 percent from optimum. Portland cement shall then be spread on the soil at the approved spread rate. The Contractor shall use an accurate scale to verify the spread rate in the presence of the Engineer. The pulverized soil and cement shall then be thoroughly mixed.

Immediately after the mixing operation is completed, the water shall be sprayed on the mixture at the approved rate using a pressurized distributor. The soil/cement/water combination shall be mixed until it is uniform, as determined by the Engineer.

502.03.08 Grade or Finished Surface Control. The surface of the base material shall be brought to line and grade and shaped to the specified cross section. Grades shall be set longitudinally and transversely with fixed controls not to exceed 25 ft (8 m) spacing. The surface material shall be compacted and smoothed over its full width using a smooth faced steel wheeled roller or if rolling is not feasible by mechanical tampers and vibratory compactors as approved by the Engineer. The finished grade shall not deviate more than 1/2 in. (13 mm) from the established grade.

502.03.09 Finishing. The surface of the base material shall be shaped to the required lines, grades and cross section specified in the Contract Documents.

502.03.10 Compaction. Immediately after placement, the soil-cement base shall be compacted to a density of not less than 100 percent of the maximum density as determined by T 134. In-place density shall be measured as specified in MSMT 350. The Contractor shall provide a portland cement concrete compaction block as specified in 204.03.04.

At the start of compaction, the percentage of moisture in the mixture shall not be more than two percentage points above or below the specified optimum moisture content of the soil-cement mixture. Compaction operations, except on superelevated curves, shall begin at the sides of the course, overlap the shoulder or berm at least 1 ft (0.3 m) and progress toward the center parallel to the center line of the roadway. Superelevated curve compaction shall begin at the low side of the superelevation and progress toward the high side. The compaction operation shall continue until all compaction marks are eliminated.

502.03.11 Construction Joints. At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a vertical face. The base for large, wide areas shall be built in a series of parallel lanes of convenient length and width, complete

with longitudinal joints, as approved by the Engineer.

502.03.12 Protection and Curing. All spreading, compacting and shaping shall be completed within three hours after mixing water, cement and soil have come in contact. Any section not conforming to these requirements shall be reconstructed as directed by the Engineer. The surface of the base course shall be maintained in a moist condition until the emulsified asphalt is applied. The emulsified asphalt shall be applied by distributing equipment as specified in 503.03.01 at the rate of 0.2 gal/yd² (0.9 l/m²). Ponding of the emulsified asphalt shall be avoided. If ponding occurs, the Contractor shall use a sand blotter or an equivalent method as approved by the Engineer.

The soil cement base course shall be allowed to cure for a period of seven days. During this period the base course shall be closed to all traffic. Any portion of the base course that is damaged shall be repaired at the Contractor's expense.

502.03.13 Maintenance. During construction and after completion of the base course, the base shall be maintained by the Contractor until the surface course is placed. Unacceptable work that cannot be repaired shall be replaced for the full depth of the base course at the Contractor's expense.

502.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for furnishing, hauling, mixing, placing, compacting, watering, control strip, emulsified asphalt, and for all labor, equipment, tools, and incidentals necessary to complete the work.

502.04.01 Soil-Cement Base Course will be measured and paid for at the Contract unit price per square yard.

Surface area measurements will be based on the width of the base as specified in the Contract Documents and the actual length measured along the center line of the base surface.

502.04.02 Portland Cement for Soil-Cement Base Course will be measured and paid for at the Contract unit price per ton.

SECTION 503 - CHIP SEAL SURFACE TREATMENT

503.01 DESCRIPTION. This work shall consist of applying one or two seal coats or a prime coat followed by one or two seal coats as specified in the Contract Documents or as directed by the Engineer. The seal coat shall consist of applying an emulsified asphalt followed by an application of aggregate. The prime coat, when required, shall consist of preparing and treating an existing surface with cutback asphalt.

503.02 MATERIALS.

MATERIAL	SECTION	APPLICATION	SIZE or GRADE	SPREAD RATE lb/yd ² (kg/m ²)	SPRAY TEMP F (C)	SPRAY RATE SINGLE COAT or FIRST COAT gal/yd ² (l/m ²)	SPRAY RATE FOR SECOND COAT (Double) gal/yd ² (l/m ²)
Aggregate	901	Single or First Coat	No. 7	25-50 (11-27)	—	—	—
		Second (Double Coat)	No. 8	20-35 (11-19)	—	—	—
Cutback Asphalts	904.04	Prime Coat	MC-30	—	75-100 (24-38)	0.1 - 0.5 (0.5 - 2.3)	—
			MC-70	—	105-175 (42-80)	0.1 - 0.5 (0.5 - 2.3)	—
Emulsified Asphalts	904.05	Seal Coat	CRS-1	—	70-140 (21-60)	0.3 - 0.5 (1.4 - 2.3)	0.2 - 0.4 (0.9 - 1.8)
			CRS-2	—	140-160 (60-71)	0.3 - 0.5 (1.4 - 2.3)	0.2 - 0.4 (0.9 - 1.8)
			RS-1	—	70-140 (21-60)	0.3 - 0.5 (1.4 - 2.3)	0.2 - 0.4 (0.9 - 1.8)
			RS-2	—	140-160 (60-71)	0.3 - 0.5 (1.4 - 2.3)	0.2 - 0.4 (0.9 - 1.8)

503.03 CONSTRUCTION. At least 30 days prior to the start of placement of the chip seal surface treatment, the Contractor shall submit to the Engineer for approval a proposed plan, including equipment and material sources.

The Contractor shall protect the treated pavement against damage from all causes. Any part of the pavement that is damaged shall be repaired or replaced by and at the expense of the Contractor.

503.03.01 Equipment. All equipment shall be subject to approval by the Engineer.

(a) **Asphalt Distributing Equipment.** Asphalt distributing Equipment will be inspected and calibrated by the Administration prior to use and shall bear a current Administration inspection and calibration tag. A calibration chart showing the total capacity, in gallons (liters), of the distributor tank, and the fractional capacity for each 1/4 in. (6 mm) of tank depth shall be carried in the unit. The unit shall be capable of uniformly applying the specified material on variable widths of surface at the rates specified in 503.02. In addition, the equipment shall include the following:

- (1) A fifth wheel tachometer for maintaining uniform speed.
- (2) A thermometer graduated in 2 F (1 C) increments to determine the specified temperature ranges.
- (3) Heaters for uniformly heating the materials to the proper temperatures.
- (4) Full circulation spray bars that are laterally and vertically adjustable, plus a hand spray.
- (5) A calibrated tank to determine the quantity of asphalt in each load and the amount used.
- (6) A valve or petcock built into the equipment for sampling the asphalt.
- (7) A motor driven pump with pressure gauges to deliver the material to the spray bars. When a variable speed pump and metering system is used, the Contractor shall provide the Engineer with charts prepared by the manufacturer for selecting the proper pump speed for each application.

(b) **Aggregate Spreader.** The aggregate spreader shall be either self propelled or attached to a truck tailgate.

(c) **Rollers.** Refer to 504.03.01(c).

503.03.02 Weather. The chip seal surface treatment shall be placed only when the ambient air and surface temperature is at least 50 F (10 C) and rising. Pavement shall be clean and dry. When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk. If placement of the material is stopped by the Engineer, all material en route shall be wasted at the Contractor's expense.

503.03.03 Foundation Preparation. Prior to placement of the chip seal surface treatment material, the foundation for the chip seal shall be constructed as specified in the Contract Documents and as directed by the Engineer. When paving over existing pavement, ruts and pot holes shall be repaired to provide a smooth surface for the application of the chip seal surface treatment.

503.03.04 Prime Coat. Prior to the application of the prime coat, the surface shall be cleaned of all loose and foreign materials. The prime coat shall be uniformly applied to the surface at the application rate specified in 503.02. Excess material in pools shall be removed before the next coat.

503.03.05 First Seal Coat.

- (a) A minimum of 24 hours after the application of the prime coat, an emulsified asphalt shall be sprayed on the surface at the application rate specified in 503.02.
- (b) Immediately following the asphalt application, a dry, dust free aggregate shall be spread on the surface at the application rate specified in 503.02. Excess aggregate shall be removed and all areas containing insufficient aggregate shall be corrected.

503.03.06 Rolling. Immediately following the aggregate application, the surface shall be rolled until the aggregate is uniformly embedded into the asphalt. The rolling shall be discontinued if the aggregate begins to crush.

503.03.07 Second Seal Coat. When specified, but no sooner than 24 hours after the first seal coat, a second seal coat shall be applied to the

surface, omitting the prime coat. The application rate for emulsified asphalt and aggregate shall be as specified in 503.02. Excess aggregate shall be removed and all areas containing insufficient aggregate shall be corrected. The surface shall then be rolled as specified in 503.03.06.

503.03.08 Traffic. Completed sections shall be closed to traffic until the final seal coat has completely cured as directed by the Engineer. The Contractor shall maintain the treated surface after it has been opened to traffic until final acceptance.

503.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for the foundation preparation, furnishing, hauling, preparing, removing excess aggregate, placing materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Chip Seal Surface Treatment will be measured and paid for at the Contract unit price for one or more of the items listed below as specified in the Contract Documents.

503.04.01 No. 7 Aggregate for Single Coat Chip Seal Surface Treatment per ton.

503.04.02 No. 8 Aggregate for Second Coat Chip Seal Surface Treatment per ton.

503.04.03 Cutback Asphalt for Prime Coat per gallon.

503.04.04 Emulsified Asphalt for Seal Coat per gallon.

The actual number of gallons of cutback asphalt (if specified) and emulsified asphalt distributed will be corrected to the corresponding volume at 60 F (16 C) as determined by use of conversion tables furnished by the Administration.

SECTION 504 - HOT MIX ASPHALT PAVEMENT

504.01 DESCRIPTION. This work shall consist of constructing Hot Mix Asphalt (HMA) pavement as specified in the Contract Documents. Except

as otherwise provided in Section 506, this section includes requirements for open graded friction course (OGFC).

504.02 MATERIALS.

Tack Coat	904.05
Hot Mix Asphalt (HMA)	904.06
Crack Filler	911.01
Production Plant	915

504.03 CONSTRUCTION. A pre-paving Conference shall be held on site before any paving is begun. The Contractor shall make the request sufficiently ahead of time to schedule the Pre-paving Conference as needed. Before the finish surface course is begun the Contractor must receive authorization to proceed with surface paving from the Engineer.

The Contractor shall protect the pavement against damage from all causes. Any part of the pavement that is damaged shall be repaired or replaced by and at the expense of the Contractor.

504.03.01 Equipment. All equipment, including the production plant and paving equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations.

- (a) **Hauling Units.** Refer to 915.02(g). Pressure Distribution Equipment must be capable of uniformly applying the specified bituminous material on variable widths of surface at rates of 0.01 to 0.10 ga./yd² of residual asphalt. The equipment must be in accordance with Section 503.03.01 when the tack coat is a separate pay item. Due regard shall be given to the safety and convenience of the public while applying and maintaining the tack coat. Provisions shall be made to minimize hauling trucks from tracking tack coat onto the adjacent pavement.
- (b) **Pavers.** Pavers will be inspected and approved by the Engineer based upon requirements in the manufacturer's specification manual with a copy to be provided by the Contractor. The paver shall be

a self-contained, power propelled unit capable of spreading the mixture true to line, grade and cross slope. The paver shall be equipped with a screed or strike off assembly which can produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. The paver shall have automatic controls for transverse slope and grade. Controls shall be capable of sensing grade from an outside reference line or ski and sensing the transverse slope of the screed to maintain the required grade and transverse slope within plus or minus 0.1 of the required slope percentage.

Manual operation will be permitted in the construction of irregularly shaped and minor areas, or where directed by the Engineer. Whenever a breakdown or malfunction of any automatic control occurs, the equipment may be operated manually for the remainder of the work day as directed by the Engineer.

Reference lines or other suitable markings to control the horizontal alignment shall be provided by the Contractor, subject to the approval of the Engineer.

When placing any surface lane greater than 500 feet in length, a ski of 15 feet or greater must be used at each edge, unless a reference line is set or joint matcher is used when abutting previous surface paving or gutter pan, or slope control is provided on the machine.

- (c) **Rollers.** Rollers shall be self-propelled, reversible, steel-wheeled or pneumatic tired. Vibratory rollers may be used, except they shall not be in vibratory mode when paving on bridge decks or surface courses without the approval of the Engineer. Pneumatic tire rollers shall have multiple tires of equal size with smooth tread. Wheels shall be arranged to oscillate in pairs, or they may be individually sprung. Tires shall be uniformly inflated at the operating pressure approved by the Engineer. The Contractor shall furnish the Engineer a manufacturer's table showing this data. The difference in tire pressure between any two tires shall not be greater than 5 psi (35 kPa). The Contractor shall provide a means for checking the tire pressure on the job at all times.

(d) Reserved.

(e) Grade References: The Contractor must provide a ten-foot straightedge, stringline, and paint for marking grade references.

(f) Thermometers: The Contractor shall provide a thermometer for measuring the temperature of hot mix in trucks. Trucks must have a sufficient side hole for access to the truck bed. In addition, a probe-type surface thermometer shall be provided for checking mat temperature.

504.03.02 Weather. Pavement shall not be placed when the air temperature at the surface is below that indicated for the following courses: 50 degrees Fahrenheit and rising for smooth seal, or any course one inch or less; 40 degrees Fahrenheit and rising for surface course, or any course having a nominal depth of less than 2 inches; or 32 degrees Fahrenheit and rising for any other paving course. The base shall be clean and dry and approved by the Engineer before HMA paving begins. HMA pavement shall not be placed on a frozen base. When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk. If placement of the material is stopped by the Engineer, all material en route shall be wasted at the Contractor's expense.

504.03.03 Foundation Preparation

A. Foundation Preparation. Prior to the placement of paving material, the foundation shall be constructed as specified in the Contract Documents and approved by the Engineer. When paving over existing pavement, all excess crack filling or patch material shall be removed and all spalls and potholes shall be cleaned, tack coated, filled, and tamped with hot mix asphalt before placement. Manholes, valve boxes, inlets, and other appurtenances within the area to be paved shall be set 1/4 inch below the finished grade of the road surface and the mortar shall be allowed to set a minimum of twelve hours before the surface course is placed. Reference lines for horizontal alignment and grade markings for vertical control shall

be provided by the Contractor subject to the approval of the Engineer. This shall include marking with paint the depth of mat needed to achieve the finished surface elevation. Such depth marks shall be made at checkpoints on the surface upon which the paving material is to be placed.

- B. On development projects when the plans indicate a paving section consisting of courses of 2 1/2 in. and 1 1/2 in. of bituminous concrete (minimum) the item Bituminous Concrete Wedge/Level will be included in the proposal. The item will be used to level any depressions in the first (lower) bituminous course caused by construction activity or settlement.

This item will only be used to correct irregularities of paving due to an approved lapse of time between placing the two paving courses. The first course of bituminous base will be checked to determine its correctness immediately after placement to assure it is within specified tolerances. Any needed corrections will be made at that time but will not be part of this item.

Upon resuming the paving operation, grades will be checked to assure the first course surface meets the following tolerances immediately prior to placing surface paving. The bituminous concrete wedge/level will be placed where the first course of bituminous paving is more than 1/4 in. below the proposed grade or where there are deviations of more than 3/8 in. 10 ft. to the plane of the paving. Grades will be rechecked after wedge/level operations. No payment will be made as part of the Bituminous Concrete Wedge/Level item for material placed beyond the upper limits of the first course.

- C. **Foundation Preparation.** To protect against accidental clogging, existing sanitary sewers shall be covered within manholes, as directed by the engineer, prior to any grubbing or grading operations. All adjustments to utilities other than those specifically included in the proposal shall be performed by the utility owners. Adjustments to water services between the meter and the main must be performed by qualified Utility Contractors. Adjustments between the

meter and the house must be performed under the supervision of a Registered Master Plumber. Adjustments to sanitary sewers outside of the County right-of-way must be performed under the supervision of a Registered Master plumber. It shall be the Contractor's responsibility to obtain all permits necessary for the performance of this work.

504.03.04 Tack Coat. Prior to application of the tack coat, the surface shall be cleaned of all loose and foreign materials. The tack coat shall be uniformly applied to the surface by full circulation spray bars that are laterally and vertically adjustable and provide triple fanning and overlapping action so that the resulting coating shall be applied at a rate of 0.02 to 0.05 gallons per square yard asphalt emulsion as directed by the Engineer.

504.03.05 Hot Mix Asphalt Placement. HMA shall be placed by the paver. Delivery of the mixture by the hauling units and placement shall be continuous. The temperature of the mixture shall not be less than 225 F (107 C) at the time of placement. Broadcasting of loose mixture over the new surface will not be permitted.

504.03.06 Compaction. Immediately following placement of the HMA, the mixture shall be compacted by rolling to an in-place density of 92.0 to 97.0 percent of the maximum density. In-place compaction shall be completed before the mixture cools below 185 F (85 C), as determined by a probe type surface thermometer, supplied by the Contractor and approved by the Engineer. Price adjustment due to noncompliance with the required density will be as specified in 504.04.03.

Rolling shall consist of six separate operations in the following sequence:

- (a) Transverse joint.
- (b) Longitudinal joint.
- (c) Edges.
- (d) Initial breakdown rolling.
- (e) Second or intermediate rolling.
- (f) Finish rolling.

Steel wheel rollers shall be used for the first rolling of all joints and edges, the initial breakdown rolling, and the finish rolling.

Rollers shall start at the sides and proceed longitudinally toward the center of the pavement, except on superelevated curves. The rolling shall begin at the low side and progress toward the high side. Successive trips of the roller shall overlap by at least one half the width of the roller, and alternate trips shall not end at the same point. In base widening too narrow to permit the use of conventional rollers, a power driven trench roller shall be used. If the trench must be excavated wider than the proposed width of the widening, an earth berm or shoulder shall be formed against the loose HMA as soon as it is placed. The two materials shall be rolled and compacted simultaneously. Roller marks shall not be visible after rolling operations. After rolling is completed, no traffic of any kind will be permitted on the pavement until the pavement has cooled to <140 F (60 C) or as directed by the Engineer.

504.03.07 Joints. Both longitudinal and transverse joints in successive courses shall be staggered so that one is not above the other. Transverse joints shall be staggered by the length of the paver. Longitudinal joints shall be staggered a minimum of 6 in. (150 mm) and shall be arranged so that the longitudinal joint in the top course shall be within 6 in. (150 mm) of the line dividing the traffic lanes.

Joints shall be constructed to provide a continuous bond between the old and new surfaces. Joints shall be coated with tack coat as directed by the Engineer. In the case of surface course, the edge of the existing pavement shall be cut back for its full depth on transverse joints to expose a fresh surface and the surface shall be coated with tack coat material as directed by the Engineer. Before placing the mixture against curbs, gutters, headers, manholes, etc., all contact surfaces shall be coated with tack coat.

All joints shall be well-bonded and sealed. Cold joints shall be painted with tack and adjoining material shall be placed so as to overlap contiguous surfaces by one to two inches forming a consolidated lip of material equal to 1/4 the thickness, or depth, of the unrolled surface. This overlapping lip shall be luted back onto the edge of the unrolled surface material creating a blunt ridge which shall be rolled into the new joint. Overlapping material shall not be broadcast onto the hot lane. When lanes are placed simultaneously, with two pavers moving in tandem, the loose depth shall match exactly.

The Engineer's representative may direct the edge of old or previously placed pavement be cut down to full depth and cut back far enough to expose a fresh surface before joining a new material in order to assure a clean, even, and dense bond. All transverse joints shall be constructed in this manner. At all existing pavement, new material shall be installed to overlap existing paving by one or two inches and luted back onto the edge of the unrolled mix as specified above.

Curbs, gutters, manholes etc. which will abut or join new material or pavements, shall be painted with a thin, uniform coating of hot tack before the hot mixture is placed against them. After the hot mixture is placed by the finishing machine, sufficient hot material shall be placed to fill any spaces left open. In addition, a sufficient quantity of hot material shall overlap the contact surfaces to allow for a luted ridge that will compact 1/4 inch above gutter edges, manholes, and inlet frames. At reverse gutters the finished edges shall be flush. Finished surfaces shall not be stained.

504.03.08 Heeling-In. Where tapering of the material from specified thicknesses is required to tie in with an existing asphalt pavement or structure, heeling-in to the existing pavement or structure will be required. The heeling-in operation shall include the removal of a transverse portion of the existing pavement or structure in areas indicated by the Engineer.

504.03.09 Sampling and Testing. The Contractor shall furnish and deliver to the materials testing laboratory designated by the Engineer samples cut from each compacted course at locations designated by the Engineer. The sampling frequency must be approximately one per 200 tons (sub-lot), but not less than two per working day (lot). These cores shall be delivered no later than the next work day after compaction. The unit weight of these samples will be determined by the laboratory personnel. Results will be available to the Contractor the next work day after receiving cores. The Contractor is responsible for repairs to areas from which samples are cut.

Exceptions: Density test samples are not required on contracts of less than 200 tons, where bituminous concrete is used in non-traffic-bearing areas, and on resurfaced bridge decks.

Should the Contractor fail to submit cores, a minimum of five percent (5%) shall be deducted from the pay factor.

504.03.10 Control Strip. Reserved

504.03.11 Smoothness Tolerance in Base, Binder and Surface Course. After final compaction, the surface of the pavement shall be true to the established crown and grade, and shall be sufficiently smooth so that when tested with a straightedge placed upon the surface parallel with the centerline, the surface shall not vary more than one-eighth (1/8) inch from a true surface.

The transverse slope of the finished surface shall be uniform to such a degree that when tested with a straightedge placed perpendicular to the centerline, the surface shall not vary greater than three-sixteenth (3/16) inch from a true surface. Transverse joints shall be checked with a straightedge immediately after the initial rolling. Should the surface vary more than one-eighth (1/8) inch from true, the contractor shall make immediate corrections suitable to the Engineer so that the finished joint surface shall not vary more than one-eighth (1/8) inch from a true surface and the material in all other aspects shall meet these Specifications.

The Contractor shall have available at all times an approved ten (10) foot straightedge.

504.03.12 Curbs, Gutters, Etc. Where permanent curbs, gutters, edges, and other supports are planned, they shall be constructed and backfilled prior to placing the HMA, which shall then be placed and compacted against them.

504.03.13 Shoulders. Shoulders abutting the HMA surface course of any two lane pavement that is being used by traffic shall be completed as soon as possible after completion of the surface course on that lane. Shoulder construction shall be as specified in the applicable portions of Category 600 and the Contract Documents.

504.03.14 Pavement Profile. Reserved.

504.04 MEASUREMENT AND PAYMENT. Hot Mix Asphalt Pavement will be measured and paid for at the Contract unit price per ton. The payment will be full compensation for furnishing, hauling, placing all materi-

als including antistripping additive, tack coat, pot hole and spall repairs, setting of lines and grades where specified, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Removal of the existing pavement or structure to heel-in the Hot Mix Asphalt will not be measured but the cost will be incidental to the Contract unit price per ton for Hot Mix Asphalt Pavement. When the existing pavement is milled, heel-in is not required.

Adjustment of existing visible manholes, valve boxes, inlets, or other structures will be paid on a force account basis unless an item for payment is provided in the Contract.

For development projects, repairs to failures in the first bituminous course will be paid by a negotiated pay item or force account, as will the cost of cleaning the surface of the first course.

Protection of sanitary sewer manholes shall not be a separate pay item but will be included in the cost of other bid items.

504.04.01 Bid Price Adjustment Hot Mix Asphalt. An adjustment will be made to the final Contract unit price of hot mix asphalt if the price of asphalt cement fluctuates significantly from the prevailing price as quoted in the Contract Documents to the date of placement. For Contracts scheduled to be paved during more than one construction season or having an estimated mix quantity of 10 000 tons (9080 Mg) or more, the Contract unit price will be adjusted by the amount of fluctuation above 5 percent. For Contracts completed within one construction season and having an estimated mix quantity of less than 10 000 tons (9080 Mg), the adjustment will be based upon the amount of fluctuation above 15 percent. Only the differential percent change beyond the noted 5 and 15 percent will be used.

Materials used under “maintenance of traffic” items will not be considered. No adjustment to bid price will be made for contracts requiring less than 1000 tons. To be eligible for payment, the Contractor must submit to the County a request including a breakdown of the computations and data involved. To receive a credit from the Contractor, the County will be responsible for providing the documentation. Payments or credits will be made

by Supplemental Agreement when all paving has been completed or at the end of any month that the accrued unpaid adjustment exceeds \$1,000.

For the purpose of making these calculations, a monthly price index will be maintained by the Administration. This index will be the average F.O.B. selling price of asphalt cement at the supplier's terminal in Maryland.

The adjusted bid price of hot mix asphalt will be computed monthly by using the following formula:

$$F = \frac{P_p - P_b}{P_b} \times 100$$

where:

F = percent price increase/decrease of asphalt cement.

P_p = index price of asphalt cement/ton at placement date, and

P_b = prevailing index price of asphalt cement/ton as specified in the Invitation for Bids.

Adjusted bid price due Contractor when price of asphalt cement increases:

$$A = B + (D \times T \times P_b)$$

Adjusted bid price due Administration when price of asphalt cement decreases:

$$A = B - (D \times T \times P_b)$$

where:

A = adjusted bid price/ton of Hot Mix Asphalt.

B = bid price/ton of Hot Mix Asphalt.

D = differential percentage expressed as a decimal
(F - 5 percent or F - 15 percent as defined above).

T = design target asphalt content expressed as a decimal, and

P_b = prevailing index price of asphalt cement/ton as specified in the Invitation for Bids.

504.04.02 Bid Price Adjustment Asphalt Content. A price adjustment may be made as specified in the General Provisions GP-5.02 when asphalt content tests indicate that the asphalt content of a hot mix pavement mixture does not conform to Specifications. The Contract unit price will be adjusted in conformance with these procedures and MSMT 413. The pay factor will be as noted in the following table. If the weighted average deviation exceeds the values in the following table, the Engineer may invoke other provisions of GP-5.02.

The price adjustment for asphalt content deviation will be applied to the adjusted bid price of hot mix asphalt.

PRICE ADJUSTMENT BASED ON AC DEVIATIONS FROM TARGET VALUE				
PAY FACTOR	— WEIGHTED AVERAGE DEVIATIONS (dw)			
	2 TEST VALUE	3 TEST VALUE	4 TEST VALUE	5 TEST VALUE
1.00	< .55	< .47	< .42	< .39
0.95	.55 - .61	.47 - .52	.42 - .46	.39 - .43
0.90	.62 - .68	.53 - .58	.47 - .51	.44 - .47
0.80	.69 - .75	.59 - .64	.52 - .56	.48 - .52
0.70	.76 - .82	.65 - .70	.57 - .61	.53 - .56
0.60	.83 - .89	.71 - .76	.62 - .66	.57 - .60
0.50	.90 - .97	.77 - .82	.67 - .71	.61 - .64
LOT PAYMENT = (CONTRACT UNIT PRICE) X (PAY FACTOR) X (TONNAGE)				

504.04.03 Pavement Density Adjustment. The price adjustment due to noncompliance with the density requirements will be made against the adjusted bid price for hot mix asphalt in conformance with the following table. Price adjustment will be waived for that portion of the pavement where the Engineer determines that inadequate density is due to a poor foundation.

DENSITY PRICE ADJUSTMENT	
Average Compaction, Percent of Maximum Density	Pay Factor %
greater than or equal to 92 percent	100%
greater than or equal to 89% and less than 92.0	95%
greater than or equal to 87% and less than 89%	85%
greater than or equal to 85% and less than 87%	75%

The price adjustment shall be based on the average of the cores representing that day's production (minimum of 2) Any sub-lot (200 tons) below 85% density will be cause to reject the entire lot (day's production) at the Engineer's discretion.

504.04.04 Profile Index Price Adjustment. Reserved

504.04.05 Thickness Tolerance.

- (a) Deficient Thickness: After the pavement is placed and before the final acceptance, the thickness as determined by measuring cores (a minimum of two being required) cut on approximately 300 ft intervals from the pavement must not be below the required thickness by more than 0.5 in (0.2 in for full payment).
- (b) Excess Thickness: No payment shall be made for material in excess of 110 percent of the theoretical yield for the required thickness.

- (c) **Reduced Prices:** When a deficiency is indicated, supplementary cores shall be taken to define the area; the cores must have a minimum spacing of 10 ft. Payment will be made at a reduced price as specified in the following table:

Core Thickness Deficiency (D)	Proportional Part Contract Price Allowed
0.0 - 0.2 inches	100 %
0.2 - 0.5 inches	75 %
Greater than 0.5 in.	0 %

When the thickness of the pavement is deficient by more than 0.5 inches, the paved area shall be immediately removed and replaced to the specified thickness, or overlaid to the Engineer's satisfaction. Payment shall be allowed only after compliance.

- (d) **Responsibility for Extra Work:** If the work proves satisfactory upon examination, the uncovering, removing, and replacing of material shall be paid as extra work. If the work proves deficient, the removal, replacement, and repair (as well as core drillings) shall be an expense borne by the Contractor.

SECTION 505 - HOT MIX ASPHALT PATCHES

505.01 DESCRIPTION. This work shall consist of repairing rigid or flexible pavement by removing sections of the existing pavement and replacing the removed material using hot mix asphalt (HMA) paving material. The locations of the repairs will be as specified in the Contract Documents or as directed by the Engineer.

505.02 MATERIALS. Materials shall conform to 504.02 and the following:

Aggregate for Base Course	901, Table 901 A
HMA	901, Table 901 C
Asphalt Cement	904.02

505.03 CONSTRUCTION. The existing pavement shall be removed with a minimum disturbance to the base material and the faces of the remaining pavement shall be plane without ragged edges. The use of equipment that could damage the existing pavement is prohibited.

505.03.01 Weather Restrictions. Refer to Section 504.

505.03.02 Preparation of Existing HMA Pavement. The existing pavement shall be removed by making a perpendicular saw cut full depth for the full perimeter of the designated area.

505.03.03 Preparation of Existing PCC Pavement. Refer to the applicable portions of 522.03.03.

505.03.04 Subgrade Preparation. The Engineer will evaluate the subgrade to determine if it is suitable as a foundation for the patch. If the Engineer determines that the subgrade material is not stable, it shall be compacted as specified in 501.03.11 to the satisfaction of the Engineer. If the Engineer determines that the subgrade material is unsuitable, the Contractor shall replace it with aggregate base conforming to Section 501. The replacement aggregate material shall be compacted in layers of 4 in. (100 mm) maximum depth. At the Contractor's option, HMA may be substituted for aggregate base. The existing pavement materials that are removed shall be hauled away from the repair site immediately by the Contractor.

Protection of the subgrade after preparation shall be the responsibility of the Contractor. No payment will be made for removal and replacement of subgrade that was not protected.

505.03.05 Subgrade Drains. The Engineer may direct that subgrade drains be constructed in areas of wet underlying subgrade or areas where, in the Engineer's opinion, there may be a future drainage problem.

505.03.06 Emergency Filler. The Contractor shall have readily available sufficient graded aggregate to completely fill the void of the repair area. The material shall be subject to the approval of the Engineer and shall be placed and compacted in the void and covered with a steel plate when directed by

the Engineer. At the beginning of the next day's work, this material shall be completely removed as directed by the Engineer.

505.03.07 Steel Plates. The Contractor shall have an ample supply of 12 X 14 ft X 1 in. (3.7 X 4.6 m X 25 mm) thick steel plates available on the project to cover the emergency filler.

505.03.08 Patch Construction. Patch construction shall conform to the applicable portions of Section 504. Manual operation will be permitted for placement of the HMA. Cores, control strip, and pavement profile measurements are waived. Equipment, placement, compaction, and quality control procedures will be as approved by the Engineer.

505.03.09 Patch Placement. Prior to placing the HMA, the exposed vertical surface of all adjacent pavement shall be thoroughly cleaned and all vertical surfaces shall be tack coated in conformance with 504.03.04. Each patch shall be full depth, full lane width and shall be placed in a minimum of two lifts. No lift shall exceed 3 in. depth. The HMA mixture may be spread by shovel, by rake or other method approved by the Engineer.

HMA shall not be placed on a frozen base.

505.03.10 Testing and Acceptance. Acceptance will be determined by nuclear in-place density test data. The nuclear gauge shall be calibrated in conformance with MSMT 417. The Contractor shall take one, one minute special calibration nuclear test from each lift of each patch. Test locations shall be randomly selected from within the patch. A special calibration nuclear test is defined as an average of two (minimum) special calibration readings taken at the same location after rotating the nuclear gauge 180 degrees.

Nuclear test in-place density data shall be expressed as a percentage of the maximum specific gravity determined for each day's production. The in-place density of each patch shall be 92.0 percent minimum.

The results of all nuclear density tests from each patch shall be averaged and compliance will be determined on the basis of each patch tested.

505.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for steel plates, emergency filler, saw cutting, removal, disposal, and trimming of the existing pavement, subgrade preparation, placing all materials including tack coat, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

All steel plates and emergency filler, when satisfactorily removed from the project, remain the property of the Contractor.

505.04.01 Hot Mix Asphalt Patches will be measured and paid for at the Contract unit price per square yard.

505.04.02 Removal of Unsuitable Material and Refill (Contingent) will be measured and paid for at the Contract unit price per cubic yard.

505.04.03 Hot Mix Asphalt Patches will be measured and paid for at the Contract unit price per ton.

SECTION 506 - OPEN GRADED FRICTION COURSE

506.01 DESCRIPTION. This work shall consist of constructing an Open Graded Friction Course (OGFC) as specified in the Contract Documents. Unless otherwise specified herein, OGFC shall conform to Section 504, Hot Mix Asphalt Pavement.

506.02 MATERIALS.

OGFC	904.06
Production Plant	915, modified as follows:

The time between plant mixing and shipment shall not exceed ½ hour.

The time from shipment from the plant to placement shall not exceed one hour.

506.03 CONSTRUCTION.

506.03.01 Equipment. Equipment shall conform to Section 504, except as follows:

- (a) Hauling units shall conform to 915.02(g) and shall be insulated so that the temperature of the mix will not decrease from the time of loading to the time of placement by more than 25 F (4 C) below the temperature stated on the delivery ticket.
- (b) **Paver.** Automatic controls are waived. A joint matcher shall be used.
- (c) Rollers shall be steel wheeled only, weighing 8 to 10 tons (7 to 9 Mg). Vibratory rollers are prohibited.

506.03.02 Weather. The weather restrictions specified in Section 504 shall apply, except as follows:

- (a) **Temperature and Surface Conditions.** OGFC shall only be placed when the ambient air and surface temperature are > 60 F (15 C) and rising.
- (b) **Precipitation.** When precipitation has occurred during the previous 24 hours, the Engineer will determine if the OGFC may be placed or if the work will be delayed until the surface is sufficiently dry.

506.03.03 Tack Coat. Refer to 504.03.04 except that the resulting coating shall be residual asphalt applied at a rate of 0.02 to 0.05 gal/yd² (0.1 to 0.23 l/m²).

506.03.04 OGFC Placement. Temperature of the mix at the time of placement shall not be more than 40 F (4 C) below the temperature for the mix design specified in 904.06.03.

506.03.05 Heeling-In. The design thickness of OGFC shall be maintained.

506.03.06 Compaction. Density requirements are waived. No more than two passes of the roller will be permitted.

506.03.07 Joints. Longitudinal joints shall be butted.

506.03.08 Sampling and Testing. Cores, density testing and nuclear density measurement requirements are waived.

506.03.09 Control Strip. Density requirements are waived. A full lane width control strip having a minimum length of 400 ft (120 m) shall be constructed on the finished grade prior to paving start up. The appearance will be used by the Engineer to evaluate the application of the tack coat and to determine the compactive effort.

506.03.10 Pavement Profile. Measurements are waived.

506.04 MEASUREMENT AND PAYMENT. Open Graded Friction Course will be measured and paid for at the Contract unit price per ton. The payment will be full compensation for furnishing, hauling, setting of lines and grades where specified, placing all materials, antistripping additive, tack coat, approved control strip, compaction, and for all labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 507 - SLURRY SEAL

507.01 DESCRIPTION. This work shall consist of constructing a slurry seal course using one of the following:

- (a) Slurry Seal (SS) or
- (b) Latex Modified Slurry Seal (LMSS) as specified in the Contract Documents or as directed by the Engineer.

507.02 MATERIALS.

Mineral Filler	901
Water	921.01
Aggregate	923.01
Emulsified Asphalt	923.03
Latex Modified Emulsion	923.04

507.03 CONSTRUCTION.

507.03.01 Weather. The slurry seal shall only be placed when the air and surface temperatures are >50 F (10 C), when it is not raining, and when the local weather forecast does not predict precipitation or the temperature to fall below 40 F (4 C) within 24 hours from the time the mixture is placed.

When the surface or air temperature falls below the specified limits, placement of the mix shall cease. Material en route may be placed at the Contractor's risk.

507.03.02 Mixing Equipment. Slurry seal shall be produced in a self propelled, front feed, continuous loading mixing machine. The unit shall proportion and deliver the materials to a revolving, multiblade, shafted mixer and discharge it continuously and uniformly.

The mixer shall have devices that control the proportioning of each material at all times. The mixer shall be calibrated for the mix design in the presence of an Administration representative, or certified calibration documents may be accepted by the Engineer. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, additives, and water to maintain an adequate supply of the materials for the proportioning controls.

Mixing machines shall be equipped with water pressure systems and nozzle spray bars to provide a water spray ahead of and outside the spreader box when required. Mineral filler shall be added to the aggregate in the proper amount before introduction into the mixer.

Truck mounted machines with positive, nonslipping aggregate delivery systems, but without a front feed continuous loading feature, may be used on project segments of less than $15\,000$ yd² ($12\,542$ m²) or for spot repair projects.

If truck mixing machines are used, a minimum of two shall be on the project prior to construction.

507.03.03 Spreading Equipment. Slurry seal shall be spread uniformly

by means of a mechanical squeegee box attached to the mixer and equipped with paddles mounted on an adjustable shaft to continuously agitate and distribute the materials. The equipment shall provide sufficient turbulence to prevent the mix from setting in the box or causing excessive side buildup or lumps. The Contractor shall attach flexible seals to the box in contact with the road, front and rear, to prevent loss of the mixture. Spraying of additional water into the spreader box is prohibited.

507.03.04 Surface Preparation. The surface shall be clean, dry and free of all objectionable materials prior to applying the tack coat and slurry seal.

A tack coat consisting of one part asphalt emulsion to three parts water shall be applied to all surfaces unless otherwise directed by the Engineer. The tack coat shall be the same emulsion type and grade as used in the slurry seal. The application rate shall be 0.05 to 0.10 gal/yd² (0.23 to 0.45 l/m²) or as determined by the Engineer.

507.03.05 Application. The slurry seal shall be spread to repair slight irregularities and achieve a uniform, skid resistant surface without skips, lumps or tears, as determined by the Engineer.

The Contractor shall use squeegees and lutes to spread the mixture in areas inaccessible to the spreader box and areas requiring hand spreading.

If hand spreading is necessary, additives may be used to provide slower setting time. The SS and LMSS shall be poured in a small windrow along one edge of the surface to be covered and then spread uniformly. A smooth, neat seam shall be constructed where two passes meet. Excess material shall be removed immediately from the ends of each run.

(a) **Slurry Seal.** The SS shall be applied at the rate of 16 ±2 lb/yd² (8.7 ±1.1 kg/m²) for Type II Mix and 20 ±2 lb/yd² (10.8 ±1.1 kg/m²) for Type III Mix, based on the dry aggregate weight, unless otherwise specified in the Contract Documents.

(b) **Latex Modified Slurry Seal.** The LMSS shall be applied in one or two lifts, as directed by the Engineer.

For roadways specified to receive one application, the LMSS shall be applied at the rate of $16 \pm 2 \text{ lb/yd}^2$ ($8.7 \pm 1.1 \text{ kg/m}^2$) for Type II Mix and $22 \pm 2 \text{ lb/yd}^2$ ($11.9 \pm 1.1 \text{ kg/m}^2$) for Type III Mix based on the dry aggregate weight, unless otherwise specified in the Contract Documents.

When two applications are specified, the material shall be applied at the combined rate of $28 \pm 2 \text{ lb/yd}^2$ ($15.2 \pm 1.1 \text{ kg/m}^2$) for Type II Mix and $32 \pm 2 \text{ lb/yd}^2$ ($17.4 \pm 1.1 \text{ kg/m}^2$) for Type III Mix.

(c) **Surface Rehabilitation (SR).** The application rate for the SR (rut filling) will be determined by the Engineer.

507.03.06 Certification. Certified weight tickets shall be furnished to the Engineer for the emulsion, latex emulsion, aggregate, and mineral filler used to insure specified application rates.

507.03.07 Sampling and Testing. The Contractor shall sample the mixtures at least once daily during paving. Each sample shall be placed in a plastic one gallon container. Samples shall be submitted to the Regional Laboratory for testing. Residual asphalt content, gradation, stability and flow shall be determined for SS and LMSS in conformance with T 30, T 164 and T 245 (modified), respectively.

507.03.08 Tie-Ins for Entrances and Connecting Roads. Tie-ins shall be made at entrances and connecting roads as directed by the Engineer.

507.03.09 Traffic. SS and LMSS shall be capable of curing at rates which will permit traffic on the pavement within two hours and one hour respectively after application, without damaging the surface. Any damage to the SS or LMSS caused by traffic shall be repaired by and at the expense of the Contractor.

507.04 MEASUREMENT AND PAYMENT. Slurry Seal and Latex Modified Slurry Seal will be measured and paid for at the Contract unit price per square yard for one or more of the pay items listed below. The payment will be full compensation for the aggregate, tack coat, tie-ins to

entrances and connecting roads, mineral filler, emulsion, latex emulsion and for all labor, equipment, tools, and incidentals necessary to complete the work.

507.04.01 Slurry Seal using Type II Mix (one coat).

507.04.02 Slurry Seal Using Type III Mix (one coat).

507.04.03 Latex Modified Slurry Seal Using Type II Mix (one coat).

507.04.04 Latex Modified Slurry Seal Using Type III Mix (one coat).

507.04.05 Latex Modified Slurry Seal Using Type II Mix (first coat).

507.04.06 Latex Modified Slurry Seal Using Type III Mix (second coat).

507.04.07 Surface Rehabilitation (rut filling) per ton. The payment will be full compensation for furnishing, hauling, placement, and all materials, labor, equipment, tools, and incidentals necessary to complete the work.

507.04.08 Price Adjustment. Material not conforming to these Specifications may be accepted at a reduced price if it is not considered detrimental to the work, as determined by the Engineer. The following price adjustment will apply:

- (a) The residual asphalt content of samples will be averaged for each day's production, per lift and will be compared to the mix design submitted by the Contractor. A one percent reduction in bid price per square yard will be applied for each 0.10 percent the asphalt content is out of tolerance.
- (b) The bid price per square yard will be reduced 0.5 percent for each gram per square foot of Wet Track Abrasion Test loss between 75 and 100 grams. Material having a loss greater than 100 grams will be rejected.
- (c) For applications less than the specified rate, the price bid per square yard will be reduced 3 percent for each pound per square yard

below the specified rate. This adjustment will be determined by comparing the certified delivery tickets with the project specifications. Material applied at more than the specified rate will not be considered for payment.

SECTION 508 - MILLING EXISTING HOT MIX ASPHALT PAVEMENT

508.01 DESCRIPTION. This work shall consist of milling the existing asphalt pavement to the depth and at the locations specified in the Contract Documents, or as directed by the Engineer.

508.02 MATERIALS.

Hot Mix Asphalt (HMA)	904
-----------------------	-----

508.03 CONSTRUCTION. Roadway patching shall be performed before the milling operation. Additional roadway patching may be required after the milling operation to correct pavement defects made visible by the milling operation. Refer to Section 505 for Hot Mix Asphalt Patches.

The machine for removing the asphalt pavement shall be a power operated planing machine or grinder capable of removing, in one pass, a layer of asphalt pavement no less than half the lane width to be removed. The machine shall be capable of accurately establishing profile grade control and shall have positive means for controlling slope elevation. The resultant surface shall be true to the established grade and shall be skid resistant. Unless otherwise directed by the Engineer, a tolerance of $\pm 1/8$ in. (3 mm) when using a 10 ft (3 m) straightedge shall be maintained. The machine shall be capable of preventing dust from escaping into the atmosphere.

In addition to any other equipment required to remove debris behind the milling operation, a street sweeper equipped with a vacuum shall be used to remove the dust prior to returning the area to traffic.

After the milling operation is complete, all depressions, potholes, and other irregularities shall be filled and any existing water valves, meters, manhole covers, etc., shall be wedged using hot mix asphalt.

508.04 MEASUREMENT AND PAYMENT.

508.04.01 Milling Existing Hot Mix Asphalt Pavement will be measured and paid for at the Contract unit price per square yard. The square yard measurement will be computed for the actual width and length measured along the area that has been milled. The payment will be full compensation for milling, the disposal of milled material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

508.04.02 Filling depressions and potholes, and wedging water valves, meters, etc., using hot mix asphalt will be measured and paid for as specified in 106.04.

508.04.03 Hot Mix Asphalt Patches will be measured and paid for as specified in 505.04.

SECTIONS 509 THRU 519 - RESERVED

SECTION 520 - PLAIN AND REINFORCED PORTLAND CEMENT CONCRETE PAVEMENTS

520.01 DESCRIPTION. This work shall consist of constructing plain and reinforced portland cement concrete pavements as specified in the Contract Documents or as directed by the Engineer.

520.02 MATERIALS.

Portland Cement Concrete and Related Products	902
Reinforcing Steel	908
Joint Materials	911
Portland Cement Concrete Plant	915.03
Epoxy Coating for Reinforcement	917.02

520.03 CONSTRUCTION. At least 30 days prior to the start of paving operations, the Contractor shall submit for approval, a proposed paving plan, including production plants, location of plants with respect to project

site, equipment, proposed material sources, and whether the fixed or slip form method shall be used.

The Contractor shall protect the pavement against damage from all causes. Any part of the pavement that is damaged shall be repaired or replaced by the Contractor at his expense.

No concrete shall be mixed, placed, or finished when natural light is insufficient, unless an adequate artificial lighting system approved by the Engineer is operated.

520.03.01 Equipment. All equipment, including the production plant and paving equipment, shall be approved by and acceptable to the Engineer. The plant, including central mixers, batching plant, truck mixers, and hauling equipment shall conform to Section 915. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations. Paving equipment shall be on the job site, ready for inspection, at least 24 hours prior to the start of construction operations.

Slip form pavers shall be selfpropelled on crawler tracks, and no other tractive force other than that which is provided and controlled by the paving machine itself shall be applied. The paver shall be capable of being automatically controlled for both alignment and grade.

The equipment and methods used shall provide means of obtaining the prescribed weights within the allowable tolerances to achieve the consistency specified with a minimum amount of water, to achieve proper placement of the mixture in a condition of maximum density with no segregation, and to finish and cure the pavement as specified herein.

520.03.02 Weather.

- (a) **Temperature and Surface Conditions.** Concrete placement shall begin only when the ambient air and surface temperature is at least 40 F (4 C) and rising and discontinued anytime the temperature falls below 40 F (4 C). These requirements may be waived for incidental concrete construction. Concrete shall not be placed on a frozen base.

(b) **Precipitation.** The Contractor shall have on hand sufficient material, approved by the Engineer, to cover freshly placed concrete as protection against precipitation.

(c) **Wind.** Concrete shall not be placed when the Engineer determines that the wind would have a detrimental effect on the work.

When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk.

If placement of the material is stopped by the Engineer for any other reason, all material en route shall be wasted at the Contractor's expense.

520.03.03 Foundation. Prior to the installation of fixed forms or the use of slip forms on the foundation, the foundation shall be constructed as specified in the Contract Documents and approved by the Engineer. The total width of the foundation shall be the width of the pavement to be placed, and extend a minimum of 4 in. (100 mm) outside the base of the fixed form or the outermost edge of the slip form paver track or wheel. No additional payment will be made for the extended width.

520.03.04 Forms. Side forms shall be made of steel not less than 7/32 in. (5.6 mm) thick with a depth equal to the edge thickness of the pavement. Built up forms shall not be used. Forms shall not be warped and shall be of sufficient strength to resist all loads applied in the paving process. Forms shall have a base equal to their height and a flat flanged tread or top surface not less than 2 in. (50 mm) wide. They shall not be less than 10 ft (3 m) long except for installation along curves with a radius of less than 200 ft (60 m). When the curve radius is less than 200 ft (60 m), the forms shall not be more than 6 ft (2 m) long or the forms shall be curved. Stake sockets to accommodate a 1 in. (25 mm) diameter steel stake shall be provided, and there shall be at least three stake sockets in each section of form 10 ft or more in length and at least 2 stake sockets in each section of form less than 10 ft (3 m) long.

Forms for keyways shall be rigidly fastened to the road form. Holes shall be provided through both forms and keyways to accommodate tie bars or dowels that may be required.

The forms shall be constructed to a tolerance that will ensure proper concrete placement. The top of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 ft (3 m), and the face shall not vary from a true plane more than 1/4 inch (6 mm) in 10 ft (3 m). The forms shall provide means for locking the ends of abutting sections. Forms shall be clean and coated with a form release compound as specified in 902.08. Forms that are bent, deformed, or broken shall be removed or repaired as directed by the Engineer.

Grade controls shall be set at intervals not to exceed 25 ft (8 m). Forms shall be set a minimum of 400 ft (120 m) prior to concrete placement. After the forms have been set to the correct grade, if the foundation has been disturbed, it shall be corrected by the Contractor and approved by the Engineer. The alignment and grade of the forms shall be checked by the Contractor for conformance with the Contract Documents. The foundation grade shall be checked by a measuring device, approved by the Engineer, such as a scratch board and corrections shall be made by the Contractor immediately before concrete placement.

Wooden forms may be approved for use in exceptional cases, such as on curves of very short radius or when a nonstandard length of straight form is required.

520.03.05 Slip Form Paving. Minimum width of slip form paving shall be 24 ft (7 m). If 24 ft (7 m) width is impractical, written approval is required from the Engineer. The total foundation width shall be graded using machine methods.

Grade controls shall be set by string lines at intervals not to exceed 25 ft (7 m). A foundation, approved by the Engineer set to the final line and grade shall be constructed as specified in 520.03.03 and completed at least 1000 ft (300 m) ahead of the paver before paving begins. Paving shall be stopped and a bulkhead construction joint installed whenever the paving machine comes to within 200 ft (60m) from the end of the approved foundation. If the paver will be used for paving adjacent to an existing pavement, the paver shall have wheels with rubber tires or protective pads on crawler treads which shall provide a minimum clearance of 1 ft (0.3 m) from the outermost edge of the paver track or wheel to the edge of the existing pavement.

Slip forms shall be of a length sufficient to prevent slumping or sagging of the sides and top edges of the pavement slab. They shall be spaced and braced to a uniform and constant width and shall also be held vertical. Slip form equipment shall be capable of placing and securing embedded tie bars and keyways in proper position in the plastic concrete before the edge of the pavement slab is free of the slip form.

520.03.06 Reinforcement. Reinforcement shall be as specified in the Contract Documents. Reinforcement shall be kept clean and free from foreign material that may prevent proper bonding of the concrete.

- (a) Dowel bars at joints shall be installed on the approved foundation parallel to the foundation grade, sufficiently ahead of the placement of slab reinforcement and concrete. The longitudinal half of each dowel intended to slip shall be coated with a water insoluble lubricant acceptable to the Engineer. Dowel bars may be machine placed or set on chairs or prefabricated assemblies approved by the Engineer, providing proper alignment, depth and spacing.
- (b) Tie bars for longitudinal construction joints may be placed on chairs or machine placed so that upon the initial set of the concrete they shall be at proper alignment, depth and spacing, and shall be at right angles to the center line of the pavement. Chairs or machine placement devices must be approved by the Engineer prior to use.
- (c) Fabric and mat reinforcement shall be furnished in flat sheets and shall be kept flat during placement. Reinforcement clearance shall be as specified in the Contract Documents.
- (d) When using slip forms, tied reinforcing bars or prefabricated mats may also be installed ahead of the placement of concrete by being supported on chairs set upon the underlying material. Reinforcement installed in this manner shall be in place ahead of the paver at least 500 ft (150 m) or a two hour run of the paver before any paving may begin. Paving shall be stopped and a bulkhead construction joint shall be installed whenever it comes to within 100 ft (30m) of the end of such steel placement. All reinforcement shall be adequately secured against displacement or movement.

520.03.07 Concrete Placement. Before concrete is placed on the foundation, the foundation shall be in a moist condition. In addition, if the concrete is exposed to the direct rays of the sun and the ambient temperature is 70 F (21 C) and rising, the forms and reinforcement shall be sprinkled with cool water just before placement of the concrete. Concrete shall be deposited on the foundation within the forms and rehandling shall be minimized.

Where concrete is to be placed adjoining a previously constructed lane of pavement, mechanical spreading and finishing equipment may be operated upon the existing lane of pavement only after the existing concrete has reached a splitting tensile strength of 300 psi (2.1 MPa) conforming to 902.10.03. Wheels which rest on the previously completed concrete shall be flat without flanges, and operated far enough from the edge of the slab to preclude spalling or damage. The tread of the wheels shall not be less than 3 in. (75 mm). wide. Sampling for control testing shall be done at the time of concrete placement and shall conform to 902.10.08.

The total depth of the slab shall be deposited in a single layer except as otherwise specified herein or approved by the Engineer. Two layer placement shall be used for pavement using bar mat or wire fabric reinforcement unless the Contractor demonstrates that the bar mat or wire fabric can be properly supported on devices approved by the Engineer.

(a) Single Layer Placement. Reinforcement shall be set on chairs to maintain the stability and proper elevation of the reinforcement. Welding of reinforcement to the chairs in lieu of wire ties will be permitted, except for epoxy coated reinforcement, welding will be permitted only if the epoxy coating is applied after the welding. Any damage to epoxy coating shall be repaired as directed by the Engineer using materials specified in 917.02.

(b) Two Layer Placement. The placing of concrete and wire fabric reinforcement shall be a continuous operation. Concrete shall first be placed to the specified depth of reinforcement, the wire fabric shall immediately be placed on the freshly deposited concrete. The second layer of concrete shall be placed immediately after the reinforcement is set in place.

520.03.08 Consolidation of Concrete.

- (a) **Fixed Form Paving.** Concrete shall be consolidated by means of immersion type vibrators. The vibrators shall advance with the paving equipment. Vibrator spacing, amplitude and depth shall insure proper consolidation, clear reinforcement by ½ in. (13 mm), and shall be subject to approval by the Engineer. Special care shall be taken to insure thorough consolidation along the faces of all forms and joint assemblies. Vibrators shall not come in contact with the side forms, joint assemblies, or underlying material. Excessive vibration which results in segregation shall be avoided.
- (b) **Slip Form Paving.** Concrete consolidation systems shall be incorporated in the paving equipment, and shall be approved by the Engineer.

520.03.09 Finishing.

- (a) **Machine Finishing.** The machine shall be equipped with two transverse screeds with provision for adjustment to insure that the concrete is placed to the specified crown and grade. Following the transverse screeds, the concrete shall be screeded longitudinally. The width of the working face of the screeds shall not be less than 6 in. (150 mm). A chevron or “V” type nonreciprocating finishing float, or other type as approved by the Engineer shall be used. The float shall be suspended from a frame that does not ride directly on the forms. Following the finishing float, a scraping straightedge 10 ft (3 m) long, equipped with a long handle shall be used to bring the pavement to the correct grade. When the finishing machine is operated over concrete which has partially set, provisions shall be made to prevent damage to the concrete by the machine wheels.
- (b) **Hand Finishing.** Where approved by the Engineer, hand finishing may be substituted for machine finishing. Rakes shall not be used for handling concrete.

520.03.10 Slab Surface and Thickness Checks.

- (a) **Surface Check.** After finishing, and before texturing of the concrete, the entire surface of the pavement shall be checked with a 10 ft (3 m) long metal straightedge approved by the Engineer. The surface shall not deviate from a straight line or vertical curve transversely or longitudinally more than 1/8 inch (3 mm) in 10 ft (3 m).
- (b) **Thickness Check.** After the pavement is placed and before final acceptance, the thickness will be checked by the Engineer from cores cut by the Contractor. Coring shall be as specified in MSMT 552. Cores shall be spaced every 1000 ft (300 m) for each lane unless otherwise specified or directed by the Engineer. Core holes shall be filled by the Contractor, at his expense. When the thickness of pavement is deficient by more than 1 in. (25 mm), the full section of deficient pavement shall be removed and replaced by and at the expense of the Contractor. Deficiencies up to 1 in. (25 mm) will be subject to reduced payment as specified in 520.04.

520.03.11 Texturing and Edging.

- (a) **Texturing.** Following concrete finishing and surface check the roadway surface shall be given a textured finish using a texturing device which produces transverse corrugations 1/8 in. (3 mm) wide by 1/8 in. (3 mm) deep spaced between 5/8 and 7/8 in. (16 and 22 mm). A 2 in. (50 mm) space shall be provided between passes of the texturing device and a 3 in. (75 mm) space provided between the last corrugation and the center line of all transverse joints. Texturing shall begin when the concrete surface is plastic enough to allow texturing to the depth specified but dry enough to prevent the plastic concrete from flowing back into the grooves being formed. Care shall be exercised to avoid overlaps and the tearing of the concrete in the texturing operation. Texturing on open sections shall be uniform for the full width of pavement. On closed sections, the last 12 in. (300 mm) of the roadway adjacent to the curb shall be left untextured to facilitate drainage. The completed textured finish shall be uniform in appearance.

- (b) **Edging.** After the texturing of the surface, and after the concrete has taken its initial set, transverse and longitudinal slabs shall be edged using a tool with a 1/4 in. (6 mm) radius.

520.03.12 Curing. Following texturing and edging, the concrete shall be cured for a minimum of 72 hours. If at any time during the curing period the ambient air temperature falls below 40 F (4 C), insulated blankets shall be used to maintain the concrete temperature above 40 F (4 C). Insulated blankets shall not be used in lieu of the curing material. The Contractor shall provide a sufficient number of high/low thermometers to monitor the temperature of the concrete. The concrete shall be cured using one of the following methods:

- (a) **Liquid Membrane Forming Compound.** A liquid membrane forming compound used for curing shall conform to 902.07.03 and shall be applied to the surface as soon as the free water has disappeared from the surface. The compound shall be applied by a spraying machine approved by the Engineer with drive wheels that straddle the freshly placed concrete. Standby equipment shall be provided nearby in the event of failure of the spraying machine. The spraying machine shall be equipped with an adequate wind guard and shall produce a fine spray of material which covers the surface with a uniform continuous film. The film shall be free of pin holes and other imperfections and shall not check, crack or peel. Discontinuities in the film shall be corrected by application of an additional coat to the affected area within 30 minutes of the original coat. The compound shall be applied in two applications at a rate of 1 gal/200 ft² (4 l/4.91 m²) for both coats. Sprayed surfaces which are subjected to damaging rainfall within three hours after the second application shall be resprayed at no additional cost to the Administration.

Vertical surfaces of longitudinal and transverse joints shall be kept free of curing compound by the use of rope or other masking methods approved by the Engineer. Sprayed surfaces shall be protected to prevent disruption of the continuity of the membrane. Application of compound by hand operated spraying equipment in irregular areas shall be as directed by the Engineer.

- (b) **Burlap Curing.** Burlap conforming to 902.07.01 shall be placed on the freshly placed concrete as soon as practical, without damaging the concrete. Burlap shall be overlapped to provide a double thickness on the entire surface. The burlap shall be saturated with water before placement and kept continuously wet during the curing period.
- (c) **Cotton Mat Curing.** Cotton mats conforming to 902.07.04 shall be placed on the freshly placed concrete as soon as practical, without damaging the concrete. Mats shall be saturated with water prior to placement and kept continuously wet during the curing period.
- (d) **Sheet Materials.** Sheet materials conforming to 902.07.02 shall be placed on the freshly placed concrete as soon as practical without damaging the concrete. Sheets shall be lapped at least 1 ft (0.3 m) and extend outside the slab. Laps and edges shall be held securely in place to provide continuous contact of the sheet with the pavement surface.

520.03.13 Form Removal of Fixed Form Paving. Unless otherwise directed by the Engineer, forms shall not be removed before concrete has set at least 12 hours. The sides of slabs which are not damaged shall be cured for the remaining 60 hours of the 72 hour curing period. Damaged or honeycombed areas shall be repaired and cured for an additional 72 hours.

520.03.14 Joints. Joints shall conform to the details specified in the Contract Documents and shall be perpendicular to the finished grade of the pavement and shall be sealed as specified in Section 523. Transverse expansion and contraction joints shall be straight and continuous from edge to edge of the pavement.

- (a) **Transverse Construction Joints.** Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. These joints shall be located at a planned joint, except in case of equipment breakdown. When concrete placement cannot be continued, the transverse construction joint may be installed within the slab unit but not less than 10 ft

(3 m) from a planned transverse joint. Transverse construction joints shall be doweled as specified in the Contract Documents.

(b) Expansion Joints. Expansion joints shall be formed by means of a preformed filler material conforming to 911.02. The filler shall be securely held in position by means of metal supports, as approved by the Engineer, which shall remain in the pavement. A removable metal channel cap bar shall be used to hold the parts of the joint in proper position and protect the filler from damage during concreting operations. The cap bar shall be removable without damage to the pavement to provide a space for sealing of the joint. Adjacent sections of filler shall be fitted tightly together, and the filler shall extend across the full width of the paving lane in order to prevent entrance of concrete into the expansion space. Expansion joints shall be formed around structures and features that project through, into, or against the pavement, using joint filler of the type, thickness, and width specified in the Contract Documents or as directed by the Engineer.

(c) Contraction Joints. Longitudinal and transverse contraction joints shall be constructed by sawing. If gravel aggregate is used, joints shall be tooled or formed by using an insert approved by the Engineer.

(1) Sawed Joints. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch (3 mm) blade to the depth as specified in the Contract Documents. The time of sawing shall vary depending on existing and anticipated weather conditions and shall prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. After expiration of the curing period, the upper portion of the groove shall be widened by sawing to the width and depth specified. The saw blades may be single or gang type, with one or more blades mounted in tandem. At no time shall sawing cut into load transfer devices. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with

water until all waste from sawing is removed from the joint. Any membrane cured surface damaged during the sawing operations shall be resprayed as soon as the surface becomes dry.

(2) Insert Type Contraction Joints. Insert type contraction joints shall be constructed by installing a preformed insert in the plastic concrete to form a weakened plane to induce cracking. The equipment for installing inserts shall be a machine equipped with a vibratory bar for cutting a groove in the plastic concrete for placement of the insert or for vibrating the insert into place at the prescribed joint location. Installation of the insert shall be to the required depth throughout the full width of the paving lane. Vibration units shall be arranged so that the vibration will be uniformly distributed throughout the bar. The intensity of vibration shall be adjustable as necessary to form a groove of proper size for the filler or for forcing the insert into the plastic concrete and consolidating the concrete around the in-place insert. For concrete placed by slip form pavers, the edges of the plastic concrete shall be supported to prevent slumping during the vibration and placement of inserts. The vibratory float shall be used following placement of the insert material in lieu of hand floating or troweling the finish. The insert shall be installed in the plastic concrete immediately following the final machine finishing with a maximum of two joint spacings between the finishing machine and the inserter. Additional straightedge and texturing operations shall be accomplished without disturbing the installed insert. Adjacent sections of the joint inserts within each slab unit shall be securely joined together, and the insert shall be thoroughly consolidated against and for the full depth of the insert. The insert shall be perpendicular to the finished grade of the pavement and shall be straight in alignment at the joint locations specified, with the top of the insert flush or not more than 1/8 in. (3 mm) below the pavement surface.

(3) Sawing Inserts. After the expiration of the curing period, the top portion of fiberboard fillers or sawable preformed inserts shall be removed by power sawing approved by the Engineer.

520.03.15 Pavement Profile. After the concrete has cured, the pavement surface shall be profiled by the Contractor in the presence of the Engineer as specified in MSMT 559. Longitudinal profiles shall be made 3 ft (1 m) from, and parallel to each edge of pavement for each traffic lane and at the approximate location of each transverse joint. Longitudinal profiles shall be run at evenly spaced locations across the pavement at not greater than 12 ft (4 m) intervals. Profile data shall be provided to the Engineer as soon as possible but no later than 24 hours after any portion of the pavement requiring testing is placed. Price adjustments due to noncompliance with the required pavement profile will be as specified in 520.04.

Pavement profile shall conform to the following:

- (a) Pavements on tangent alignment and horizontal curves with a center line radius of 2000 ft (610 m) or more shall have a Profile Index of 7 in. (175 mm) per mile or less.
- (b) Pavements on horizontal curves with a center line radius between 1000 and 2000 ft (300 and 610 m) and pavement within the superelevation transition of such curves shall have a Profile Index of 12 in. (300 mm) per mile or less.

The Contract unit price per square yard will be adjusted as specified in 520.04.02 for pavements having a profile greater than specified in paragraphs (a) and (b) above.

The following pavement areas shall not be profiled but shall conform to 520.03.10(a):

- (a) Within 50 ft (15 m) of bridge approaches.
- (b) Pavement within 50 ft (15 m) of the transverse joint that separates the pavement from an existing pavement not constructed under this Contract.
- (c) Pavement for exit ramp termini, ramps and connectors with grades and rates of superelevation greater than 6 percent.

- (d) Pavements on Contracts or projects with roadway area less than 20 000 yd² (16 700 m²) of finished concrete surface.

If the above criteria are not met, the Contractor shall do the following at his expense, as directed by the Engineer.

- (a) Suspend paving operations until corrective action is taken.
- (b) Perform additional grinding to reduce the Profile Index to values specified above in any 0.1 lane mile section.
- (c) Remove and replace any unacceptable pavement that cannot be corrected by grinding.
- (d) Accept pay factor as specified in 520.04.02.

The Contractor shall reduce high points in excess of 0.3 in. (8 mm) by grinding with a grinding procedure approved by the Engineer until the high points are in compliance with the Specifications.

The Engineer will test random sections of paving for compliance with the profile requirements of these Specifications. If the Contractor's data is not within 15 percent of the independent assurance data, the measuring devices shall be recalibrated at the site. After reliability of the Contractor's equipment is established, the profile data will be accepted.

520.03.16 Opening to Traffic. The pavement may be opened to vehicular traffic after having attained a splitting tensile strength of 300 psi (2.1 MPa). Tests of field samples shall conform to T 23.

520.04 MEASUREMENT AND PAYMENT. Plain and Reinforced Portland Cement Concrete Pavements will be measured and paid for at the Contract unit price per square yard. The square yard measurement will be computed on the basis of plan width and as-built length measured along the pavement center line. The payment will be full compensation for all concrete, forms, reinforcement steel, chairs, epoxy coating, finishing, curing, joints, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

520.04.01 Pavement Thickness Adjustment. Payment in areas that are accepted at a reduced price for deficient thickness will be adjusted by the factors shown in the following table. Deficiencies will be determined by procedures specified in 520.03.10. There will be no additional payment for excess thickness.

DEFICIENT THICKNESS PRICE ADJUSTMENTS	
DEFICIENCY IN INCHES	PERCENT OF PAYMENT CONTRACT UNIT PRICE
0.00 to 0.20	100
0.21 to 0.30	80
0.31 to 0.40	72
0.41 to 0.50	68
0.51 to 0.75	57
0.76 to 1.00	50
Greater than 1.00 *See 520.03.10	0*

520.04.02 Profile Index Adjustment. The price adjustment for each 0.1 mile section of portland cement concrete pavement failing to conform to the Profile Index requirements will be made against the adjusted bid price in conformance with the following:

PROFILE INDEX PRICE ADJUSTMENT	
PROFILE INDEX EXCEEDS SPECIFICATION in per mile per 0.1 mile section	PERCENT OF PAYMENT UNIT PRICE BID
by 0.1 to 1.0	98
by 1.1 to 2.0	96
by 2.1 to 3.0	94
by 3.1 to 4.0	92
by 4.1 to 5.0	90
by 5.1 or more	Corrective work required; See 520.03.15

520.04.03 Joints. Joint shaping, forming, sawing, inserts, and expansion joint fillers in expansion joints will not be measured but the cost will be incidental to the Contract unit price per square yard for Portland Cement Concrete Pavement.

SECTION 521 - CONTINUOUSLY REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT

521.01 DESCRIPTION. This work shall consist of constructing continuously reinforced portland cement concrete pavement on a prepared subgrade as specified in the Contract Documents.

521.02 MATERIALS. Materials shall conform to 520.02 and the following:

Reinforcement. The Contractor shall select the type of reinforcement from one of the following:

- (a) Deformed steel bar mats conforming to 908.07. The longitudinal bars shall be No. 5, Grade 60, and the transverse bars shall be No. 4, Grade 60.
- (b) Loose deformed steel bars conforming to 908.01. The longitudinal bars shall be No. 5, Grade 60, and the transverse bars shall be No. 4, Grade 60. The longitudinal bars shall have a minimum length of 40 ft (12 m).

Transverse bars shall be epoxy coated.

- (c) Welded deformed steel wire fabric conforming to 908.06.

521.03 CONSTRUCTION. Construction shall be as specified in 520.03 with the following modifications:

521.03.01 Placing Reinforcement. The reinforcement shall be preset on

chairs or chair bars with the transverse members placed down. Placement of the longitudinal bars shall be within the tolerances specified in the Contract Documents when measured from the top of the pavement to the bottom of the bar.

Rust, mud, oil or other coatings which may reduce bonding shall be removed before placing the concrete. The mat or fabric reinforcement shall be flat and free from distortions. Loose steel bars shall be free from kinks or bends that may prevent them from being properly assembled or installed.

Chairs or chair bars shall be designed to support the reinforcement in position without deflection or displacement during the placing and consolidation of the concrete. Chair bases shall have sufficient bearing to prevent overturning or penetration into the subgrade. The design of the chairs shall not impede the placing of the concrete. The Contractor shall obtain the Engineer's approval for the type of chair or chair bar to be used. Welding of chairs to the transverse bars prior to epoxy coating will be permitted.

If the support system does not hold the reinforcement within the specified tolerances, the Contractor shall increase the number of chairs or take other steps to assure proper positioning of the steel.

521.03.02 Placing Concrete. Concrete shall be placed in one lift, and care shall be exercised to consolidate the full depth.

The concrete shall be internally vibrated over its full width and depth by immersion vibrators mounted at intervals not to exceed 30 in. (760 mm) center to center, across the full width of the slab being placed. The vibrators shall be operated at a frequency and an amplitude sufficient to be perceptible on the surface of the concrete more than 1 ft (0.3 m) in any direction and shall be equipped to provide variable controlled frequencies. The battery of vibrators shall advance longitudinally with the paving machinery. The vibrators shall be hinge mounted to facilitate riding over any obstruction and shall be set to clear the reinforcement by approximately 1/2 in. (13 mm).

All screeding and vibrating operations shall stop immediately whenever forward motion of the paving machinery is stopped.

521.03.03 Joints. No transverse expansion or contraction joints will be permitted in continuously reinforced portland cement concrete pavement. Transverse construction of bulkhead joints shall be formed only at the end of any working period or when necessary to stop concreting operations for more than 30 minutes. They shall be formed with an approved header board in conformance with the cross section of the pavement, placed at right angles to the center line, and perpendicular to the surface. Additional bars shall be furnished and installed as specified in the Contract Documents. The pavement shall be finished to the header board without edging. These joints shall be made with extreme care and the bulkhead kept clean. The roadway reinforcement shall extend continuously through the joint. The reinforcement extending through the joint shall be securely supported on chairs or wooden sills to prevent it from deflecting.

Paving operations shall not resume until the concrete has set as determined by the Engineer. The bulkheads and all debris shall be removed, and the joint shall be cleaned before placing concrete against it.

All joints shall be sealed as specified in Section 523.

521.03.04 Terminal Joints. Terminal joints shall be constructed as specified in the Contract Documents.

521.03.05 Thickness Check. After the pavement is placed and before final acceptance, the thickness will be checked by the Engineer from cores cut by the Contractor. Coring shall be as specified in MSMT 552 and shall be spaced every 1000 ft (305 m) for each lane unless otherwise specified or directed. Filling of core holes shall be at the Contractor's expense. When the thickness of pavement is deficient by more than 1 in. (25 mm), the full section of deficient pavement shall be removed and replaced by and at the expense of the Contractor. Deficiencies up to 1 in. (25 mm) will be subject to reduced payment as specified in 520.04.

521.03.06 Pavement Profile. The pavement profile shall be as specified in 520.03.15.

521.03.07 Opening to Traffic. Refer to 520.03.16.

521.04 MEASUREMENT AND PAYMENT. Continuously Reinforced Portland Cement Concrete Pavement will be measured and paid for at the Contract unit price per square yard. The square yard measurement will conform to 520.04. The payment will be full compensation for all concrete, forms, reinforcement steel, chairs, epoxy coating, finishing, curing, joints, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

521.04.01 Pavement Thickness Adjustment. Pavement in areas that are accepted at a reduced price for deficient thickness will be adjusted by factors shown in the following table. Deficiencies will be determined by procedures set forth in 521.03.05. There will be no additional payment for excess thickness.

DEFICIENT THICKNESS PRICE ADJUSTMENT	
DEFICIENCIES IN INCHES	PERCENT OF PAYMENT CONTRACT UNIT PRICE
0.00 to 0.20	100
0.21 to 0.30	80
0.31 to 0.40	72
0.41 to 0.50	68
.51 to 0.75	57
0.76 to 1.00	50
Greater than 1.00 *See 520.03.10	0*

521.04.02 Profile Index Adjustment. The price adjustment for each 0.1 mile section of Continuously Reinforced Portland Cement Concrete Pavement failing to conform to the Profile Index requirements will be made against the adjusted bid price in conformance with the following:

PROFILE INDEX PRICE ADJUSTMENT	
PROFILE INDEX EXCEEDS SPECIFICATION in. per mile per 0.1 mile section	PERCENT OF PAYMENT UNIT PRICE BID
by 0.1 to 1.0	98
by 1.1 to 2.0	96
by 2.1 to 3.0	94
by 3.1 to 4.0	92
by 4.1 to 5.0	90
by 5.1 or more	Corrective work required. See 520.03.15

521.04.03 Terminal Joints. Terminal joints will be measured and paid for at the Contract unit price per linear foot. The payment will be full compensation for all steel beams, stiffener plates, end plates, drilled holes, welding, cutting, styrofoam, joint filler, concrete, reinforcement, bond breaker, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 522 - PORTLAND CEMENT CONCRETE PAVEMENT REPAIRS

522.01 DESCRIPTION. This work shall consist of repairing plain, conventionally reinforced, or continuously reinforced portland cement concrete pavement as specified in the Contract Documents or as directed by the Engineer. Repairs are either Type I or Type II. Type I repairs are from 6 ft (2 m) to less than 15 ft (5 m) in length. Type II repairs are 15 ft (5 m) and greater in length. The minimum repair length shall be 6 ft (2 m).

522.02 MATERIALS. Materials shall conform to 520.02 except as follows:

Graded Aggregate for Base Course	901
Graded Aggregate Subbase	901
High Range Water Reducing Admixture	902.06.03
Nonshrink Grout	902.11(c)
Epoxy Grout	902.11(d)
Epoxy Adhesive	921.04

522.02.01 Concrete Mix Design. Concrete shall be Mix No. 6 as specified in 902.10.03, except that the minimum cement factor shall be 800 lb/yd³ (475 kg/m³), contain a high range water reducing admixture and shall have a minimum compressive strength of 2500 psi (17.2 MPa) in 12 hours. Testing shall conform to 902.10.08 except that cylinders shall remain in the molds until tests are conducted.

522.02.02 Field Control. Field control will be by compressive strength, cement content, slump, water/cement ratio and air entrainment. Acceptance will be based on a minimum compressive strength of 3000 psi (20.7 MPa) in 24 hours. If test results fall below the specified value, a new mix design shall be prepared by the Contractor as directed by the Engineer.

522.02.03 Polyester Grout. The Contractor may substitute polyester grout in lieu of epoxy grout providing the grout conforms to 902.11 (d). Cartridge type systems shall be identified with a batch or lot number.

522.02.04 Epoxy Adhesives. Epoxy adhesives shall conform to 921.04 and shall be Type IV, Grade 3, Class B and C, and shall be water insensitive.

522.02.05 Reinforcement. Reinforcement, including load transfer assemblies, tie bars, deformed steel bars and longitudinal tie devices shall conform to Section 908 and shall be epoxy coated.

522.03 CONSTRUCTION. Areas to be repaired and type of repair will be determined by the Engineer. Prior to the start of repairs, the Contractor shall submit for approval, a proposed repair plan, including equipment, meth-

ods and procedures. The Contractor shall protect the repair area against damage from all causes. If any part of the repaired pavement is damaged, it shall be repaired or replaced by and at the Contractor's expense. Repairs shall be made in only one lane at a time for each roadway.

522.03.01 Equipment. Refer to 520.03.01.

522.03.02 Weather. Weather restrictions shall be as specified in 520.03.02 except that the work shall be performed during the months of April through October, unless otherwise permitted, in writing, by the Engineer. When the range in daily temperature is expected to exceed 15 F (9 C), concrete placement will be permitted in the late afternoon after the existing pavement has achieved its maximum expansion, unless otherwise directed by the Engineer.

Cold weather protection shall conform to 520.03.12, except that insulated blankets shall be used when the ambient air temperature is less than 70 F (21 C).

522.03.03 Saw Cuts and Removal of Existing Pavement. Concrete slabs shall be removed by the lift out method in large sections. No other method of slab removal shall be used unless permitted by the Engineer. All areas where the pavement has been removed shall be repaired in the same working day.

If, during removal operations, any portion of adjacent slabs are damaged, the damaged portions shall be repaired by and at the expense of the Contractor.

Saw cuts and pavement removal procedures are as follows:

- (a) **Plain and Conventionally Reinforced Portland Cement Concrete Pavement.** Existing pavement shall be removed by making a perpendicular saw cut, full depth, for the full slab width using a diamond saw blade. Full depth saw cuts shall be spaced a minimum of 2 in. (50 mm) from and parallel to, longitudinal joints between pavement slabs. When repairs are to be made on only one side of an existing transverse joint, the removal shall extend into the

adjacent slab a sufficient distance to insure that existing dowels are removed. Saw cuts shall not be made more than one week prior to removal of the concrete slab. Repairs shall be completed in a continuous operation.

- (b) Continuously Reinforced Portland Cement Concrete Pavement.** Existing pavement shall be removed by making a perpendicular saw cut for the full slab width using a diamond saw blade. Saw cuts shall not be made more than 72 hours prior to removal of the concrete slab. The Contractor shall saw cut to the top of the reinforcement steel. This cut shall be 2 in. (50 mm) minimum depth, for the full width of the lane at the boundaries of the repair without cutting the steel reinforcement. The boundaries shall not be closer than 18 in. (460 mm) from the nearest transverse tight crack for normally spaced tight cracks. However, where cracks are closely spaced, repair boundaries shall not be closer than 6 in. (150 mm) from the nearest crack. The Contractor shall saw cut, full depth, across the full width of the slab a minimum of 22 in. (560 mm) inside each boundary saw cut. Additional full depth saw cuts shall be made along all longitudinal edges not bounded by construction joints. Concrete shall be removed to its full depth within the boundaries of the repair area. Existing reinforcement bars shall not be bent.

The equipment used to remove concrete in the areas between each 2 in. (50 mm) and full depth saw cut shall be restricted to a maximum jackhammer size of 60 lb (27 kg) and hand tools only. The existing pavement edge shall be neatly trimmed and vertical. A minimum of 22 in. (560 mm) of reinforcement shall remain exposed on each side of the repair. The Engineer will require the removal of any pavement breaking equipment from the project which could damage the adjacent concrete pavement.

When the saw cuts close due to temperature prior to removal of the existing slab, full depth, full width saw cuts shall be made to relieve pressure. The material between the narrowly spaced saw cuts or the longitudinal joint and the 2 in. (50 mm) minimum offset longitudinal cut shall be removed, but not by the use of heavy drop hammers or large jackhammers. If air hammers are used to re-

move the material, they shall not be heavier than 60 lb (27 kg). Tie bars protruding from the longitudinal offset cut shall be cut flush with the existing concrete. All waste material shall be immediately removed from the repair site.

Any saw blade cuts that extend into adjacent slabs, curbs or gutter shall be sealed as specified in Section 523.

522.03.04 Subgrade Preparation. Following the removal of the existing pavement, the Engineer will evaluate the subgrade to determine if it is suitable as a foundation for the new pavement. If the Engineer determines that the subgrade material is suitable but unstabilized, it shall be compacted as specified in 501.03.11 in a manner acceptable to the Engineer. If the Engineer determines that the subgrade material is unsuitable, the Contractor shall replace the unsuitable material with aggregate base material conforming to Section 901, which shall be thoroughly compacted in layers not greater than 4 in. (100 mm) deep. Construction of the base shall conform to Section 501. The subgrade for all types of repairs shall be moistened with water.

522.03.05 Subgrade Drains. The Engineer may direct that subgrade drains be constructed. The work shall conform to Section 306. Additional work shall be as directed by the Engineer.

522.03.06 Forms. The forms used shall conform to 520.03.04, or shall be as directed by the Engineer. Forms shall overlap the existing pavement on each side of the patch a minimum of 1 ft (300 mm) and be securely fastened to prevent movement when concrete is placed. To provide space for the forms, the Contractor shall excavate the adjacent shoulder the width of the form plus 6 in. (150 mm). After removal of the form, the excavated shoulder area shall be repaired using the same type of material as used in the original shoulder.

522.03.07 Reinforcement. Reinforcement shall conform to the Contract Documents and 520.03.06. Doweled joints shall be located at the slab face closest to the original doweled joint location.

Holes having a diameter 1/4 in. (6 mm) larger than the dowels, load trans-

fer tie bars and longitudinal tie devices shall be drilled into the face of the existing slab at mid depth. After drilling, the hole shall be blown out and allowed to dry. The dowels, load transfer tie bars and longitudinal tie devices shall be grouted or epoxied into place. The alignment of the reinforcement shall be in the direction of the pavement and parallel to the plane of the surface.

A plastic grout retention disk conforming to the Contract Documents shall be placed on each dowel to prevent loss of the bonding material.

Reinforcement steel bars for continuously reinforced portland cement concrete pavement shall be the same size and spacing as the existing steel and shall be spliced to the exposed steel of the existing pavement by lapping, welding or using a mechanical device that is approved by the Engineer. For lap splices, the steel reinforcement shall be lapped a minimum of 22 in. (560 mm) and secured with tie wires. Longitudinal steel reinforcement bars shall be continuous for the full length of the repair and the amount of steel in the repair area shall be at least equal to the amount of steel in the existing pavement. The reinforcement steel bars shall be supported by chairs or as approved by the Engineer.

For plain and conventionally reinforced pavement, the protruding ends of the dowel bars shall be coated with a water insoluble lubricant approved by the Engineer.

522.03.08 Joints. Joints shall conform to 520.03.14 and the Contract Documents.

All joints shall be sealed as specified in Section 523.

522.03.09 Concrete Placement. Concrete placement shall conform to 520.03.07 except that the split tensile test shall not be used. Prior to placing concrete, the exposed vertical surfaces of all adjacent concrete shall be cleaned. Refer to 520.03.02 for weather requirements. The temperature of the concrete at placement shall be 50 to 90 F (10 to 32 C).

Concrete for continuously reinforced portland cement concrete pavement shall be placed when the air temperature is a minimum 40 F (4 C) and rising.

When the range in daily temperature is expected to exceed 15 F (9 C), placement of concrete will be permitted in the late afternoon after the existing pavement has achieved maximum expansion unless otherwise directed by the Engineer.

Plain and continuously reinforced concrete pavement repairs shall be cast in one full depth operation. Conventionally reinforced concrete pavement repairs shall be poured in two equal lifts with the wire mesh laid on the surface of the first lift.

All concrete shall be vibrated.

522.03.10 Finishing. Following the concrete placement, the surface shall be struck off to the finished grade by means of an adjustable steel or wooden template and floated to a smooth finish. The repair shall be screeded longitudinally to provide uniformity of ride to adjacent pavement. The final surface shall match the contour of the existing roadway. The Contractor shall provide a metal straightedge and perform surface checks as specified in 520.03.10.

522.03.11 Curing. The concrete shall be cured as specified in 520.03.12 except that the curing shall continue for 12 hours after placement of the concrete or until the repair is put into service.

522.03.12 Emergency Filler. The Contractor shall have readily available sufficient graded aggregate subbase to completely fill the void of the repair area. The material shall be placed and compacted in the void and covered with a steel plate when directed by the Engineer. At the beginning of the next day's work, this material shall be completely removed using procedures which shall not disturb the subgrade, dowels, load transfer tie bars, load transfer assemblies or reinforcement that has been previously placed.

522.03.13 Steel Plates. The Contractor shall have an ample supply of 12 ft by 14 ft by 1 in. (3.7 by 4.3 m by 25 mm) thick steel plates available on the project to cover emergency filler or be placed over the patch area until the concrete has developed sufficient strength to carry traffic.

522.03.14 Unacceptable Repairs. Pavement repairs which have been

damaged by traffic or other causes or have not conformed to these Specifications shall be removed and replaced by, and at the expense of, the Contractor.

522.04 MEASUREMENT AND PAYMENT. Portland Cement Concrete Pavement Repairs will be measured in place and paid for at the Contract unit price for one or more of the items listed below as specified in the Contract Documents. The payment will be full compensation for saw cuts, furnishing, hauling, placing of all materials, removal and disposal of old concrete, grout, drilled holes, chairs, all tie devices, reinforcement, epoxy coating, steel plates, emergency filler, joint sealing, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Steel plates and emergency filler, when satisfactorily removed from the project, remain the property of the Contractor.

522.04.01 Plain Portland Cement Concrete Pavement Type I Repairs per square yard.

522.04.02 Plain Portland Cement Concrete Pavement Type II Repairs per square yard.

522.04.03 Conventionally Reinforced Portland Cement Concrete Pavement Type I Repairs per square yard.

522.04.04 Conventionally Reinforced Portland Cement Concrete Pavement Type II Repairs per square yard.

522.04.05 Continuously Reinforced Portland Cement Concrete Pavement Type I Repairs per square yard.

522.04.06 Continuously Reinforced Portland Cement Concrete Pavement Type II Repairs per square yard.

522.04.07 Removal of Unsuitable Material and Refill per cubic yard.

522.04.08 Subgrade Drains will be measured and paid for as specified in the applicable portions of Section 306.

522.04.09 Shoulder Repairs per square yard. Repairs to existing shoulders necessitated by the placement of forms are also included.

522.04.10 Load Transfer Assemblies per each.

SECTION 523 - JOINT SEALING OF PORTLAND CEMENT CONCRETE PAVEMENTS

523.01 DESCRIPTION. This work shall consist of cleaning and sealing joints of portland cement concrete pavements as specified in the Contract Documents or as directed by the Engineer.

523.02 MATERIALS.

Joint Sealers	911.01
Preformed Joint Fillers	911.02

Backer Rod. Backer rod used with joint sealer shall be flexible, compressible, nonshrinkable, have a surface which will prohibit bond with the joint sealer, and be capable of uniformly containing the joint sealer within the desired shape factor. Hard rubber and materials that deform at sealer application temperatures, or swell when wet, shall not be used.

523.03 CONSTRUCTION. Joints shall be sealed the same day they are shaped and prepared. All sealing shall be completed prior to opening the roadway to traffic, unless otherwise directed by the Engineer.

523.03.01 Joint Construction. Joint construction shall be as specified in 520.03.14. If the joint is tooled, preformed joint fillers shall not be used.

523.03.02 Joint Preparation. Joints shall be cleaned by one of the following methods as directed by the Engineer:

- (a) High pressure water blasting.
- (b) Sandblasting.

- c) Oil free air blowing at a minimum of 90 psi (585 kPa).

All joint walls and surfaces to which the joint material is to adhere shall be dry prior to installing the joint filler.

All prepared joints will be inspected and approved by the Engineer prior to sealing.

523.03.03 Sealing. Preformed joint filler shall be installed in conformance with the manufacturer's recommendations and the Contract Documents. The Contractor shall insert the backer rod as specified in the Contract Documents.

Silicone sealer shall be applied in conformance with the manufacturer's recommendations.

No backer rod shall be inserted into longitudinal joints.

The ambient air and pavement temperatures shall both be a minimum of 45 F (7 C) and rising at the time of sealer application.

Sealer that is hot applied shall be heated as specified in the manufacturer's recommendations in a kettle or other equipment acceptable to the Engineer. The kettle shall have a mechanically operated agitator, recirculation pumps, and a positive thermostatic temperature control. The applicator wand and all connecting hoses shall be insulated. Overheating or direct heating of the sealer will not be permitted.

Sealer that has been overheated, subjected to heating for more than four hours, or any amount that remains in the applicator wand at the end of the day's operation shall be withdrawn and disposed of. Prior to the start of each day's operation, the Contractor shall withdraw and dispose of a minimum of one gal (4 l) of sealer drawn from the container through the applicator wand.

All joints shall be filled with sufficient material that will result in the final surface of the sealer being recessed 1/4 in. (6 mm) below the surface of the pavement. Any joint with the sealer recessed more than 5/16 in. (8 mm)

below the surface of the pavement two hours after sealing shall be resealed.

Silicone sealer shall be tooled so that the final surface of the sealer will have a parabolic shape in the surface cross sectional area. The deepest point at the center of the joint shall be 5/16 in. (8 mm) below the pavement surface. The Contractor shall use a tool approved by the Engineer that is capable of obtaining the parabolic shape at the surface of the sealer.

Curing time for silicone material varies with temperature and humidity and therefore may delay opening of the pavement to traffic. The Contractor is advised to consult the manufacturer's recommendations for curing time.

Silicone joint sealer shall be installed in conformance with the manufacturer's recommendations. The Contractor shall remove any excess sealer from the surface of the pavement.

Joints not sealed the same working day shall be recleaned and dried as specified in 523.03.02.

All traffic shall be kept off the pavement surface until the sealer has cured.

Any sealer that pulls loose from the joints or shows excessive bubbling within one week after opening the pavement to traffic shall be replaced by and at the Contractor's expense.

523.04 MEASUREMENT AND PAYMENT. Joint Sealing of Portland Cement Concrete Pavement will be measured and paid for at the Contract unit price per linear foot of joint unless otherwise specified in the Contract Documents. The payment will be full compensation for furnishing, hauling, placing all materials including preformed joint filer, joint sealer, backer rod, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Joint construction for new Portland Cement Concrete Pavement is not included in this Specification. The cost to construct these joints shall be incidental to the Contract unit price per square yard for the pavement specified in the Contract Documents.