

Add the following:

ITEM D-702 SLOTTED DRAINS

DESCRIPTION

702-1.1 This item shall consist of the construction of steel slotted drains according to these Specifications and in reasonably close conformity with the lines and grades shown on the Plans. Typical details shall be shown on the Plans.

MATERIALS

702-2.1 GENERAL. All slotted drains shall meet the requirements shown on the Plans and specified below. All slotted drains shall meet specified hydraulic design requirements and shall support the loadings specified.

Standard details can be found in the American Association of State Highway and Transportation Officials (AASHTO)-AGC-ARTBA publication "A Guide to Standardized Highway Drainage Products." All products used shall meet the most demanding aircraft loading and tire pressure requirements, as well as maintenance and equipment loadings.

702-2.2 PIPE.

- a. **Steel slotted Drain.** Pipe shall be metallic coated (galvanized or aluminized steel type II) corrugated steel type I meeting the requirements of AASHTO M 36. Pipe diameter and gage shall be as shown on the Plans. The corrugated steel pipe shall have a minimum of two rerolled annular ends.
- b. **Not Used.**

702-2.3 GRATES AND CASTINGS.

- a. **Steel Slotted Drain.** Grates shall be manufactured from ASTM A36 or ASTM A1011, Grade 36 steel. Spacers and bearing bars (sides) shall be 3/16-inch material. The spacers shall be welded to each bearing bar with four 1-1/4-inch long by 3/16-inch wide fillet welds on each side of the bearing bar at spacings not exceeding 6 inches. The grates shall be 6 inches high or as shown on the Plans and shall have a maximum 1-3/4-inch opening in the top.

Grates shall be galvanized according to AASHTO M 111 except with a 2 ounces per square foot galvanized coating.

The grates shall be fillet welded to the corrugated steel pipe with a minimum weld 1 inch long on each side of the grate at every other corrugation. Weld areas and the heat affected zones where the slot is welded to the corrugated pipe shall be thoroughly cleaned and painted with a zinc-rich paint according to repair of damaged coatings in AASHTO M 36.

Each 20-foot length of drain delivered to the job site shall be within the following tolerances: vertical bow \pm 3/8-inch, horizontal bow \pm 5/8-inch, twist \pm 1/2-inch.

- b. **Not used.**

702-2.4 CONCRETE. Plain or reinforced concrete used for steel slotted shall conform to the requirements of Section P-610 Concrete for Miscellaneous Structures.

CONSTRUCTION METHODS

702-3.1 EXCAVATION. The width of the trench shall be sufficient to permit satisfactory installation and jointing of the slotted drain and placing of a concrete backfill material under and around the drain, but shall not be less than the external pipe diameter plus 6 inches on each side. The depth of the trench shall be a minimum of 2 inches below the invert for steel slotted drain.

702-3.2 INSTALLATION. Slotted drains shall be laid in sections joined firmly together with coupling bands or as shown on the Plans. The top of all drains shall be held firmly in place to the proper grade, to preclude movement during the backfilling operation.

702-3.3 JOINING. Slotted steel drain joints shall be firmly joined by modified hugger type bands, or as indicated, to secure the pipe and prevent infiltration of the backfill. When the slotted steel drain is banded together, the adjacent grates shall have a maximum 3-inch gap.

702-3.4 BACKFILLING. Slotted drains shall be inspected before any backfill is placed. Damaged drains shall be aligned or replaced at the expense of the Contractor.

The trench holding the slotted drain assembly shall be backfilled with concrete that will easily flow under and around the drain and the trench wall. The opening in the top of grates shall be covered to prevent unwanted material from entering the drain during the backfilling and subsequent surfacing operations.

METHOD OF MEASUREMENT

702-4.1 The length of slotted drain will be measured in linear feet of slotted drain in place, completed, and approved. It will be measured along the centerline of the drain from end or inside face of structure to the end or inside face of structure, whichever is applicable. The classes, types, and sizes will be measured separately. All fittings will be included in the length as typical pipe sections being measured.

BASIS OF PAYMENT

702-5.1 Payment will be made at the contract unit price per linear foot for each kind of slotted drain type and size designated and at the contract unit price per cubic yard of concrete for backfill.

Payment will be made under:

Item D702.010.0000	Slotted Drain, 18-inch, 14 Gauge Pipe – per linear foot
Item D702.020.0000	Concrete for Backfill – per cubic yard
Item D702.030.0000	Trench Drain – per linear foot

MATERIAL REQUIREMENTS

AASHTO M 36	Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
AASHTO M 111	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36	Structural Steel
ASTM A1011	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High Strength Low Alloy with Improved Formability, and Ultra High Strength
Information	<i>A Guide to Standardized Highway Drainage Products</i> disseminated under the sponsorship of the American Association of State Highway and Transportation Officials, Associated General Contractors, and the American Road and Transportation Builders Association

ITEM D-752 CONCRETE CULVERTS, HEADWALLS, AND MISCELLANEOUS DRAINAGE STRUCTURES

DESCRIPTION

752-1.1 This item shall consist of plain or reinforced concrete culverts, headwalls, and miscellaneous drainage structures constructed according to these Specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Plans or required by the Engineer.

MATERIALS

752-2.1 CONCRETE. Concrete shall meet the requirements of Item P-610.

CONSTRUCTION METHODS

752-3.1 UNCLASSIFIED EXCAVATION.

- a. Trenches and foundation pits for structures or structure footings shall be excavated to the lines and grades or elevations shown on the Plans. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the Plans, shall be considered as approximate only; and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.
- b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and excavation to final grade shall not be made until immediately before the concrete or reinforcing steel is to be placed.
- c. The Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for excavation.
- d. All bracing, sheathing, or shoring shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or mar finished concrete. The cost of removal shall be included in the unit price bid for excavation.
- e. After each excavation is completed, the Contractor shall notify the Engineer. No concrete or reinforcing steel shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

752-3.2 BACKFILLING.

- a. After a structure has been completed, backfill with approved material, in horizontal layers not to exceed 8 inches in loose depth, and compact. The field density of the compacted material shall be at least 95% of the maximum density. The maximum density shall be determined according to ATM 207 or ATM 212. The field density and moisture content shall be determined according to ATM 213.
- b. No backfilling shall be placed against any structure until approved by the Engineer. For concrete, approval shall not be given until the concrete has been in place 7 days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill or the placement method.

- c. Fill placed around concrete culverts shall be deposited on each side at the same time and to approximately the same elevation. All slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent wedge action against the structure.
- d. Backfill will not be measured for direct payment. Performance of this work shall be considered as a subsidiary obligation of the Contractor, covered under the contract unit price for "unclassified excavation for structures."

752-3.3 WEEP HOLES. Weep holes shall be constructed as shown on the Plans.

752-3.4 NOT USED.

METHOD OF MEASUREMENT

752-4.1 Unclassified excavation for structures will be measured in original position, between vertical planes 18 inches outside of and parallel to the neat lines of the footings.

752-4.2 Concrete will be measured by the dimensions shown on the Plans or approved by the Engineer, complete in place and accepted. No measurements or other allowances will be made for forms, false work, cofferdams, pumping, bracing, expansion joints, or finishing of the concrete. No deductions will be made for the volumes of reinforcing steel or embedded items.

752-4.3 Reinforcing steel will be measured by the theoretical weight shown on the Plans, complete in place and accepted. The unit weight used for deformed bars will be the weight of plain square or round bars, as the case may be, of equal nominal size.

BASIS OF PAYMENT

752-5.1 Payment will be made at the contract unit price per cubic yard for unclassified excavation for structures; at the contract unit price per cubic yard for concrete for the structures; and at the contract unit price per pound for reinforcing steel.

Payment will be made under:

Item D752.010.0000	Unclassified Excavation for Structures – per cubic yard
Item D752.020.0000	Structural Concrete – per cubic yard
Item D752.030.0000	Reinforcing Steel – per pound
Item D752.040.0000	Trench Drain – per linear foot

TESTING REQUIREMENTS

ATM 212	Standard Density of Coarse Granular Materials Using the Vibratory Compactor
ATM 207	Moisture-Density Relations of Soils
ATM 213	In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods

**ITEM P-207 IN-PLACE FULL DEPTH RECLAMATION (FDR)
RECYCLED ASPHALT AGGREGATE BASE COURSE**

DESCRIPTION

207-1.1 This item consists of a recycled asphalt aggregate base course resulting from the in-place full depth reclamation (FDR) of the existing pavement section (asphalt wearing surface and aggregate base), plus mechanical stabilization with additional aggregate or chemical stabilization with Portland cement, or asphalt emulsion, when shown on the plans.

MATERIALS

207-2.1 AGGREGATE. The FDR shall consist of materials produced by recycling (pulverizing and mixing) the existing asphalt pavement, aggregate base, subgrade, and any additional aggregate as necessary. .

The FDR shall meet the gradation in Table 207-1, below.

TABLE 207-1. FDR GRADATION

Sieve	Minimum Percentage by weight passing sieves
2-inch	
1-1/2-inch	100
1-inch	90-100
No. 4	
No. 200	

- a. **Deleterious substances.** Materials for aggregate base shall be kept free from weeds, sticks, grass, roots and other foreign matter.
- b. **Uniformity.** The materials shall be thoroughly recycled (pulverized and mixed) to ensure a uniform gradation.

207-2.2 STABILIZATION.

- a. **Mechanical stabilization.** Addition of corrective aggregate material to adjust gradation shall be equivalent to P-209 Crushed Aggregate Base Course.
- b. **Chemical Stabilization.** Provide the specific chemical stabilization material designated in the Plans. Portland cement shall meet the requirements of AASHTO M 85. Emulsified asphalt cement shall meet the requirements of AASHTO M 140. Cationic emulsified asphalt shall meet the requirements of AASHTO M 208. Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.

207-2.3 WATER. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

207-2.4 QUALITY CONTROL (QC) SAMPLING AND TESTING. The Contractor shall take at least two FDR samples per day of production in the presence of the Engineer to check the gradation. Sampling shall be per ATM 301. Material shall meet the requirements in paragraph 207-2.1. Samples shall be taken from the in-place, un-compacted material at random sampling locations according to ATM SP 4.

CONSTRUCTION METHODS

207-3.1 MILLING. The existing asphalt pavement shall be milled to the depth below surface grade shown on the plans.

207-3.2 CONTROL STRIP. The control strip shall be 12 feet in width and 300 feet in length. The Engineer will designate the location of control strips. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

207-3.3 RECYCLING (PULVERIZATION AND MIXING). The asphalt pavement and aggregate base shall be recycled (pulverized and mixed) into a uniformly blended mixture to the depth shown on the plans. Add mechanical and chemical stabilization materials of the type(s) and in proportions shown on the plans to the mixture of asphalt pavement and aggregate base. All material over approximately 1-1/2 inches will be removed by the Contractor. The mixture shall be brought to the desired moisture content.

The maximum lift thickness of the recycled aggregate base course material to be compacted is shown on the plans.

207-3.4 GRADING AND COMPACTION. Immediately upon completion of recycling (pulverization and mixing), the material shall be shaped and graded in accordance with the project plans. The Engineer will use ATM 412 to determine the density standard from the control strip. The recycled asphalt aggregate base course shall be compacted within the same day to an in-place density of 98 percent as determined by ATM 213. Compact the remainder of the project to not less than 98 percent of the density standard, in accordance with ATM 213. The number, type and weight of rollers shall be sufficient to compact the material to the required density.

207-3.5 FINISHING. The surface of the aggregate base course shall be finished by blading or with automated equipment designed for this purpose. If the top layer is 1/2 inch or more below grade, the top layer shall be scarified to a depth of at least 3 inches, new material added, and the layer blended and re-compacted to bring it to grade. The addition of layers less than 3 inches shall not be allowed.

207-3.6 PROOF ROLLING. Compacted asphalt aggregate base course shall be proof rolled with a tandem axle dual wheel dump truck loaded to the legal limit with tires inflated to 80 psi in the presence of the Engineer. Soft areas that deflect greater than 0.5 inch or show permanent deformation greater than 0.5 inch shall be removed and reworked at the Contractor's expense.

207-3.7 WEATHER LIMITATIONS. When weather conditions detrimentally affect the construction process and/or quality of the materials, the Contractor shall stop construction. Portland cement shall not be applied when wind conditions affect the distribution of the materials. Do not use any frozen material or compact on a frozen base. Construction shall not be performed unless the atmospheric temperature is above 35°F and rising or approved by the Engineer. When the temperature falls below 35°F, protect all completed areas against detrimental effects of freezing by approved methods. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

207-3.8 MAINTENANCE. The asphalt aggregate base course shall be maintained in a satisfactory condition until the work is accepted by the Engineer. Equipment used in the construction of an adjoining section may be routed over completed sections of asphalt aggregate base course, provided that no damage results and equipment is routed over the full width of the completed asphalt aggregate base course. Any damage to the recycled asphalt aggregate base course shall be repaired by the Contractor at the Contractor's expense.

207-3.9 SURFACE TOLERANCES. The finished surface shall be tested for smoothness and accuracy of grade. Any area failing smoothness or grade shall be scarified to a depth of at least 3 inches, reshaped and re-compacted by the Contractor at the Contractor's expense.

- a. **Smoothness.** The finished surface shall not vary more than 3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.
- b. **Grade.** The grade shall be measured on a 50-foot grid and shall be within +0 and -1/2 inch of the specified grade.

207-3.10 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. FDR base course will be accepted for density and thickness on an area basis. One (1) test for density and thickness will be made for each 1200 square yds. Sampling locations will be determined on a random basis in accordance with ATM SP 4.

- a. **Density.** The Engineer will perform all density tests.

Each area will be accepted for density when the field density is at least 98 percent of the density standard of the FDR base course in accordance with ATM 412. The in-place field density will be determined in accordance with ATM 213, and ATM 213 will be used to determine the moisture content of the material. The machine will be calibrated in accordance with ATM 213. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompact and two additional random tests made. This procedure will be followed until the specified density is reached.

- b. **Thickness.** The thickness of the base course shall be within +0 and -1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Engineer for each area. Where the thickness is deficient by more than 1/2-inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material, and recompact to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

METHOD OF MEASUREMENT

207-4.1 See GCP Section 90, and the following:

- a. FDR asphalt aggregate base course, by the area of the finished top surface.
- b. Emulsified asphalt, by the ton.
- c. Portland cement, by the ton.
- d. FDR asphalt aggregate base course, by Lump Sum. Chemical stabilization is subsidiary.

BASIS OF PAYMENT

207-5.1 Payment will be made at the contract unit price, per unit of measurement, accepted in place. Corrective aggregate material, if required, will be paid under Item P-209.

Payment will be made under:

P207.010.0010	FDR asphalt aggregate base course – per square yard
P207.010.0020	Emulsified asphalt – per ton.
P207.010.0030	Portland cement – per ton.
P207.010.0040	FDR asphalt aggregate base course – per Lump Sum.

References

ASTM C1602 Mixing Water Used in the Production of Hydraulic Cement Concrete

AASHTO M 85	Portland Cement
AASHTO M 140	Emulsified Asphalt
AASHTO M 208	Cationic Emulsified Asphalt
ATM 213	In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth), FOP for AASHTO T 310
ATM 301	Sampling of Aggregates FOP for AASHTO T 2
ATM 412	Relative Standard Density of Treated Mixtures by the Control Strip Method
ATM SP 4	Random Sampling

ITEM P-318 FOAMED ASPHALT STABILIZED BASE COURSE

DESCRIPTION

318-1.1 Construct a foamed asphalt stabilized base course by uniformly mixing together asphalt binder, water, Portland cement, recycled aggregate and imported aggregate. Spread, shape, and compact the mixed material in conformity to the dimensions and typical cross section shown on the Plans. Build runway, taxiway, or aprons in a series of parallel lanes using a plan of processing that reduces longitudinal and transverse joints to a minimum.

MATERIALS

318-2.1 ASPHALT BINDER. Conform to Table 318-1 Asphalt Binder when testing in accordance with AASHTO M 320. Binders shall be free of polymer modifiers and antistripping additives.

TABLE 318-1: ASPHALT BINDER

Property	Test Methods	Performance Grade Requirements
Performance Grading (Temp. range, Deg. C.)	AASHTO M 320	PG 52-28

The Contractor shall furnish vendor's certificate of compliance and certified test reports for each lot of asphalt binder shipped to the project. The vendor's certified test report for the asphalt binder can be used for acceptance or tested independently by the Engineer.

The following documents shall be furnished at delivery:

- a. Manufacturer's certificate of compliance
- b. Certified test reports for the lot.
- c. Lot number, storage tanks, and shipping containers (if applicable) used.
- d. Date and time of load out for delivery.
- e. Type, grade, temperature, and quality of asphalt binder loaded.

All excess asphalt binder shall remain the property of the Contractor. Removal of excess asphalt binder from the project area shall be incidental to the contract and no separate payment will be made.

318-2.2 PORTLAND CEMENT. Conform to the requirements of ASTM C150, Type I or II and include the low-alkali cement requirement shown in Table 2 of ASTM C150.

318-2.3 WATER. Use water that is clean and free from sewage, oil, acid, strong alkalies, or vegetable matter. Test water of questionable quality in accordance with the requirements of AASHTO T 26.

318-2.4 AGGREGATE. Aggregates recycled from existing materials shall consist of crushed stone or crushed gravel with or without sand or other inert finely divided mineral aggregate, as approved by the Engineer.

For Recycled Asphalt Pavement (RAP) aggregate, conform to Item P-161, Table 161-1 for RAP gradation.

For imported aggregate, conform to:

- a. **Item P-209.** See Table P-209-1 for D-1 gradation.

- b. **Item P-299.** See Table P-299-1 for E-1 gradation.

COMPOSITION

318-3.1 COMPOSITION OF MIXTURE. The foamed asphalt stabilized base course shall be composed of a mixture of asphalt binder, Portland cement, water, and aggregates. The resulting mixture shall meet the requirements of the Job Mix Design (JMD).

- a. **Sampling.** The Department will conduct laboratory tests of the material samples in accordance with ATM 301 for coarse and fine aggregate, and AASHTO T 127 for mineral filler. If testing fails, the Contractor must provide a full set of samples to retest. At least 15 days prior to the production of foamed asphalt stabilized base course, the Contractor shall furnish the proposed materials and documentation to SOA DOT&PF CR Materials, 5750 East Tudor Road, Anchorage, AK 99507, (907) 269-6200:
- (1) 500-pound representative sample of existing subgrade material
 - (2) 500-pound representative sample of imported aggregates (D-1 or E-1)
 - (3) 200-pound representative sample of RAP
 - (4) 10 gallons of asphalt binder
 - (5) One 94-pound sack of Portland cement with appropriate certifications
 - (6) A statement describing anticipated field proportioning of submitted materials
- b. **Job Mix Design (JMD).** The Department will determine the JMD and provide the following:
- (1) The percent of foamed asphalt binder to be added to the aggregate
 - (2) The optimum percent water to be added to the asphalt binder during the foaming process
 - (3) The minimum Foamed Asphalt Expansion Characteristics required
 - (4) The temperature of asphalt binder at the time of injection
 - (5) The percent by weight of Portland cement added to the aggregate
 - (6) The gradation of the in-place aggregate
 - (7) The optimum moisture content for proper compaction and dispersion of foamed asphalt binder
 - (8) Design dry indirect splitting tensile strength
 - (9) The JMD unit weight

When a change in source materials occurs, the Contractor must furnish samples according to subsection 318-3.1a. A new JMD will be determined before the new source materials can be used.

CONSTRUCTION REQUIREMENTS

318-4.1 FOAMED ASPHALT TECHNICIAN. The Contractor will provide a qualified Foamed Asphalt Technician on site during any foaming operations and as directed by the Engineer. Minimum qualifications include:

- a. **Qualified Person.** A person knowledgeable in the principles and practice of foamed asphalt stabilized base course paving, with required experience stated in subsection 318-4.1b, c, & d.

- b. **Work Experience.** 5 years experience with foamed asphalt stabilized base course
- c. **Supervisory Experience.** 5 successfully supervised foamed asphalt stabilized base course projects
- d. **JMD Experience.** Developed a foamed asphalt stabilized base course mix design, a processing plan, and a Quality Control (QC) plan

The Contractor may use a consultant or a manufacturer's representative to satisfy these requirements. At the Preconstruction Conference per GCP 80, provide a Foamed Asphalt Technician submittal that includes:

- a. **Technical Resume.** Include experience as specified in subsections 318-4.1 a-c.
- b. **List of Successful Projects:**
 - (1) Clients name and contact information (address and telephone number)
 - (2) Projects location
 - (3) Description of foamed asphalt binder equipment used on the projects
 - (4) Appropriate Certifications

318-4.2 PRE-FOAMING MEETING. Conduct a meeting at the job site with the Engineer and the Foamed Asphalt Technician a minimum of 5 days before initiating foaming operations, where following documents will be provided by the Contractor:

- a. **List and Configuration of Equipment**
- b. **Sequence of Operations**
- c. **Approved QC Plan**
- d. **Safety Plan**
- e. **Traffic Control Plan**
- f. **Public Notification Plan**

Safety Plan must include procedures to be implemented prior to and during foaming operations.

318-4.3 QUALITY CONTROL (QC) PLAN. The Contractor shall provide their QC plan to the Department for approval no less than 15 calendar days prior to the start of foaming operations. The QC plan must ensure operational activities shall provide finished material of acceptable quality.

The Contractor is required to furnish a project specific QC plan that includes, at a minimum, the following:

- a. **Description of the Contractor's QC Organization.** The number of full-time equivalent employees, an organizational line of authority, and reporting responsibilities.
- b. **QC Sampling, Testing, and Analysis Plan.** Methods that include a description of how random locations for sampling and testing are determined. Provide the sampling and testing frequency.
- c. **Protection from Excessive Moisture.** Procedures to protect foamed asphalt stabilized base course material from receiving excessive moisture from weather events and corrective actions when criteria are not met.
- d. **Contingency Plan.** Addressing but not limited to:
 - (1) Inclement weather
 - (2) Equipment breakdowns
 - (3) Material that does not break or cure

- (4) Production modifications due to changes in ambient and/or material temperature
- (5) Material moisture changes
- (6) In-situ material changes
- (7) Material shortages

The Contractor shall provide the following:

- e. **Production Records.** Daily production records for each subplot, including the quantity of asphalt binder, Portland cement, and in-place compaction moisture content. Any other daily and average quantities displayed or transmitted by the recycler on which the above quantities are based.
- f. **Foaming Characteristics.** Measure and report expansion ratio and half-life of foamed asphalt binder for every 4 hours of production.
- g. **In-Place Field Density.** Monitor and report in-place field density of the foamed asphalt stabilized base course for each subplot.

318-4.4 CONTROL STRIP. A control strip shall be constructed prior to full production of each new mix design. At the Pre-Foaming Meeting, provide information on the location of the control strip demonstration site. Before full production, the Contractor shall use the equipment specified for the foamed asphalt stabilized base course operation and construct a control strip section at a location approved by the Engineer. Process material in the control strip, two passes wide and a minimum of 300 feet long, and to the depth shown on the Plans. The Foamed Asphalt Technician shall supervise this process. The control strip shall produce results specified in subsection 318-4.8. Additional control strips shall be required if there are changes in the material.

318-4.5 WEATHER LIMITATIONS. Do not mix foamed asphalt stabilized base course while the ambient air or surface temperature is below 40°F, when conditions indicate that the temperature may fall below 40°F within 24 hours, when the aggregate is above the optimum compaction moisture content, or when the aggregate or subgrade is frozen. Follow the recommendations made by the technician as approved by the Engineer regarding the acceptability of the weather conditions for the foaming operation.

318-4.6 EQUIPMENT. At the Preconstruction Conference, the Contractor must provide a submittal that verifies the equipment specifications meet the requirements of this section. The Engineer must approve the proposed equipment for use before construction of the foamed asphalt stabilized base course control strip.

- a. **Cold In-Place Recycler.** Use a recycler that has the following features and capabilities:
 - (1) A minimum power capability of 600 horsepower.
 - (2) The capability to pulverize to the size specified, excavate, mix and recycle material to the depth shown on the Plans.
 - (3) Ability to increase the effective volume of the mixing chamber in relation to depth of cut.
 - (4) Two microprocessor controlled systems, complete with independent pumping systems and spray bars, to regulate the application of foamed asphalt binder, separate from water that is used to increase the moisture content of the mixed material. Both systems perform in relation to the forward speed of the recycler and the mass of the material being processed.
 - (5) Two spray bars, one for foamed asphalt binder and one for compaction moisture, each fitted with self-cleaning nozzles at a maximum spacing of one nozzle for each 6-inch width of the mixing chamber. Monitor the flow rate at each nozzle to verify that all nozzles are producing foamed asphalt binder at the same rate.

- (6) The foamed asphalt binder is produced at the spray bar in individual expansion chambers into which both hot asphalt binder and water are injected under pressure through individual and small orifices that promote atomization. The rate of addition of water into the hot asphalt binder is kept at a constant percentage by mass of asphalt binder by the same microprocessor.
- (7) An inspection or test nozzle fitted at one end of the spray bar that produces a representative sample of foamed asphalt binder.
- (8) An electrical heating system capable of maintaining the temperature of asphalt binder flow components above 300°F.
- (9) A single asphalt binder feed pipe installed between the recycler and the supply tanker. Do not use circulating systems that incorporate a return pipe to the supply tanker.
- (10) A system within the operator cabin to verify the foamed asphalt binder is being evenly distributed across the full width of the spray bar. Demonstrate the system to the Engineer to verify even spraying.
- (11) The ability to display and/or transmit asphalt binder quantities used during production, at any point during the work shift and for the entire day's production.
- (12) The teeth on the mandrel mixing head form a Chevron pattern.
- (13) Emulsion injection system spray bar equipped with individual valves that can be turned off to minimize emulsion overlap on subsequent passes.
- (14) Minimum of 4 different drum speeds for control of machine.

b. Cold Recycling Mixing Plant. Use a cold recycling mixing plant that has the following features and capabilities:

- (1) Plant specifically designed to produce cold mixes that operates independently of external power sources and can be transported to the job site.
- (2) Minimum mixing capacity of 200 tons per hour.
- (3) Capable of combining all stabilizing agents and aggregates up to 2-inch diameter.
- (4) Two microprocessor controlled systems, complete with independent pumping systems and spray bars, to regulate the application of foamed asphalt binder, separate from water that is used to increase the moisture content of the mixed material. Both systems perform in relation to the mass of the material being processed.
- (5) Two spray bars, one for foamed asphalt binder and one for compaction moisture, each fitted with self-cleaning nozzles at a maximum spacing of one nozzle for each 6-inch width of the mixing chamber. Monitor the flow rate at each nozzle to verify that all nozzles are producing foamed asphalt binder at the same rate.
- (6) The foamed asphalt binder is produced at the spray bar in individual expansion chambers into which both hot asphalt binder and water are injected under pressure through individual and small orifices that promote atomization. The rate of addition to water into the hot asphalt binder is kept at a constant percentage by mass of asphalt binder by the same microprocessor.
- (7) An inspection or test nozzle fitted at one end of the spray bar produces a representative sample of foamed asphalt binder.
- (8) An electrical heating system capable of maintaining the temperature of asphalt binder flow components above 300°F.

- (9) A single asphalt binder feed pipe installed between the recycler and the supply tanker. A circulating system that has a return pipe to the supply tank may be used.
 - (10) A system accessible by the operator to verify the foamed asphalt binder is being evenly distributed across the full width of the spray bar. Demonstrate the system to the Engineer to verify even spraying.
 - (11) The ability to display and/or transmit asphalt binder quantities used during production, at any point during the work shift and for the entire day's production.
- c. **Portland Cement Distributor.** Use a distributor that is designed to spread a uniform coverage of Portland cement at a specified rate.
 - d. **Roller.** Provide the following rollers:
 - (1) Self-propelled vibratory pad foot roller having a minimum dynamic force of 60,000 pounds;
 - (2) Pneumatic tired roller having a minimum operating weight of 50,000 pounds;
 - (3) Vibratory steel drum roller.
 - e. **Grader.** Provide a grader with calibrated automatic cross slope blade controls.

318-4.7 PREPARATION. The area to be stabilized with foamed asphalt binder may require pulverization, removal or addition of material, grading, scarifying, shaping, and compacting, as directed by the Engineer, to conform to the grades and typical section shown on the Plans.

The subgrade shall be firm and able to support, without yielding or subsequent settlement, the construction equipment and the compaction of the foamed asphalt material. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

318-4.8 PULVERIZATION AND MIXING. Pulverize the existing asphalt pavement and underlying materials to the depth as shown on the Plans so that 100% passes a 2-inch sieve, as determined by ATM 304. Multiple passes may be required to size the insitu material and to adjust moisture content before applying Portland cement and injecting foamed asphalt.

318-4.9 FOAMED ASPHALT BINDER AND PORTLAND CEMENT APPLICATION, MIXING, AND SPREADING. Accomplish the mixing of the foamed asphalt binder, Portland cement, water, and aggregates by the cold recycling methods. Ensure that the percentage of moisture in the aggregate, at the time of Portland cement application, does not exceed the quantity that will permit a uniform mixture during mixing operations, and that it does not exceed the specified optimum moisture content for the foamed asphalt stabilized base course mixture.

- a. **Cold In-Place Recycling.** Before cement is applied, scarification or pulverization may be required for grade control, as directed by the Engineer. Pulverize to the depth required while simultaneously injecting foamed asphalt binder and compaction water. Mixing shall continue until the foamed asphalt binder, Portland cement and compaction water have been sufficiently blended with the aggregates.
- b. **Cold Recycling Mixing.** The foamed asphalt stabilized base course shall be placed in one lift. Material may be placed using either a paver or grader. Assure that there is sufficient material placed to meet the desired finish grade after compaction.

318-4.10 COMPACTION. Thoroughly compact the mixture. Accomplish the initial compaction with the vibratory pad foot roller. Accomplish intermediate compaction with the vibratory steel drum roller. Accomplish finish compaction with the pneumatic tire roller.

Field density of the compacted mixture shall be evaluated in accordance with subsection 318-5.5. The in-place field density will be determined by direct transmission in accordance with ATM 213, Method A. The

moisture content of the mixture at the start of compaction shall not exceed the optimum moisture content as determined by the foamed asphalt stabilized base course mix design.

318-4.11 FINISHING. The completed foamed asphalt stabilized base course shall conform to the required lines, grades, and cross section as shown on the Plans. If necessary, scarify the surface to eliminate any deep imprints and re-compact the surface to the required density. Seal the surface with water and a pneumatic roller. Apply tack coat within 24 hours after completing finishing operations as specified in subsection P-603-3.3, using application rates in Table P-603-1.

318-4.12 CONSTRUCTION LIMITATIONS. The operation of cement, bituminous application, mixing, spreading, compacting and finishing shall be continuous and completed within four hours from start of mixing. When any of the operations after the application of Portland cement are interrupted for more than 30 minutes or when the uncompacted mixture is wetted by rain so that the optimum moisture content is exceeded by 2%, the decision to reconstruct the portion affected shall be determined by the Engineer. In the event the uncompacted, rain-wetted mixture exceeds the specified moisture content tolerance, the Contractor shall reconstruct at the Contractor's expense the portion affected. Material along the longitudinal or transverse construction joints not properly compacted shall be reconstructed, at the Contractor's expense, with properly moistened and mixed foamed asphalt stabilized base course compacted to specified density.

318-4.13 SURFACE TESTS. The finished surface shall not vary more than 3/8-inch when tested with a 10-foot straightedge applied parallel with, or at right angles to, the longitudinal axis of the foamed surface. Correct any variations in excess of this tolerance at the Contractor's expense, and in a manner satisfactory to the Engineer.

318-4.14 THICKNESS. The Engineer will continually monitor thickness. Provide an average thickness of the base constructed during one day that is within 1/2-inch of the thickness shown on the plans, except that the thickness of any one point may be within 3/4-inch of that shown on the plans. Where the average thickness shown by the measurements made in one day's construction is not within the tolerance given, the Engineer may direct reconstruction at the Contractor's expense.

318-4.15 MAINTENANCE AND REPAIR. At the Contractor's expense, maintain the entire foamed asphalt stabilized base course surface within the limits of the Contract in a condition satisfactory to the Engineer from the time work starts until the work is completed. Maintenance includes immediate repairs of any defects that may occur either before or after the foamed asphalt stabilized base course has been constructed. Repeat maintenance as often as necessary to keep the area within specified limits at all times. Make repairs in a manner that will insure restoration of a uniform surface without compromising the durability of the part repaired. Reconstruct faulty work to the full depth as shown on the Plans. Reconstruct low areas by removing and replacing the material for the full depth of treatment rather than by adding a thin layer of foamed asphalt stabilized base course to the completed work. Traffic, with the exception of aircraft over 100,000 pounds, will be allowed to travel over the foamed asphalt stabilized base course layer for a maximum of 7 days prior to pavement operations, or as directed by the Engineer.

METHOD OF MEASUREMENT

318-5.1 FOAMED ASPHALT STABILIZED BASE COURSE. Foamed asphalt stabilized base course will be measured by the number of square yards of completed and accepted foamed asphalt stabilized base course, and in accordance with GCP subsection 90.

318-5.2 ASPHALT BINDER. Asphalt binder will be measured by the number of tons of asphalt binder used in the accepted foamed asphalt stabilized base course determined by one of the following methods:

- a. **Weighing.** The quantity of asphalt binder used will be determined by weighing containers on certified scales prior to and after use. All excess asphalt binder remains the Contractor's property and will not be measured for payment. The Contractor will provide supplier's invoices to the Engineer. As an alternative, Volume Method may be used as approved by the Engineer.

- b. **Supplier's Invoices.** The quantity of asphalt binder used will be determined by supplier's invoices minus waste, diversion and excess of left over. This method may be used on projects where deliveries are made in sealed tankers and the plan is producing material for one project only. Method b will be used to compute left over. Waste and diversion will be computed in a manner to be determined by the Engineer.
- c. **Volume Measure.** Volume measure (tank stickings) of actual daily uses. It is the Contractor's responsibility to notify the Engineer whenever material is to be added to the calibrated volume measure or whenever material from the volume measure is to be used for work other than that specified in this contract.

Whichever above method is selected, it must be used for the duration of the project. Another method may be used and computed as a check, but only one method will be used for payment computation.

318-5.3 PORTLAND CEMENT. Portland cement will be measured by the ton from supplier's invoices minus waste, diversion, and left over.

318-5.4 FOAMED ASPHALT TECHNICIAN. The Foamed Asphalt Technician is subsidiary to Foamed Asphalt Stabilized Base Course and will not be measured for payment.

318-5.5 EVALUATION OF MATERIAL FOR ACCEPTANCE. The quantity of foamed asphalt stabilized base course produced will be divided into lots and the lots will be evaluated individually.

A lot will be 20,000 square yards. The lot will be divided into sublots of 5,000 square yards each. The Department shall randomly sample and test for density each subplot. Sublots shall be tested for density by taking a nuclear density readings, in accordance with ATM 213, Method A, from three random test sites selected by the Engineer within each subplot. Test sites shall not be located within 12 inches of the outside edge of the foamed asphalt stabilized base course panel.

The average of the subplot density measurements will be compared to the maximum density from the approved mix design to determine the acceptability of the lot. Once the average density of the lot has been determined, the Contractor will not be permitted to provide additional compaction to raise the average. The Department shall notify the Contractor of density results as soon as possible. If two consecutive sublots produce density results less than 98.0% of the target density, the Contractor shall institute corrective action as described in the QC Plan or as recommended by the Foamed Asphalt Technician. Payment will be made according to Table 318-2.

TABLE 318-2: PAYMENT SCHEDULE FOR LOT DENSITIES.

Percent of Maximum Density from Approved Mix Design	Percent of Payment
98.0 or greater	100
97.0 to less than 98.0	90
96.0 to less than 97.0	75
Less than 96.0	See below

If the lot density falls below 96.0%, the lot will be rejected and shall be removed, replaced, or reworked as directed by Engineer at the Contractor's expense.

When test results have failed to meet specifications, retest of acceptance tests for density may be requested provided the quality control requirements of Subsection 318-4.3 are met. Only one subplot retest per lot will be permitted. Deliver this request in writing to the Engineer, within 48 hours of receipt of the final test of the lot. The Engineer will mark the locations for the density retest within a 5-foot radius of the original density locations. The original average density result will be discarded and the retest result will be used in the payment schedule regardless of whether the result gives a higher or lower percent of payment.

BASIS OF PAYMENT

318-6.1 FOAMED ASPHALT STABILIZED BASE COURSE. At the contract unit price per square yard as full compensation for furnishing all materials, except asphalt binder or Portland cement, tack coat and for all preparation, delivering, placing, and mixing of these materials; and for all labor, equipment, tools and incidentals necessary to complete the item. Density adjustment for each lot per Table 318-2 under subsection 318-5.5.

318-6.2 ASPHALT BINDER. At the contract unit price per ton as full compensation for furnishing asphalt binder and for all delivery, placing, and incorporation of this material, and for all labor, equipment, tools, and incidentals necessary to complete the item. Removal of excess asphalt binder from the project area is subsidiary to the contract and no separate payment will be made.

318-6.3 PORTLAND CEMENT. At the contract unit price per ton as full compensation for furnishing Portland cement and for all delivery, placing, and incorporation of this material, and for all labor, equipment, tools, and incidentals necessary to complete the item.

318-6.4 FOAMED ASPHALT TECHNICIAN. Payment is subsidiary to Foamed Asphalt Stabilized Base Course.

Payment will be made under:

Item P318.020.0000	Foamed Asphalt Stabilized Base Course – per square yard
Item P318.040.0000	Asphalt Binder – per ton
Item P318.050.0000	Portland Cement – per ton

TEST REQUIREMENTS

ATM 213	In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods
ATM 304	Sieve Analysis of Fine and Coarse Aggregates and Materials finer than 75- μ m (No. 200) Sieve in Mineral Aggregate by Washing
AASHTO T 26	Quality of Water to be Used in Concrete

MATERIAL REQUIREMENTS

ASTM C150	Standard Specification for Portland Cement
AASHTO M 320	Performance-Graded Asphalt Binder

ITEM P-609 CHIP SEAL COAT

DESCRIPTION

609-1.1 This item shall consist of a chip seal coat as a wearing course composed of a single or multiple application of liquid asphalt material and aggregate cover placed on the prepared primed base or properly cured wearing surface, according to these Specifications, and shall conform to the dimensions and typical cross section shown on the Plans.

609-1.2 QUANTITIES OF MATERIALS. The approximate amounts of materials per square yard for the chip seal shall be as provided in Table 609-1 for the treatment specified on the Plans. The exact amounts shall be provided to the Engineer for review and approval.

TABLE 609-1. QUANTITIES OF MATERIALS

Application No	Aggregate lbs/yd ²	Asphalt gal/yd ²	Type of Asphalt ^{1\1}
1	40-50	0.35-0.45	Asphalt Cement
		0.40-0.50	Emulsified Asphalt
2	20-25	0.15-0.25	Asphalt Cement
		0.20-0.35	Emulsified Asphalt
3	15-20	0.15-0.20	Emulsified Asphalt

^{1\1} See Table 609-4 for grades of asphalt and spraying temperatures.

MATERIALS

609-2.1 AGGREGATE MATERIALS. The aggregate material shall be either crushed stone or crushed gravel. The cover material shall be screenings; sand may be used when specified.

If the material is to be crushed stone, it shall be manufactured from sound, hard, durable rock of accepted quality and crushed to specification size. All strata, streaks, and pockets of clay, dirt, sandstone, soft rock, or other unsuitable material accompanying the sound rock shall be discarded and not allowed to enter the crusher.

If the material is to be crushed gravel, it shall consist of hard, durable, fragments of stone or gravel of accepted quality and crushed to specification size. All strata, streaks, and pockets of sand, excessively fine gravel, clay, or other unsuitable material including all stones, rocks, and boulders of inferior quality shall be discarded and not allowed to enter the crusher. When tested according to ATM 305, the crushing of the gravel shall result in a product in which the material retained on the separate No. 4, 3/8-inch, and 1/2-inch sieves shall have at least 90% of particles with at least one fractured face.

TABLE 609-2. AGGREGATE MATERIAL REQUIREMENTS

Material Test	Requirement	Standard
L.A. Wear	Loss: 40% maximum	AASHTO T 96
Soundness of Aggregates by Use of Sodium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate	AASHTO T 104
Degradation Value	50 minimum	ATM 313
Percentage of Fractured Particles	Minimum 90% by weight of particles with at least one fractured faces ¹	ATM 305
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 3:1	ATM 306

¹ The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be achieved by crushing.

The crushed aggregate for the applications shall meet the requirements for gradation given in Table 609-3 when tested according to ATM 304.

TABLE 609-3. REQUIREMENTS FOR GRADATION OF AGGREGATE¹

Sieve Designation (square openings)	Percentage by Weight Passing Sieves		
	Aggregate No. 1	Aggregate No. 2	Aggregate No. 3
1 inch	100		
3/4 inch	90-100		
1/2 inch	20-55	100	
3/8 inch	0-15	85-100	100
No. 4	0-5	10-30	60-85
No. 8		0-10	0-25
No. 16		0-5	0-5
No. 200	0-1	0-1	0-2

¹ Locally available aggregate used for chip seals with similar gradations may be used provided the maximum aggregate size is the same; and the aggregate meets all other quality requirements in these specifications.

The gradations in the table represent the limits which shall determine suitability of aggregate for use for the specified applications from the sources of supply. The final gradations decided on, within the limits designated in the table, shall be uniformly graded from coarse to fine.

The aggregate to be used shall show no evidence of stripping or swell when tested according to ATM 414. The use of antistripping agents for the control of stripping shall be used if necessary.

609-2.2 ASPHALT MATERIAL. The types, grades, controlling specifications, and application temperatures for the asphalt materials are shown in Table 609-4. Provide the specific liquid asphalt material designated in the Plans.

TABLE 609-4. ASPHALT MATERIALS

Type and Grade	Specification	Spraying Temperature \1\Deg. F
Asphalt Cement		
PG 52-28	AASHTO M 320	275+
Emulsified Asphalt		
RS-1	AASHTO M 140	70-140
RS-2	AASHTO M 140	125-175
MS-1, HFMS-1	AASHTO M 140	70-160
CRS-1	AASHTO M 208	125-175
CRS-2	AASHTO M 208	125-175
CRS-2P	AASHTO M 316	140-170

\1\ The maximum temperature for asphalt cements shall be below that at which fogging occurs.

The Contractor shall provide samples of the asphalt material and a copy of the manufacturer's Certificate of Analysis (COA) for each carload or equivalent of the asphalt material to the Engineer for review and

acceptance before the asphalt material is applied. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties. The furnishing of COA for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

609-2.3 SAMPLING AND TESTING Sampling and testing is the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor, subject to approval by the Engineer. Sampling shall be according to ATM 301 for aggregates and ATM 401 for asphalt material, unless otherwise directed. Perform aggregate gradation tests on each sample according to ATM 304. Perform all other aggregate tests on the initial source samples and repeat tests when there is a change of source. Perform sieve analyses daily from material samples. The tests shall include an analysis of each gradation of material. Submit copies of test results to the engineer, within 24 hours after completion of each test.

CONSTRUCTION METHODS

609-3.1 WEATHER LIMITATIONS. Asphalt material shall be applied only when the existing surface is dry and the atmospheric temperature is above 60°F. No material shall be applied when rain is imminent or when dust or sand is blowing.

609-3.2 EQUIPMENT AND TOOLS. The Contractor shall furnish all equipment, tools, and machines necessary for the performance of the work.

- a. **Asphalt Distributor.** The distributor shall be designed, equipped, maintained, calibrated according to ASTM D2995, and operated so that asphalt material at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 5%. Distributor equipment shall include a tachometer, pressure gages, volume-measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.
- b. **Aggregate Spreader.** The aggregate spreader shall be a self-propelled mechanical spreader or truck-attached mechanical spreader capable of uniformly distributing aggregate at the specified rates.
- c. **Power Rollers.** Power rollers shall be steel-wheeled or pneumatic-tired type, conforming to the following requirements:
 - (1) Steel-wheeled rollers shall have at least one steel drum and weigh a minimum of 5 tons. Steel wheels of the rollers shall be equipped with adjustable scrapers.
 - (2) Pneumatic-tired rollers shall be self-propelled and have wheels mounted on two axles in such manner that the rear tires will not follow in the tracks of the forward group. Tires shall be uniformly inflated to not less than 60 psi nor more than 80 psi pressure. The pneumatic-tired rollers shall be equipped with boxes or platforms for ballast loading and shall be loaded so that the tire print width of each wheel is not less than the clear distance between tire prints.
- d. **Power Broom.** A power broom and/or blower shall be provided for removing loose material from the surface to be treated.

609-3.3 PREPARING UNDERLYING COURSE. The surface of the underlying course shall be prepared, shaped, and conditioned to a uniform grade and section, as shown on the Plans and as specified. Loose dirt and other objectionable material shall be removed from the surface.

On those type of bases where a prime coat is required and specified, the prime shall be applied and satisfactorily cured before starting the asphalt surface treatment.

When specified, the Contractor shall be required to patch, with premixed material, any holes or other malformations deviating from the true cross section and grade. The premixed material shall be made of the asphalt material specified and prepared by the method directed by the Engineer. All small patches shall be thoroughly hand tamped while the large patches shall be rolled with a power or pneumatic roller.

609-3.4 CONTROL STRIP. Prior to providing a complete chip seal coat and in the presence of the Engineer, treat three lengths of at least 100-feet for the full width of the distributor bar. Use the appropriate typical application rates shown in Table 609-1 for one surface treatment trial. Make other chip seal coat trials using various amounts of materials, as required by the Engineer.

609-3.5 APPLICATION OF ASPHALT MATERIAL. Asphalt material shall be applied on the properly prepared surface at the rate and temperature specified using a pressure distributor to obtain uniform distribution at all points. To insure proper drainage, the strips shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope. During all applications, the surfaces of adjacent structures shall be protected in such manner as to prevent their being spattered or marred. Asphalt materials shall not be discharged into borrow pits or gutters or upon the airport area.

609-3.6 APPLICATION OF AGGREGATE MATERIAL. Immediately after the application of the asphalt material, or as directed by the Engineer, uniformly spread the aggregates over the asphalt material at the rate specified for each designated application. Trucks spreading aggregate shall be operated backward so that the asphalt material will be covered before the truck wheels pass over it. The aggregate shall be spread in the same width of application as the asphalt material and shall not be applied in such thickness as to cause blanketing. Back-spotting or sprinkling of additional aggregate material, and pouring additional asphalt material over areas that show up having insufficient cover or asphalt, shall be done by hand whenever necessary. Additional spreading of aggregate material shall be done with a motor-patrol grader equipped with broom moldboard, a broom drag, kick broom, or a power broom, as directed by the Engineer.

Immediately after spreading each application, the aggregate shall be rolled. The rolling shall be continued until no more aggregate can be worked into the surface. In the construction of the second and third application, blading with the wire-broom moldboard attachment, kick broom, or broom dragging shall begin as soon as possible after the rolling has started and after the surface has set sufficiently to prevent excessive marking. Further blading and rolling on the strip being placed and on adjacent strips previously placed, shall be done as often as necessary to keep the aggregate material uniformly distributed. These operations shall be continued until the surface is evenly covered and cured to the satisfaction of the Engineer.

Succeeding applications shall not be applied until the preceding application has set and in no case until at least 24 hours have elapsed. If dust, dirt, or other foreign matter accumulates on the surface between the applications, the Contractor shall sweep and clean the surface as specified herein. The asphalt material and the aggregate shall be spread upon the clean and properly cured surface and handled as required. Avoid brooming or tracking dirt or any foreign matter on any portion of the pavement surface under construction.

All surplus aggregate from the final application shall be swept off the surface and removed prior to final acceptance of the work.

609-3.7 CORRECTION OF DEFECTS. Any defects, such as raveling, low centers, lack of uniformity, or other imperfections, shall be corrected to the satisfaction of the Engineer.

All defective materials resulting from over-heating, improper handling, or improper application shall be removed by the contractor and replaced with approved materials according to these specifications.

609-3.8 FREIGHT AND WAYBILLS. Before the final estimate is allowed the Contractor shall file with the Engineer receipted bills where railroad shipments are made, and certified waybills when materials are received in any other manner, of the asphalt and covering materials actually used in the construction covered by the contract. The Contractor shall not remove asphalt material from the tank car or storage tank

until the initial outage and temperature measurements have been taken by the Engineer, nor shall the car or tank be released until the final outage has been taken by the Engineer. Copies of all freight bills and waybills shall be furnished to the Engineer during the progress of the work.

METHOD OF MEASUREMENT

609-4.1 The asphalt material will be measured by the ton. Water added to emulsified asphalt will not be measured for payment.

609-4.2 The quantity of aggregate material for the first, second, and third application to be paid for will be the number of tons of aggregate used for the accepted work.

609-4.3 Chip Seal Coat, [number of aggregate] Applications. Section 90, by square yard of chip seal coat. Chip seal coat will be measured by the square yard, all preparation, materials, and application, completed and accepted. Liquid asphalt material, aggregate, blotter material, water used for aggregate and preparation, sweeping and dust control are subsidiary to P-609 items. Any areas of asphalt surface treatment found unacceptable by the Engineer shall be removed and reconstructed at the Contractor's expense. The pay unit/payment is for all layers/full depth of the surface treatment.

BASIS OF PAYMENT

609-5.1 Payment will be made at the contract unit price per ton for asphalt material for surface treatment and per ton for the first, second, and third aggregate application, or by the square yard for the completed chip seal coat application, as shown in the Bid Schedule.

Payment will be made under:

Item P609.010.0000	Asphalt Material – per ton
Item P609.020.0000	First Application Aggregate – per ton
Item P609.030.0000	Second Application Aggregate – per ton
Item P609.040.0000	Third Application Aggregate – per ton
Item P609.050.0000	Chip Seal Coat, ____ Applications – square yard.

TESTING REQUIREMENTS

ATM 301	Sampling of Aggregates
ATM 304	Sieve Analysis of Aggregates & Soils
ATM 305	Percentage of Fracture in Coarse Aggregate
ATM 306	Percentage of Flat and Elongated Particles in Coarse Aggregate
ATM 313	Degradation Value of Aggregate
ATM 401	Sampling Asphalt Materials
ATM 414	Anti-Strip Requirements of Hot Mix Asphalt
AASHTO T 96	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

MATERIAL REQUIREMENTS

AASHTO M 140

AASHTO M 208

AASHTO M 320

Emulsified Asphalt

Cationic Emulsified Asphalt

Performance Graded Asphalt Binder

ITEM P-626 EMULSIFIED ASPHALT SLURRY SEAL SURFACE TREATMENT

DESCRIPTION

626-1.1 This item shall consist of a mixture of emulsified asphalt, polymer, mineral aggregate, and water properly proportioned, mixed, and spread on an asphalt pavement surface, including airport pavements serving airplanes of 12,500 lbs or less, roads, and other general applications. The application of the surface treatment shall be according to these Specifications and shall conform to the dimensions shown on the Plans or as directed by the Engineer.

626-1.2 ACRONYMS. Also see Subsection GCP-10-02.

ISSA International Slurry Surfacing Association, Washington, DC

MATERIALS

626-2.1 AGGREGATE. The aggregate shall consist of sound and durable manufactured sand, slag, crusher fines, crushed stone, or a combination thereof. The aggregate shall be clean and free from vegetable matter, dirt, and other deleterious substances. The aggregate shall have a sand equivalent of not less than 45 percent when tested according to ATM 307. The aggregate shall show a loss of not more than 35 percent when tested according to AASHTO T 96. The sodium sulfate soundness loss shall not exceed 12 percent, after 5 cycles when tested according to AASHTO T 104. Aggregates shall have a minimum degradation value of 50 when tested according to ATM 313. Aggregate shall be 100% crushed.

The combined aggregate shall conform to the gradation shown in Table 626-1 when tested according to ATM 304. The specific aggregate gradation type will be designated in the Plans.

TABLE 626-1. GRADATION OF AGGREGATES

Sieve Size	Percent by Weight Passing Sieve		
	Type I	Type II	Type III
3/8 in.	100	100	100
No. 4	100	90 - 100	70 - 90
No. 8	90 - 100	65 - 90	45 - 70
No. 16	65 - 90	45 - 70	28 - 50
No. 30	40 - 65	30 - 50	19 - 34
No. 50	25 - 42	18 - 30	12 - 25
No. 100	15 - 30	10 - 21	7 - 18
No. 200	10 - 20	5 - 15	5 - 15
Residual asphalt content, percent dry weight of aggregate	10% - 16%	7.5% - 13.5%	6.5% - 12%

The job mix design (JMD) shall be run using aggregate within the gradation band for the desired type shown in Table 626-1. Once the JMD has been submitted and approved by the Engineer, the aggregate used on the project shall not vary by more than the tolerances shown in Table 626-2. At no time shall the aggregate used go out of the gradation bands in Table 626-1.

The aggregate will be accepted at the job location or stockpile. The aggregate will be accepted based on five gradation test samples according to ATM 301. If the average of the five tests is within the gradation tolerances, the materials will be accepted by the Engineer. If the tests show the material to be out of tolerance, the Contractor has the choice either to remove the material or blend other aggregates with the stockpile material to bring it into specification. Materials used in blending shall meet the quality tests before blending and shall be blended in a manner to produce a consistent gradation. This blending may require a new JMD.

Screening shall be required at the project stockpile site if there are oversize materials in the mix. Precautions shall be taken to prevent segregation of the aggregate in storing and handling. The stockpile shall be kept in areas that drain readily.

- a. **Aggregate Tolerance.** Once the JMD has been accepted, the aggregate gradation used on the project may vary from the aggregate gradation used in the JMD on each sieve by the percentages shown in Table 626-2. If the project aggregate fails to remain within this tolerance, a new JMD will be required by the Engineer at the expense of the Contractor.

TABLE 626-2. AGGREGATE TOLERANCE

Sieve Size	Tolerance, percent passing by weight
3/8 in.	± 5
No. 4	± 5
No. 8	± 5
No. 16	± 5
No. 30	± 5
No. 50	± 4
No. 100	± 3
No. 200	± 2
Residual Asphalt, percent dry weight of aggregate	± 1

626-2.2 MINERAL FILLER. If mineral filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of AASHTO M 17 and shall be used in the amounts required by the JMD. The mineral filler shall be considered as part of the aggregate.

626-2.3 EMULSIFIED ASPHALT. The specific emulsified asphalt is designated in the Plans, and shall conform to the requirements of AASHTO R 5. The cement mixing test is waived for these slurry type emulsions. The type of emulsified asphalt shall be either anionic or cationic, whichever is best suited to the aggregate and job conditions to be encountered.

The Contractor shall provide samples of the emulsified material and a copy of the manufacturer's Certificate of Analysis (COA) for each carload or equivalent of the asphalt material to the Engineer for review and acceptance before the emulsified asphalt material is applied. The furnishing of COA for the emulsified asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

626-2.4 POLYMER. The Contractor shall submit manufacturer's technical data, the manufacturer's certification indicating that the polymer meets the requirements of the specification, and the asphalt material manufacturer's approval of its use to the Engineer.

626-2.4 WATER. All water used in mixing or curing the slurry shall be from potable sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

COMPOSITION AND APPLICATION

626-3.1 COMPOSITION. The slurry seal shall consist of a mixture of emulsified asphalt, mineral aggregate, a minimum of 1% polymer (when specified), additives as necessary, and water.

626-3.2 JOB MIX DESIGN. No slurry seal for payment shall be placed until a JMD has been approved by the Engineer. The JMD shall be developed by a laboratory with experience in designing slurry seal mixes and a signed copy shall be submitted in writing by the Contractor to the Engineer at least 10 days prior to the start of operations.

The laboratory report JMD shall indicate the proportions of aggregates, mineral filler (min. and max.), water (min. and max.), polymer (%), and asphalt emulsion based on the dry aggregate weight. It shall also report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effects). The JMD shall be in effect until modified in writing by the Engineer. Should a change in sources of materials be made, a new JMD shall be established before the new material is used.

The Contractor shall submit to the Engineer for approval a complete JMD on the materials proposed for use, prepared and certified by an approved laboratory. Compatibility of the aggregate, emulsion, mineral filler, and other additives shall be verified by the JMD. The JMD shall be made with the same aggregate and grade of emulsified asphalt that the Contractor will provide on the project. At a minimum the required tests and values needed are shown in Table 626-3:

TABLE 626-3. SLURRY MIX TESTS

TEST	DESCRIPTION	SPECIFICATION
ISSA TB-100	Wet Track Abrasion of Slurry Surfacing Systems, One Hour Soak	50 g/ft ² Max
ISSA TB-115	Determination of Slurry Seal Compatibility	Pass

626-3.3 APPLICATION RATE. Unless otherwise specified, the slurry seal shall be applied to at the application rates shown in Table 626-4 for that gradation of material used. The rate of application shall not vary more than ± 2 lb/yd².

TABLE 626-4. SLURRY APPLICATION RATES
(Pounds of mixture per square yard)

Type I	Type II	Type III
8 - 12	12 - 20	18 - 30

626-3.4 CONTROL STRIPS. Control Strips, of 60 yd² each, shall be placed prior to the start of the slurry seal work in the presence of the Engineer. The test area will be designated by the Engineer and will be located on the existing pavement. Control strips shall be made by each machine after calibration. Samples of the slurry seal may be taken and the mix consistency verified by using ISSA TB-106 Slurry Seal Consistency test. In addition, the proportions of the individual materials may be verified by the Engineer by using the calibration information provided after machine calibration. If any test does not meet specification requirements, additional tests shall be made at the expense of the Contractor, until an acceptable control strip is placed.

CONSTRUCTION METHODS

626-4.1 WEATHER LIMITATIONS. The slurry seal shall not be applied if the pavement or air temperature is below 50°F and falling but may be applied when both pavement and air temperature are above 45°F and rising. No slurry seal shall be applied when there is danger that the finished product will freeze before 24 hours. Do not apply slurry seal during rain or other adverse weather conditions. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time.

626-4.2 EQUIPMENT AND TOOLS. The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of this work.

- a. **Slurry Mixing Equipment.** The machine shall be specifically designed and manufactured to lay slurry seal. The material shall be mixed by a self-propelled slurry seal mixing machine of either truck mounted or continuous run design. Either type machine shall be able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, and water to a revolving mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for materials to maintain an adequate supply to the proportioning controls.

If continuous run equipment is used, the machine shall be equipped to allow the operator to have full control of the forward and reverse speed of the machine during application of the slurry seal,

with a self-loading device, with opposite side driver stations, all part of original equipment manufacturer design.

The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients. No excessive mixing shall be permitted. The mixing machine shall be equipped with a fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed into the mixer.

The mixing machine shall be equipped with a water pressure system and fog-type spray bar adequate for complete fogging of the surface with an application of 0.05 to 0.10 gal/yd² preceding the spreading equipment.

Sufficient machine storage capacity to mix properly and apply a minimum of 5 tons of the slurry shall be provided. Proportioning devices shall be calibrated prior to placing the slurry seal.

- b. **Slurry Spreading Equipment.** The mixture shall be spread uniformly by means of a conventional surfacing spreader box attached to the mixer and equipped to agitate and spread the material evenly throughout the box. A front seal shall be provided to ensure no loss of the mixture at the surface contact point. The rear seal shall act as the final strike-off and shall be adjustable. The spreader box and rear strike-off shall be so designed and operated to produce a free flow of material of uniform consistency to the rear strike-off. The spreader box shall have suitable means provided to side shift the box to compensate for variations in the pavement geometry. A burlap drag or other approved screed may be attached to the rear of the spreader box to provide a uniform mat.

A continuous spreading operation shall be maintained by means of a continuous charging operation so that a minimum of construction joints occur. Continuous operating is defined as one in which the spreading operation progresses prior to initial setting or breaking of the slurry mix, which starts within approximately 15 minutes.

Provide suitable storage facilities for the asphalt emulsion, using containers equipped to prevent water from entering the emulsion. If necessary, suitable heat shall be provided to prevent freezing.

- c. **Auxiliary Equipment.** Other tools or equipment such as brushes, hand squeegees, hose equipment, tank trucks, water distributors and flushers, power blowers, barricades, etc., shall be provided as required.
- d. **Roller.** The roller shall be a self-propelled pneumatic-tired roller capable of exerting a contact pressure during rolling of 50 psi. It shall be equipped with a water spray system, to be used if the slurry is picking up on the tires during rolling.
- e. **Tack Coat and Distributor.** Normally a tack coat is not required unless the surface to be covered is extremely dry and raveled or is concrete or brick. If required, the tack coat should consist of one part emulsified asphalt and three parts water. The emulsified asphalt may be the same as that used in the mix. Pressure distributors used for application of the diluted asphalt emulsion tack coat shall be self-propelled, equipped with pneumatic tires, and capable of uniformly applying 0.05 to 0.15 gal/yd² of the diluted emulsion over the required width of application. Distributors shall be equipped with tachometers, pressure gages, and volume-measuring devices. The tack coat shall be applied at least 2 hours before the slurry seal but within the same day.

626-4.3 EQUIPMENT CALIBRATION. Each slurry mixing unit to be used on the project shall be calibrated in the presence of the Engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering devices. No machine will be allowed to work on the project until either the calibration has been completed or a previous calibration is accepted by the Engineer.

626-4.4 PREPARATION OF EXISTING SURFACE. Clean pavement surface immediately prior to placing the tack coat and slurry seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that the pavement surface is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. Water flushing will not be permitted

in areas where considerable cracks are present in the pavement surface. After cleaning, treat these areas with an oil spot primer.

All painted stripes or markings on the surface to be treated, shall be removed according to Subsection P-620-3.3. Patch asphalt pavement surfaces that have been softened by petroleum derivatives or have failed due to any other cause. Remove damaged pavement to the full depth of the damage and replace with new asphalt pavement similar to that of the existing pavement. Materials and methods of construction shall comply with the applicable sections of these specifications. Remove all vegetation and debris from cracks to a minimum depth of 1-inch. If extensive vegetation exists, treat the specific area with a concentrated solution of a water-based herbicide approved by the Engineer. Fill all cracks greater than 1/4-inch (wide) with a crack sealant meeting ASTM D6690, Type IV. The crack sealant, preparation, and application shall be compatible with the surface treatment/overlay to be used. To minimize contamination of the asphalt with the crack sealant, underfill the crack sealant a minimum of 1/8-inch, not to exceed 1/4-inch. Any excess joint or crack sealant shall be removed from the pavement surface.

626-4.5 APPLICATION OF SLURRY SEAL COAT. Charge the mixture in the following order:

- a. Water
- b. Aggregate
- c. Asphalt Emulsion

No violent mixing will be permitted. Maintain temperature range at the mixer between 90 and 120 °F. Mix until a uniform coating of the aggregate is obtained. Continue mixing until the mixture is discharged into the spreader box. Discard the entire batch if there is evidence that the emulsion has broken.

The surface shall be pre-wet by fogging ahead of the slurry spreader box. Water used in pre-wetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the slurry spreader box. The slurry mixture shall be of the desired consistency when deposited on the surface, and no additional elements shall be added. Total time of mixing shall not exceed 2 minutes. A sufficient amount of slurry shall be carried in all parts of the spreader box at all times so that complete coverage of all surface voids and cracks is obtained. Care shall be taken not to overload the spreader box which shall be towed at a slow and uniform rate not to exceed 5 mph. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry shall be removed from the pavement surface. A sufficient amount of slurry shall be fed into the box to keep a full supply against the full width of the spreader box. The mixture shall not be permitted to overflow the sides of the spreader box. No breaking of the emulsion will be allowed in the spreader box.

Apply the slurry seal to form a film with a maximum thickness of 3/8 inch. Isolated depressions and cracks may have a thickness greater than 3/8 inch in order to obtain a smooth surface.

The finished surface shall have no more than 4 tear or drag marks greater than 1/2 inch wide and 4 inches long in any 12 foot by 22 foot section. It shall have no tear or drag marks greater than 1 inch wide and 3 inches long.

The finished surface shall have no transverse ripples of 1/4 inch or more in depth, as measured with a 12-foot straight edge laid upon the surface.

Adjacent lanes shall be lapped at the edges a minimum of 2 inches with a maximum of 4 inches to provide complete sealing at the overlap. Construction longitudinal and transverse joints shall be neat and uniform without buildup, uncovered areas, or unsightly appearance. All joints shall have no more than 1/4 inch difference in elevation when measured across with a 12-foot straight edge.

After application of the slurry seal, the surface shall be rolled with a pneumatic-tired roller a minimum of 2 complete passes. The roller shall be operated at a tire pressure of approximately 50 psi.

The fresh slurry seal application shall be protected by barricades and markers and permitted to dry for 4 to 24 hours, depending on weather conditions. Any damage to uncured slurry shall be repaired at the expense of the Contractor.

In areas where the spreader box cannot be used, the slurry shall be applied by means of a hand squeegee. Upon completion of the work, the seal coat shall have no holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform and skid resistant texture satisfactory to the Engineer. All wasted and unused material and all debris shall be removed from the site prior to final acceptance.

Upon completion of the project, the Contractor shall sweep the finished surface with a conventional power rotary broom, to remove any potential loose material from the surface. The material removed by sweeping shall be disposed of in a manner satisfactory to the Engineer.

626-4.6 CERTIFICATION. Samples of the emulsion that the Contractor proposes to use, together with a statement as to its source, shall be submitted, and approval shall be obtained before using such material. The Contractor shall submit to the Engineer a manufacturer's certified report for each consignment of the emulsion. The manufacturer's certified report shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing samples of the emulsion as received for use on the project.

METHOD OF MEASUREMENT

626-5.1 The emulsified asphalt for slurry coat will be measured by the square yard.

626-5.2 Aggregate will be measured by the ton of dry aggregate.

626-5.3 Tack coat will be measured by the ton.

626-5.4 Emulsified Asphalt Slurry Seal Surface Treatment will be measured according to Section 90 by the square yard, all preparation, materials, and application, completed and accepted. Liquid asphalt material, aggregate, blotter material, water used for emulsion and preparation, sweeping and dust control are subsidiary to the work. Any areas of emulsified asphalt slurry seal surface treatment found unacceptable by the Engineer shall be removed and reconstructed at the Contractor's expense. The pay unit/payment is for all layers/full depth of slurry seal surface treatment.

BASIS OF PAYMENT

626-6.1 Payment will be made at the contract unit price per square yard for the slurry coat and at the contract price per ton for aggregate and tack coat.

Payment will be made under:

Item P626.010.0000	Emulsified Asphalt for Slurry Coat - per square yard
Item P626.020.0000	Aggregate - per ton
Item P626.030.0000	Emulsified Asphalt for Tack Coat - per ton
Item P626.040.0000	Emulsified Asphalt Slurry Seal Surface Treatment – per square yard

TESTING REQUIREMENTS

AASHTO T 96	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
ATM 313	Degradation Value of Aggregates
ISSA TB-100	Wet Track Abrasion of Slurry Surfacing Systems
ISSA TB-106	Measurement of Slurry Seal Consistency

ISSA TB-115	Determination of Slurry System Compatibility
ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D6690	Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ATM 301	WAQTC FOP for AASHTO T 2 Sampling of Aggregates
ATM 304	WAQTC FOP for AASHTO T 27/T 11 Sieve Analysis of Fine and Coarse Aggregates
ATM 307	WAQTC FOP for AASHTO T 176 Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
ATM 313	Degradation Value of Aggregates

MATERIAL REQUIREMENTS

AASHTO M 17	Mineral Filler for Bituminous Paving Mixtures
AASHTO R 5	Selection and Use of Emulsified Asphalts

ITEM P-602 EMULSIFIED ASPHALT PRIME COAT

DESCRIPTION

602-1.1 This item shall consist of an application of liquid asphalt material on the prepared base course according to these Specifications and in reasonably close conformity to the lines shown on the Plans.

MATERIALS

602-2.1 LIQUID ASPHALT MATERIAL. The types, grades, controlling specifications, and application temperatures for the prime coat are given in Table 602-1. Provide the specific prime coat material designated in the Plans.

TABLE 602-1. MATERIALS

Type and Grade	Specification	Application Temperatures \\ °F	Application Rate gal/yd ²
Emulsified Asphalt			
SS-1, SS-1h	AASHTO M 140	70-160	0.27 to 0.53
MS-2, HFMS-1	AASHTO M 140	70-160	0.27 to 0.53
CSS-1, CSS-1h	AASHTO M 208	70-160	0.27 to 0.53
CMS-2	AASHTO M 208	70-160	0.27 to 0.53
CMS-2s	\\2\\	70-160	0.22 to 0.44
Cutback Asphalt			
RC-30	ASTM D2028	80+	0.27 to 0.53
RC-70	ASTM D2028	120+	0.27 to 0.53
RC-250	ASTM D2028	165+	0.27 to 0.53
MC-30	ASTM D2027	80+	0.11 to 0.33

\\1\\ The maximum temperature for cutback asphalt shall be that at which fogging occurs.

\\2\\ CMS-2s shall meet the following specifications: Viscosity, Saybolt Furol, of 50 to 450 at 122 °F when tested under AASHTO T 59. Particle charge test of Positive when tested under AASHTO T 59. Sieve test maximum of 0.10% when tested under AASHTO T 59. Oil distillate, by volume of emulsion, of 20% maximum when tested under AASHTO T 59. Residue of 65% minimum when tested under AASHTO T 59. Penetration of 100 to 250 at 77 °F, 100 g, 5 s when tested under ASTM D5. Ductility of 40 cm minimum at 77 °F when tested under ASTM D113. Solubility in trichloroethylene of 97.5% minimum.

The Contractor shall provide samples of the prime coat material and a copy of the manufacturer's Certificate of Analysis (COA) for each carload or equivalent of the liquid asphalt material to the Engineer for review and acceptance before the liquid asphalt material is applied. The furnishing of the COA for the liquid asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

CONSTRUCTION METHODS

602-3.1 WEATHER LIMITATIONS. The prime coat shall be applied only when the existing surface is dry or contains sufficient moisture to get uniform distribution, when the surface temperature is above 45 °F, and when the weather is not foggy or rainy. The temperature requirements may be waived, but only when so directed by the Engineer.

602-3.2 EQUIPMENT. The equipment used by the Contractor shall include a self-powered pressure distributor and equipment for heating the prime coat.

The distributor shall be designed, equipped, maintained, calibrated within the past year to ASTM D2995, and operated so that prime coat at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 5%. Distributor equipment shall include a tachometer, pressure gages, volume-measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

A power broom and/or blower shall be provided for any required cleaning of the surface to be treated.

602-3.3 APPLICATION OF PRIME COAT. Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

The prime coat including solvent shall be uniformly applied with an asphalt distributor at the rate specified in Table 602-1, depending on the base course surface texture. The type of liquid asphalt material and application rate shall be approved by the Engineer prior to application.

Following the application, the primed surface shall be allowed to cure not less than 48 hours without being disturbed or for such additional time as may be necessary to permit the drying out of the prime until it will not be picked up by traffic or equipment. This period shall be determined by the Engineer. The surface shall then be maintained by the Contractor until the surfacing has been placed. Suitable precautions shall be taken by the Contractor to protect the primed surface against damage during this interval, including supplying, spreading, and removing any sand necessary to blot up excess prime coat.

602-3.4 TRIAL APPLICATION RATES. The Contractor shall conduct a trial application in the presence of the Engineer to demonstrate the liquid asphalt material can be satisfactorily applied within the application range specified in Table 602-1 for the specified material.

602-3.5 FREIGHT AND WAYBILLS. Before the final estimate is allowed, the Contractor shall file with the Engineer receipted bills when railroad shipments are made, and certified waybills when materials are received in any other manner, of the prime coat actually used in the construction covered by the contract. The Contractor shall not remove prime coat from the tank car or storage tank until the initial outage and temperature measurements have been taken by the Engineer, nor shall the car or tank be released until the final outage has been taken by the Engineer.

Copies of freight bills and waybills shall be furnished to the Engineer during the progress of the work.

METHOD OF MEASUREMENT

602-4.1 Prime coat will be measured by the ton, according to Subsection GCP-90-02. Removing any sand necessary to blot up excess prime coat is subsidiary to the work. Water added to emulsified asphalt will not be measured for payment.

BASIS OF PAYMENT

602-5.1 Payment will be made at the contract unit price per ton for accepted prime coat.

Payment will be made under:

Item P602.010.0010	Prime Coat, CSS-1 – per ton
Item P602.010.0020	Prime Coat, CSS-1h – per ton
Item P602.010.0030	Prime Coat, SS-1 – per ton
Item P602.010.0040	Prime Coat, SS-1h – per ton

TESTING REQUIREMENTS

AASHTO T59 Test for Emulsified Asphalts

ASTM D5	Penetration of Bituminous Materials
ASTM D113	Ductility of Asphalt Materials
ASTM D2995	Estimating Application Rate and Residual Application Rate of Bituminous Distributors

MATERIAL REQUIREMENTS

AASHTO M140	Emulsified Asphalt
AASHTO M208	Cationic Emulsified Asphalt
ASTM D2027	Cutback Asphalt (Medium-Curing Type)
ASTM D2028	Cutback Asphalt (Rapid Curing Type)

ITEM P-603 EMULSIFIED ASPHALT TACK COAT

DESCRIPTION

603-1.1 This item shall consist of preparing and treating an asphalt or concrete surface with liquid asphalt material in accordance with these Specifications and in reasonably close conformity to the lines shown on the Plans.

MATERIALS

603-2.1 ASPHALT MATERIALS. The asphalt material shall be an emulsified asphalt or cutback asphalt as specified in Table 603-1 as an asphalt application for tack coat appropriate to local conditions. Provide the specific tack coat material designated on the Plans.

The tack coat material shall not be diluted. The Contractor shall provide samples of the tack coat material and a copy of the manufacturer's Certificate of Analysis (COA) for the asphalt material to the Engineer for review and acceptance before the asphalt material is applied. The furnishing of COA for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

TABLE 603-1. MATERIALS

Type and Grade	Specification	Application Temperature °F
Emulsified Asphalt		
SS-1, SS-1h	AASHTO M 140	75-130
CSS-1, CSS-1h	AASHTO M 208	75-130
STE-1	\1\	68-140
Cutback Asphalt		
RC-70	AASHTO M 81	120-160

Note /1/ Special Tack Emulsion, STE-1. Meet the following, when tested using AASHTO T 59:

TESTS ON EMULSION

Viscosity @ 77 °F, SSF	30, max.
Storage Stability, 1 day, %	1, max.
Demulsibility, 35 mL 0.8% SDS, %	25, min.
Particle Charge	Positive*
Sieve Test, % Retained	0.10, max.
Distillation Oil by Vol. of Emulsion, %	5, max.
Distillation Residue by Wt. of Emulsion, %	45, min.

TESTS ON RESIDUE

Penetration @ 77 °F	100-250 (when tested under ASTM D5)
Ductility @ 77 °F, 5 cm/min., cm	40, min (when tested under ASTM D113)
Solubility in TCE, %	97.5, min.

* If Particle Charge test is inconclusive, material having a max. pH value of 6.7 is acceptable.

CONSTRUCTION METHODS

603-3.1 WEATHER LIMITATIONS. The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50°F or above; the temperature has not been below 35°F for the 12 hours

prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer.

603-3.2 EQUIPMENT. The Contractor shall provide equipment for heating and applying the tack coat material. The tack coat shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour or seven hundred (700) feet per minute.

The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a minimum 12-foot spreader spray bar with individual nozzle control with computer-controlled application rates. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper.

The distributor truck shall be equipped to effectively heat and mix the material to the required temperature prior to application as required. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Do not overheat or over mix the material.

The distributor shall be equipped with a hand sprayer.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the Engineer.

A power broom and/or power blower shall be provided suitable for cleaning the surfaces to which the asphalt tack coat is to be applied.

603-3.3 APPLICATION OF TACK COAT MATERIAL. The tack coat material shall not be diluted. Immediately before applying the tack coat, the full width of surface to be treated shall be swept with a power broom and/or power blower to remove all loose dirt and other objectionable material.

The tack coat material shall be uniformly applied with an asphalt distributor at the rates appropriate for the conditions and surface specified in Table 603-2 below. The type of liquid asphalt material and application rate shall be approved by the Engineer prior to application.

TABLE 603-2. APPLICATION RATE

Surface Type	Residual Rate, gal/SY	Application Bar Rate, gal/SY
New asphalt	0.02-0.05	0.03-0.07
Existing asphalt	0.04-0.07	0.06-0.11
Milled Surface	0.04-0.08	0.06-0.12
Concrete	0.03-0.05	0.05-0.08

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the Engineer. The Contractor shall protect the tack coat and maintain the surface until the next course has been placed. When the tack coat has been disturbed by the Contractor, tack coat shall be reapplied at the Contractor's expense.

603-3.4 FREIGHT AND WAYBILLS. The Contractor shall submit waybills and delivery tickets, during progress of the work. Before the final statement is allowed, file with the Engineer certified waybills and certified delivery tickets for all tack coat materials used in the construction of the pavement covered by the contract. Do not remove tack coat material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

METHOD OF MEASUREMENT

603-4.1 The liquid asphalt material for tack coat shall be measured by the ton according to GCP Subsection 90-02. The liquid asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of liquid asphalt material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

BASIS OF PAYMENT

603.5-1 Payment shall be made at the contract unit price per ton of accepted tack coat material.

Payment will be made under:

Item P603.010.0010	Tack Coat, STE-1 – per ton
Item P603.010.0020	Tack Coat, SS-1 – per ton
Item P603.010.0030	Tack Coat, SS-1h – per ton
Item P603.010.0040	Tack Coat, CSS-1 – per ton

References

AASHTO M 81	Cutback Asphalt (Rapid-Curing Type)
AASHTO M 140	Emulsified Asphalt
AASHTO M 208	Cationic Emulsified Asphalt
AASHTO T 59	Test for Emulsified Asphalts
ASTM D5	Penetration of Bituminous Materials
ASTM D113	Ductility of Asphalt Materials
ASTM D2995	Estimating Application Rate and Residual Application Rate of Bituminous Distributors

ITEM P-605 JOINT SEALANTS FOR PAVEMENTS

DESCRIPTION

605-1.1 This item shall consist of providing and installing a resilient and adhesive joint sealing material capable of effectively sealing joints in pavement; joints between different types of pavements; and cracks in existing pavement.

MATERIALS

605-2.1 JOINT SEALANTS. Joint sealing material shall meet the requirements of ASTM D6690 for sealing joints or cracks in Asphalt or Portland Cement Concrete Pavements. Joint sealing material shall meet the requirements of ASTM D7116 for sealing joints or cracks in Portland Cement Concrete Pavements only where fueling occurs.

Each lot or batch of sealing compound shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, and the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of this specification.

605-2.2 BACKER ROD. The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be $25\% \pm 5\%$ larger in diameter than the nominal width of the joint.

605-2.3 BOND BREAKING TAPES. Provide a bond breaking tape, or separating material that is a flexible, non-shrinkable, non-absorbing, non-staining, and non-reacting adhesive-backed tape. The material shall have a melting point at least 5°F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

605-2.4 BACKUP MATERIAL. Provide backup material that is a compressible, non-shrinking, non-staining, non-absorbing material, nonreactive with the joint sealant. The material shall have a melting point at least 5°F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The material shall have a water absorption of not more than 5% of the sample weight when tested in accordance with ASTM C509. The backup material shall be $25 \pm 5\%$ larger in diameter than the nominal width of the crack.

CONSTRUCTION METHODS

605-3.1 TIME OF APPLICATION. Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be above 50°F and rising at the time of installation of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

605-3.2 EQUIPMENT. Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, at least 15 days prior to use on the project.

- a. **Tractor-mounted routing tool.** Provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

- b. **Concrete saw.** Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified.
- c. **Sandblasting equipment.** The Contractor must demonstrate sandblasting equipment including the air compressor, hose, guide, and nozzle size, under job conditions, before approval in accordance with subsection 605-3.3. The Contractor shall demonstrate, in the presence of the Engineer, that the method cleans the joint and does not damage the joint.
- d. **Waterblasting equipment.** The Contractor must demonstrate waterblasting equipment including the pumps, hose, guide, and nozzle size, under job conditions, before approval in accordance with subsection 605-3.3. The Contractor shall demonstrate, in the presence of the Engineer, that the method cleans the joint and does not damage the joint.
- e. **Hand tools.** Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces. Hand tools should be carefully evaluated for potential spalling effects prior to approval for use.
- f. **Hot-poured sealing equipment.** The unit applicators used for heating and installing ASTM D6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.
- g. **Cold-applied, single-component sealing equipment.** The equipment for installing ASTM D5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

605-3.3 PREPARATION OF JOINTS. Pavement joints for application of material in this specification must be dry, clean of all scale, dirt, dust, curing compound, and other foreign matter. Demonstrate, in the presence of the Engineer, that the method cleans the joint and does not damage the joint.

- a. **Sawing.** All joints shall be sawed in accordance with specifications and plan details. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.
- b. **Sealing.** Immediately before sealing, the joints shall be thoroughly cleaned of all laitance, curing compound, filler, protrusions of hardened concrete, old sealant and other foreign material from the sides and upper edges of the joint space to be sealed. Cleaning shall be accomplished by tractor-mounted routing equipment, concrete saw, sandblasting (if permitted), waterblasting, or by wire brushing. Upon completion of cleaning, the joints shall be blown out with compressed air. The joint faces shall be surface dry when the seal is applied.
- c. **Backer Rod.** When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a backer rod or backup material to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backer rod or backup material is placed at the specified depth and is not stretched or twisted during installation.
- d. **Bond-breaking tape.** Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond-breaker separating tape to

prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.

Prior to resealing joints, the existing joint sealant shall be removed to the depth as shown on the Plans. If joint sealant other than that originally used is specified, all existing joint sealant shall be removed.

605-3.4 INSTALLATION OF SEALANT. Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the Engineer before sealing is allowed.

Perform a final cleaning with compressed air not more than 50 feet ahead of the joint sealing operations. Fill the joints from the bottom up to 1/8 inch \pm 1/16 inch below the top of pavement surface; or bottom of groove for grooved pavement. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Engineer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

The joint sealant shall be applied uniformly solid from bottom to top and shall be filled without formation of entrapped air or voids. Backer rod or backup material shall be placed as shown on the Plans and shall be non-adhesive to the concrete or the sealant material. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated to within 20°F below the safe heating temperature. The safe heating temperature can be obtained from the manufacturer's shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint shall be provided. Any sealant spilled on the surface of the pavement shall be removed immediately.

605-3.5 INSPECTION. The Contractor shall inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion or return to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified at no additional cost to the Department.

605-3.6 CLEAN-UP. Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

METHOD OF MEASUREMENT

605-4.1 Joint sealing material will be measured by the linear foot of sealant in place, complete, and accepted.

BASIS OF PAYMENT

605-5.1 Payment for joint sealing material will be made at the contract unit price per linear foot, and according to GCP Section 90.

Payment will be made under:

Item P605.010.0000	Joint Sealing Filler – per linear foot
Item P605.020.0000	Joint Sealing Filler – per lump sum

TESTING REQUIREMENTS

ASTM D789 Determination of Relative Viscosity of Concentrated Polyamide (PA) Solutions

MATERIAL REQUIREMENTS

ASTM C509 Elastomeric Cellular Preformed Gasket and Sealing Material

ASTM D5249	Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D5893	Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D6690	Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D7116	Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete Pavements

ITEM P-606 ADHESIVE COMPOUNDS, TWO-COMPONENT FOR SEALING WIRE AND LIGHTS IN PAVEMENT

DESCRIPTION

606-1.1 This specification covers two types of material: a liquid suitable for sealing electrical wire in saw cuts in pavement and sealing light fixtures or bases in pavement; a paste suitable for embedding light fixtures and aircraft tie-downs in the pavement. Both types of material are two-component filled formulas with the characteristics specified in Subsection 606-2.4. Materials supplied for use with asphalt and/or concrete pavements must be formulated so they are compatible with the asphalt and/or concrete.

EQUIPMENT AND MATERIALS

606-2.1 CURING. When pre-warmed to 77°F, mixed, and placed according to manufacturer's directions, the materials shall cure at temperatures of 45°F or above without the application of external heat.

606-2.2 STORAGE. The adhesive components shall not be stored at temperatures over 86°F, unless otherwise specified by the manufacturer.

606-2.3 CAUTION. Installation and use shall be according to the manufacturer's recommended procedures. Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well-ventilated areas. Keep in cool place. Keep away from children.

606-2.4 CHARACTERISTICS. When mixed and cured according to the manufacturer's directions, the materials shall have the following properties shown in Table 606-1.

TABLE 606-1. PROPERTY REQUIREMENTS

Physical or Electrical Property	Minimum	Maximum	ASTM Method
Tensile			
Portland Cement Concrete	1,000 psi		D638
Asphalt Concrete	500 psi		
Elongation			
Portland Cement Concrete	8% \1\		D638
Hot Mix Asphalt	50%		D638
Coef. of cub. exp., cm ³ /cm ³ /°C	0.00090	0.00120	D1168-08
Coef. of lin. exp., cm/cm/°C	0.00030	0.00040	D1168-08
Dielectric strength, short time test	350 volts/mil.		D149
Arc resistance	125 secs.		D495
Pull-off			
Adhesion to steel	1,000 psi		
Adhesion to Portland cement concrete	200 psi		
Adhesion to asphalt concrete	(no test available)		
Adhesion to aluminum	250 psi		

\1\ 20% or more (without filler) for formulations to be supplied for areas subject to freezing.

SAMPLING, INSPECTION, AND TEST PROCEDURES

606-3.1 TENSILE PROPERTIES. Tests for tensile strength and elongation shall be conducted according to ASTM D638.

606-3.2 EXPANSION. Tests for coefficients of linear and cubical expansion shall be conducted according to ASTM D1168-08, Method B, except that mercury shall be used instead of glycerin. The test specimen(s)

shall be mixed in the proportions specified by the manufacturer, and cured in a glass tube approximately 2 inches long by 3/8 inch in diameter. The interior of the tube shall be precoated with a silicone mold release agent. The hardened sample shall be removed from the tube and aged at room temperature for 1 week before conducting the test. The test temperature range shall be from 35°F to 140°F.

606-3.3 TEST FOR DIELECTRIC STRENGTH. Test for dielectric strength shall be conducted according to ASTM D149 for sealing compounds to be furnished for sealing electrical wires in pavement.

606-3.4 TEST FOR ARC RESISTANCE. Test for arc resistance shall be conducted according to ASTM D495 for sealing compounds to be furnished for sealing electrical wires in pavement.

606-3.5 TEST FOR ADHESION TO STEEL. The ends of two smooth, clean, steel specimens (approximately 1-inch by 1-inch by 6 inches) are bonded together with adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure on a Riehle (or similar) tensile tester. The thickness of adhesive to be tested shall be 1/4-inch.

606-3.6 ADHESION TO PORTLAND CEMENT CONCRETE.

- a. **Concrete Test Block Preparation.** The aggregate grading shall be as shown in Table 606-2.

The coarse aggregate shall consist of crushed rock having a minimum of 75% of the particles with at least one fractured face and having a water absorption of not more than 1.5%. The fine aggregate shall consist of crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a water-cement ratio of 5.5 gallons of water per bag of cement, a cement factor of 6, plus or minus 0.5, bags of cement per cubic yard of concrete, and a slump of 2-1/2 inches plus or minus 1/2 inch. The ratio of fine aggregate to total aggregate shall be approximately 40% by solid volume. The air content shall be 5.0%, plus or minus 0.5%, and it shall be obtained by the addition to the batch of an air-entraining admixture such as Vinsol® resin. The mold shall be metal with a metal base plate.

Means shall be provided for securing the base plate to the mold. The assembled mold and base plate shall be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be such that several 1-inch by 2-inch by 3-inch test blocks can be cut from the specimen with a concrete saw having a diamond blade. The concrete shall be prepared and cured according to AASHTO R 39.

TABLE 606-2. AGGREGATE FOR BOND TEST BLOCKS

Type	Sieve Size	Percent Passing
Coarse Aggregate	3/4 in.	97 to 100
	1/2 in.	63 to 69
	3/8 in.	30 to 36
	No. 4	0 to 3
Fine Aggregate	No. 4	100
	No. 8	82 to 88
	No. 16	60 to 70
	No. 30	40 to 50
	No. 50	16 to 26
	No. 100	5 to 9

- b. **Bond Test.** Prior to use, oven-dry the test blocks to constant weight at a temperature of 220 to 230°F, cool to room temperature, 73.4 ±3°F, in a desiccator, and clean the surface of the blocks of film or powder by vigorous brushing with a stiff-bristled fiber brush. Two test blocks shall be bonded together on the 1-inch by 3-inch sawed face with the adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure in a Riehle (or similar) tensile tester. The thickness of the adhesive to be tested shall be 1/4 inch.

606-3.7 COMPATIBILITY WITH ASPHALT MIX. Test for compatibility with asphalt according to ASTM D5329.

606-3.8 CERTIFICATION. The Contractor shall furnish the vendor's certified test reports for each batch of material delivered to the project. The report shall certify that the material meets specification requirements and is suitable for use with Portland cement concrete or asphalt concrete pavements. The report shall be provided to and accepted by the Engineer before use of the material. In addition the Contractor shall obtain a statement from the supplier or manufacturer which guarantees the material for one year. The supplier or manufacturer shall furnish evidence that the material has performed satisfactorily on other projects.

606-3.9 APPLICATION. Adhesive shall be applied on a dry, clean surface, free of grease, dust, and other loose particles. The method of mixing and application shall be in strict accordance with the manufacturer's recommendations. When used with Item P-605, such as light can installation, Item P-605 shall not be applied until Item P-606 has fully cured.

METHOD OF MEASUREMENT

606-4.1 The adhesive compound will be measured according to GCP Section 90 and by the pound of adhesive as specified, in place, complete and accepted with the following exceptions. When required in the installation of an in-runway lighting system, taxiway lighting system or portion thereof, or for aircraft tie-down, no measurement will be made for direct payment of adhesive, as the cost of furnishing and installing will be considered as a subsidiary obligation in the completion of the installation.

BASIS OF PAYMENT

606-5.1 Payment will be made, where applicable, at the contract unit price per pound for the adhesive. If the following pay item is absent from the bid schedule, no payment will be made.

Payment will be made under:

Item P606.010.0000	Adhesive Compound – per pound
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TESTING REQUIREMENTS

AASHTO R 39	Making and Curing Concrete Test Specimens in the Laboratory
ASTM D149	Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D495	High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
ASTM D638	Tensile Properties of Plastics
ASTM D1168-08	Hydrocarbon Waxes Used for Electrical Insulation
ASTM D5329	Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements

ITEM P-610 CONCRETE FOR MISCELLANEOUS STRUCTURES

DESCRIPTION

610-1.1 This item shall consist of concrete and reinforcement, as shown on the plans, prepared and constructed in accordance with these Specifications. This specification shall be used for all concrete other than airfield pavement which are cast-in-place.

MATERIALS

610-2.1 GENERAL. Only approved materials, conforming to the requirements of these Specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the Engineer before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

- a. **Reactivity.** Fine aggregate and coarse aggregates to be used in all concrete shall have been tested separately within six months of the project in accordance with ASTM C1260. Test results shall be submitted to the Engineer. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.08% at 14 days (16 days from casting). If the expansion either or both test specimen is greater than 0.08% at 14 days, but less than 0.20%, a minimum of 25% of Type F fly ash, or between 40% and 55% of slag cement shall be used in the concrete mix.

If the expansion is greater than 0.20%, the aggregates shall not be used, and test results for other aggregates must be submitted for evaluation; or aggregates that meet P-501 reactivity test requirements may be utilized.

610-2.2 COARSE AGGREGATE. The coarse aggregate for concrete shall meet the requirements of AASHTO M 80, Class A.

Coarse aggregate shall be well graded from coarse to fine, and shall meet AASHTO M 43, Number 57 or 67, when tested according to ATM 304.

610-2.2.1 COARSE AGGREGATE SUSCEPTIBILITY TO DURABILITY (D) CRACKING. Not Used.

610-2.3 FINE AGGREGATE. The fine aggregate for concrete shall meet all fine aggregate requirements of AASHTO M 6, Class A.

610-2.4 CEMENT. Cement shall conform to the requirements of AASHTO M 85.

610-2.5 CEMENTITIOUS MATERIALS.

- a. **Fly ash.** Fly ash shall meet the requirements of AASHTO M 295, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total available alkali content less than 3% per AASHTO M 295. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive AASHTO M 295 reports for each source of fly ash proposed in the concrete mix, and

shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Engineer.

- b. **Slag cement (ground granulated blast furnace (GGBF)).** Slag cement shall conform to AASHTO M 302, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

610-2.6 WATER. Water used in mixing or curing shall be from potable water sources. Water from 'Community' or 'Non-Transient Non-Community' sources regulated by the Alaska Department of Environmental Conservation Division of Environmental Health Drinking Water Program, or equivalent in other states, do not require testing under ASTM C1602. Other sources shall be tested in accordance with ASTM C1602 prior to use.

610-2.7 ADMIXTURES. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

- a. **Air-entraining admixtures.** Air-entraining admixtures shall meet the requirements of AASHTO M 154 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.
- b. **Water-reducing admixtures.** Water-reducing admixture shall meet the requirements of AASHTO M 194, Type A, B, or D. AASHTO M 194, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures according to the manufacturer's printed instructions.
- c. **Other chemical admixtures.** The use of set retarding, and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of AASHTO M 194, Type A, B, or D and set-accelerating shall meet the requirements of AASHTO M 194, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

610-2.8 PREMOLDED JOINT MATERIAL. Premolded joint material for expansion joints shall meet the requirements of AASHTO M 213.

610-2.9 JOINT FILLER. The filler for joints shall meet the requirements of Item P-605.

610-2.10 STEEL REINFORCEMENT. Reinforcing shall consist of Deformed and Plain Carbon-Steel Bars conforming to the requirements of ASTM A615, Welded Steel Wire Fabric conforming to the requirements of ASTM A1064, Welded Deformed Steel Fabric conforming to the requirements of ASTM A1064, or Bar Mats conforming to the requirements of ASTM A184, as shown on the Plans.

610-2.11 MATERIALS FOR CURING CONCRETE. Curing materials shall conform to Table 610-1:

TABLE 610-1. MATERIALS FOR CURING CONCRETE

CURING MATERIAL	SPECIFICATION
Burlap Cloth made from Jute or Kenaf and Cotton Mats	AASHTO M 182, Class 4
Sheet Materials for Curing Concrete	ASTM C171
Liquid Membrane – Forming Compounds for Curing Concrete	ASTM C309, Type 1-D Class B, except do not use compounds containing linseed oil.

CONSTRUCTION METHODS

610-3.1 GENERAL. The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the Engineer.

610-3.2 CONCRETE MIXTURE. The concrete shall develop a minimum compressive strength of 4,000 psi in 28 days as determined by test cylinders made according to ATM 506 and tested according to AASHTO T 22. The concrete shall contain not less than 470 pounds of cementitious material per cubic yard. The concrete shall contain 5.0% of entrained air, plus or minus 1.2%, as determined by ATM 505. Slump, as determined by ATM 503, shall match the mix design target value plus or minus 1 inch.

610-3.3 MIXING. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of AASHTO M 157.

The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F without the Engineer's approval. If approval is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F nor more than 100°F. The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his expense.

Retempering of concrete by adding water or any other material is not permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.

610-3.4 FORMS. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the Plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so that no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface.

610-3.5 PLACING REINFORCEMENT. All reinforcement shall be accurately placed, as shown on the Plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

Reinforcing bars shall be bent cold and shall conform accurately to the shape and dimensions shown on the diagram. In no case shall the radius of any bend be less than 4 times the diameter of the bar.

Place reinforcement as indicated on the Plans or as hereinafter specified. Rigidly block and wire in place, using metal or plastic supports or concrete blocks and securely tie at each intersection with annealed iron wire of at least 1/8 inch.

Do not splice bars at points not indicated on the Plans except with the consent of the Engineer. Such splices shall be at the points of minimum tensile stress and the lap shall be not less than 36 bar diameters.

Verify the quantity, size, and shape of the reinforcement against the structure drawings and make necessary corrections to the bar lists and bending schedules before ordering. Errors in the bar lists and/or bending schedules shall not be cause for adjustment of the contract prices.

If reinforcing bars are to be welded, follow AWS D12.1.

610-3.6 EMBEDDED ITEMS. Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

610-3.7 CONCRETE CONSISTENCY. The Contractor shall monitor the consistency of the concrete delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each truck at the project site in accordance with ATM 503.

610-3.8 PLACING CONCRETE. All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the Engineer. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

610-3.9 VIBRATION. Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309R, Guide for Consolidation of Concrete.

610-3.10 JOINTS. Joints shall be constructed as indicated on the plans.

610-3.11 FINISHING. All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with the finished top surface struck-off with a straightedge and floated.

610-3.12 CURING AND PROTECTION. All concrete shall be properly cured in accordance with the recommendations in American Concrete Institute (ACI) 308R, Guide to External Curing of Concrete. The concrete shall be protected from damage until project acceptance.

610-3.13 COLD WEATHER PLACING. When concrete is placed at temperatures below 40°F, follow the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

610-3.14 HOT WEATHER PLACING. When concrete is placed at temperatures greater than 85°F, follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.

ACCEPTANCE TESTING

610-4.1 ACCEPTANCE SAMPLING AND TESTING. Concrete for each day's placement will be accepted on the basis of the compressive strength specified in Subsection 610-3.2. The Engineer will sample the concrete in accordance with ATM 501; test the slump in accordance with ATM 503; test air content in accordance with ATM 505; make and cure compressive strength specimens in accordance with ATM 506; and test in accordance with AASHTO T 22. The Acceptance Testing laboratory will meet the requirements of ASTM C1077.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

610-4.2 DEFECTIVE WORK. Any defective work that cannot be satisfactorily repaired as determined by the Engineer, shall be removed and replaced at the Contractor's expense. Defective work includes, but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the concrete.

METHOD OF MEASUREMENT

610-5.1 Concrete will be measured by the number of cubic yards based on the dimensions shown on the plans of concrete complete in place and accepted, and according to GCP Section 90. When the pay items shown below are absent from the bid schedule, no measurement for payment will be made.

610-5.2 Reinforcing steel will be measured by the calculated theoretical number of pounds placed, as shown on the Plans, complete in place and accepted. The unit weight used for deformed bars will be the weight of plain square or round bars of equal nominal size. If so indicated on the Plans, the weight to be paid for will include the weight of metal pipes and drains, metal conduits and ducts, or similar materials indicated and included. When the pay items shown below are absent from the bid schedule, no measurement for payment will be made.

BASIS OF PAYMENT

610-6.1 Payment will be made at the contract unit price per cubic yard for structural portland cement concrete and per pound for reinforcing steel. If the following pay items are absent from the bid schedule, no payment will be made.

Payment will be made under:

Item P610.010.0000	Structural Portland Cement Concrete - per cubic yard
Item P610.020.0000	Steel Reinforcement - per pound
Item P610.030.0000	Standard Curb & Gutter – per linear foot
Item P610.040.0000	Depressed Curb and Gutter – per linear foot

REFERENCES

ATM 304	WAQTC FOP for AASHTO T 27/T 11 Sieve Analysis of Fine and Coarse Aggregates
ATM 501	FOP for WAQTC TM 2 Sampling Freshly Mixed Concrete
ATM 503	WAQTC FOP for AASHTO T 119 Slump of Hydraulic-Cement Concrete
ATM 505	WAQTC FOP for AASHTO T 152 Air Content of Freshly Mixed Concrete by the Pressure Method
ATM 506	WAQTC FOP for AASHTO T 23 Making and Curing Concrete Test Specimens in the Field
AASHTO M 6	Fine Aggregate for Portland Cement Concrete
AASHTO M 43	Sizes of Aggregate for Road and Bridge Construction
AASHTO M 80	Coarse Aggregate for Portland Cement Concrete
AASHTO M 85	Portland Cement
AASHTO M 154	Air-Entraining Admixtures for Concrete
AASHTO M 157	Ready-Mixed Concrete
AASHTO M 182	Burlap Cloth made from Jute or Kenaf and Cotton Mats
AASHTO M 194	Chemical Admixture for Concrete

AASHTO M 213	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
AASHTO M 295	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
AASHTO M 302	Slag Cement for Use in Concrete and Mortars
AASHTO T 22	Compressive Strength of Cylindrical Concrete Specimens
ASTM A184	Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A1064	Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C171	Sheet Materials for Curing Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C1017	Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1077	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
AWS D12.1	Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308R	Guide to External Curing of Concrete
ACI 309R	Guide for Consolidation of Concrete

ITEM P-620 RUNWAY AND TAXIWAY MARKING

DESCRIPTION

620-1.1 This item consists of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification. This item includes removal of existing painted markings from pavement surfaces as shown on the plans or as designated by the Engineer. Complete this work within the limitations of the project Construction Safety and Phasing Plan.

MATERIALS

620-2.1 MATERIALS ACCEPTANCE. The Contractor shall furnish manufacturer’s certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer’s surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive, and application requirements must be submitted and approved by the Engineer prior to the initial application of markings. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the Engineer. Provide manufacturer certification (Material Safety Data Sheet) showing that each product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

620-2.2 MARKING MATERIALS. Paint shall be waterborne or solvent-base. Paint colors shall comply with Federal Standard No. 595, and Table 620-1. Use black paint to outline a border at least 6 inch wide around markings on all light colored pavements.

TABLE 620-1. MARKING MATERIALS

Paint ¹				Glass Beads ²	
Type	Color	Fed Std. 595 Number	Application Rate Maximum	Type	Application Rate Minimum
II	White	37925	115 ft ² /gal	Type I, Gradation A	7 lb/gal)
II	Red	31136	115 ft ² /gal	Type I, Gradation A	5 lb/gal
II	Yellow	33538 or 33655	115 ft ² /gal	Type I, Gradation A	7 lb/gal
II	Black	37038	115 ft ² /gal	Not used	Not Used
II	Pink	1 part 31136 to 2 parts 37925	115 ft ² /gal	Type I, Gradation A	5 lb/gal
II	Green	34108	115 ft ² /gal	Not Used	Not Used

¹ See subsection 620-2.2a

² See subsection 620-2.2b

a. Paint

(1) Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, Type II. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis.

(2) Solvent-Base. Paint shall meet the requirements of Commercial Item Description A-A-2886B Type II.

b. Reflective media. Glass beads shall meet the requirements for Federal Specification TT-B-1325D Type I, Gradation A.

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Glass beads shall comply with Table 620-1.

CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with subsection 620-2.1. Discontinue painting when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Do not apply markings when weather conditions are forecasted to not be within the manufacturers' recommendations for application and dry time.

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross sections and clear-cut edges without running or spattering and without over spray. Marking equipment for both paint and glass beads shall be calibrated daily.

620-3.3 PREPARATION OF SURFACES. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminants that would reduce the bond between the paint and the pavement.

a. PREPARATION OF NEW PAVEMENT SURFACES. The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the Engineer to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface. Areas which cannot be satisfactorily cleaned by brooming and blowing shall be scrubbed as directed with a 10% solution of tri-sodium phosphate or an equally suitable solution. After scrubbing, the solution shall be rinsed off and the surface dried prior to painting.

b. PREPARATION OF PAVEMENT TO REMOVE EXISTING MARKINGS. Where indicated on the plans, use high pressure water to remove all visible indications of existing painted markings from pavement surfaces. Do not paint over existing markings. Remove pavement markings to the fullest extent possible without materially damaging the pavement surface, color, or texture. Group adjacent markings together into a larger rectangular removal area in conformance with FAA AC 150/5340-1, paragraph 1.3.f. and Figure 1-1, Figure 1-2, Figure 1-3 and Figure 1-4. Collect and dispose of all loose or waste material as needed to prevent interference with drainage or to prevent dusty conditions under traffic, wind, or propellers. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

- c. **PREPARATION OF PAVEMENT MARKINGS PRIOR TO REMARKING.** Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the Engineer. After removal, the surface shall be cleaned of all residue or debris according to 620-3.3.a.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufacturer’s application and surface preparation requirements must be submitted to the Engineer prior to the initial application of markings.

620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out in advance of the paint application. Layout markings and glass beads in advance of paint application at the locations shown on the Plans according to the tolerances in section 620-3.5 and according to the requirements of G-135. Space control points at such intervals to ensure accurate location of all markings. Provide an experienced technician to supervise the location, alignment, layout dimensions, and application of the paint.

620-3.5 APPLICATION. A period of 7 days minimum shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the Plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer.

The edges of the markings shall not vary from a straight line more than 1/2 inch in 50 feet, and marking dimensions and spacing shall be within the tolerances shown in Table 620-2:

TABLE 620-2. MARKING DIMENSIONS AND SPACING TOLERANCE

Dimension and Spacing	Tolerance
36 inch or less	±1/2 inch
greater than 36 inch to 6 feet	±1 inch
greater than 6 feet to 60 feet	±2 inch
greater than 60 feet	±3 inch

The paint shall be mixed in accordance with the manufacturer’s instructions and applied to the pavement with a marking machine at the rate shown in Table 620-1. The addition of thinner will not be permitted.

Pressure apply glass beads upon the marked areas at the locations shown on the Plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 620-1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

Apply temporary markings, if required, as directed by the Engineer. If pavement is opened to traffic before the pavement curing period is complete, apply paint in two coats. Apply the first coat at least 12 hours after paving is completed at 30 to 50 percent of the total application rate. Apply an additional coat at 100 percent of the total application rate following pavement curing time and after pavement grooving operations in affected areas. The direction of the second application shall be 180 degrees from the first to ensure complete coverage. Apply glass beads, if required, in the second coat only.

Return all emptied containers to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

620-3.6 NOT USED.

620-3.7 CONTROL STRIP. Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the Engineer. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads, according to Table 620-1, that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

620-3.8 RETRO-REFLECTANCE TESTING (PART 139 CERTIFICATED AIRPORTS ONLY). Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 readings shall be taken over a 6 square foot area with 3 readings taken from each direction. The average of all readings which are within 30% of each other shall be equal to or above the minimum levels shown in Table 620-3.

TABLE 620-3. MINIMUM RETRO-REFLECTANCE VALUES

Material	Retro-reflectance mcd/m ² /lux		
	White	Yellow	Red
Initial Type I	300	175	35
All materials, remark when less than ¹	100	75	10

¹Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

620-3.9 PROTECTION AND CLEANUP. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

METHOD OF MEASUREMENT

620-4.1 RUNWAY AND TAXIWAY PAINTING BY UNIT AREA. If runway and taxiway painting by unit area appears in the bid schedule, then new painted markings will be so measured.

620-4.2 REFLECTIVE MEDIA. If reflective media by unit weight appears in the bid schedule, then this material will be so measured. If reflective media appears by lump sum in the bid schedule, or does not appear at all, it will not be measured.

620-4.3 RUNWAY AND TAXIWAY PAINTING BY LUMP SUM. If Runway and Taxiway painting by a lump-sum item appears in the bid schedule, new painted markings will not be measured for payment. Reflective media is subsidiary to the work.

620-4.4 PAINTED MARKING REMOVAL. If painted marking removal by unit area, it will be measured by area. If painted marking removal by lump sum appears in the bid schedule or is absent from the bid schedule, no measurement will be made and this item will be subsidiary to painting.

620-4.5 TEMPORARY RUNWAY AND TAXIWAY PAINTING. Lump Sum. Includes all necessary maintenance or reapplication of paint necessary during the time the numbers, markings, and stripes are required.

BASIS OF PAYMENT

620-5.1 Payment will be made at the respective contract unit or lump sum price for the pay items listed below that appear in the bid schedule.

Payment will be made under:

Item P620.010.0000	Runway and Taxiway Painting – per square foot
Item P620.020.0000	Runway and Taxiway Painting – per lump sum
Item P620.030.0000	Reflective Media – per pound
Item P620.040.0000	Reflective Media – per lump sum

TESTING REQUIREMENTS

ASTM C371	Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTM D92	Flash and Fire Points by Cleveland Open Cup
ASTM D711	No-Pick-Up Time of Traffic Paint
ASTM D968	Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Epoxy Content of Epoxy Resins
ASTM D2074	Total Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Rubber Products-Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM G53	Operating Light and Water-Exposure Apparatus (Florescent UV-Condensation Type) for Exposure of Nonmetallic Materials.
Federal Test Method Standard No. 141	Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing

MATERIAL REQUIREMENTS

ASTM D476	Titanium Dioxide Pigments
Code of Federal Regulations	40 CFR Part 60, Appendix A-7, Method 24. Determination volatile matter content, water content, density, volume solids, and weight solids of surface coatings
Code of Federal Regulations	29 CFR Part 1910.1200 – Hazard Communications
Fed. Spec. TT-B-1325D	Beads (Glass Spheres) Retroreflective
Fed. Spec. TT-P1952F	Paint, traffic and Airfield Marking, Waterborne
Federal Standard 595	Colors used in Government Procurement
Commercial Item Description	A-A-2886B Paint, Traffic, Solvent Based
Advisory Circular 150/5340-1	Standard for Airport Markings
Advisory Circular 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

ITEM P-621 SAW-CUT GROOVES

DESCRIPTION

621-1.1 This item consists of constructing saw-cut grooves to minimize hydroplaning during wet weather, providing a skid resistant surface in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer.

CONSTRUCTION METHODS

621-2.1 The Contractor shall submit to the Engineer the grooving sequence and method of placing guide lines to control grooving operation, according to Section 80-03, or as directed by the Engineer.

Transverse grooves saw-cut in the pavement must form a 1/4-inch wide by 1/4-inch deep by 1 1/2 inches center-to-center configuration. The grooves must be continuous for the entire runway length. They must be saw-cut transversely in the runway and high speed taxiway pavement to not less than 10 feet from the runway pavement edge, or as shown in the plans, to allow adequate space for equipment operation.

The saw-cut grooves must meet the following tolerances. The tolerances apply to each day's production and to each piece of grooving equipment used for production. The Contractor is responsible for all controls and process adjustments necessary to meet these tolerances.

- a. **Alignment tolerance.** Plus or minus 1-1/2 inches in alignment for 75 feet.
- b. **Groove tolerance.**
 - (1) **Depth.** The standard depth is 1/4-inch. At least 90 percent of the grooves must be at least 3/16 inch, at least 60 percent of the grooves must be at least 1/4 inch, and not more than 10 percent of the grooves may exceed 5/16-inch.
 - (2) **Width.** The standard width is 1/4-inch. At least 90 percent of the grooves must be at least 3/16-inch, at least 60 percent of the grooves must be at least 1/4-inch, and not more than 10 percent of the grooves may exceed 5/16-inch.
- c. **Center-to-center spacing.** The standard spacing is 1-1/2 inches.
 - (1) **Minimum spacing** 1-3/8 inches.
 - (2) **Maximum spacing** 1-1/2 inches.

Saw-cut grooves must not be closer than 3 inches or more than 9 inches from transverse paving joints. Grooves must not be closer than 6 inches and no more than 18 inches from in-pavement light fixtures. Grooves may be continued through longitudinal joints. Where neoprene compression seals have been installed and the compression seals are recessed sufficiently to prevent damage from the grooving operation, grooves may be continued through the longitudinal joints. Where neoprene compression seals have been installed and the compression seals are not recessed sufficiently to prevent damage from the grooving operation, grooves must not be closer than 3 inches or more than 5 inches from the longitudinal joints. Where lighting cables are installed, discontinue grooving across longitudinal or diagonal saw kerfs.

The Engineer may require the Contractor to submit a written report indicating the percentage of grooves that meet tolerances by measurement zone according to Table 621-1. If reporting is required, groove tolerance shall be measured at least three times per zone per day. The Engineer may require a report indicating how many times production was adjusted. It is expected that the Contractor will routinely spot check for compliance each time the equipment aligns for a grooving pass. The Engineer may determine a written report is not required.

Blade wear and surface variability may require more testing than the minimum of three per day per zone during each day's production.

621-2.2 ENVIRONMENTAL REQUIREMENTS. Grooving operations will not be permitted when freezing conditions prevent the immediate removal of debris and/or drainage of water from the grooved area.

621-2.3 CONTROL STRIP. Groove a control strip in an area of pavement outside of the trafficked area, or as approved by the Engineer. The area shall be as long as the width of the runway or taxiway, or at least 25 feet in length, by two passes of the grooving machine, or as required by the Engineer. Demonstrate the setup and alignment process, the grooving operation, and the waste slurry disposal.

621-2.4 EXISTING PAVEMENTS. Bumps, depressed areas, bad or faulted joints, and badly cracked and/or spalled areas in the pavement shall not be grooved until such areas are adequately repaired or replaced.

621-2.5 NEW PAVEMENTS. New asphalt and Portland cement concrete pavements shall be allowed to cure for a minimum of 30 days before grooving, to allow the material to become stable enough to prevent closing of the grooves under normal use. All grade corrections must be completed prior to grooving. Spalling along or tearing or raveling of the groove edges shall not be allowed.

The Engineer may allow grooving after a curing period of less than 30 days if it can be demonstrated that grooves are stable with no spalling along or tearing or raveling of the groove edges.

621-2.6 GROOVING MACHINE. Provide a grooving machine that is power driven, self-propelled, specifically designed and manufactured for pavement grooving, and has a self-contained and integrated continuous slurry vacuum system as the primary method for removing waste slurry. The grooving machine shall be equipped with diamond-saw cutting blade groove cutting head capable of making at least 18 inches in width of multiple parallel grooves in one pass of the machine. Thickness of the cutting blades shall be capable of making the required width and depth of grooves in one pass of the machine. The cutting head shall not contain a mixture of new and worn blades or blades of unequal wear or diameter. Match the blade type and configuration with the hardness of the existing airfield pavement. The wheels on the grooving machine shall be of a design that will not scar or spall the pavement. The machine must be equipped with devices to control depth of groove and alignment.

621-2.7 WATER SUPPLY. Water for the grooving operation shall be provided by the contractor.

621-2.8 CLEAN-UP. During and after installation of saw-cut grooves, the Contractor must remove from the pavement all debris, waste, and by-products generated by the operations to the satisfaction of the Engineer. Cleanup of waste material must be continuous during the grooving operation. Flush debris produced by the machine to the edge of the grooved area or pick it up as it forms. The dust coating remaining shall be picked up or flushed to the edge of the area if the resultant accumulation is not detrimental to the vegetation or storm drainage system. Accomplish all flushing operations in a manner to prevent erosion on the shoulders. Waste material must be disposed of in an approved manner. Waste material must not be allowed to enter the airport storm or sanitary sewer system. The Contractor must dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

621-2.9 REPAIR OF DAMAGED PAVEMENT. Grooving must be stopped and damaged pavement repaired at the Contractor's expense when directed by the Engineer.

ACCEPTANCE

621-3.1 ACCEPTANCE TESTING. Grooves will be accepted based on results of zone testing. All acceptance testing necessary to determine conformance with the groove tolerances specified will be performed by the Engineer.

Instruments for measuring groove width and depth must have a range of at least 0.5-inch and a resolution of at least 0.005-inch. Gage blocks or gages machined to standard grooves width, depth, and spacing may be used.

Instruments for measuring center-to-center spacing must have a range of at least 3 inches and a resolution of at least 0.02-inch.

The Engineer will measure grooves in five zones across the pavement width. Measurements will be made at least three times during each day's production. Measurements in all zones will be made for each cutting head on each piece of grooving equipment used for each day's production.

The five zones are as shown in Table 621-1:

TABLE 621-1. DEFINITION OF MEASUREMENT ZONES

ZONE Number	ZONE Position
Zone 1	Centerline to 5 feet left or right of the centerline.
Zone 2	5 feet 25 feet left of the centerline.
Zone 3	5 feet to 25 feet right of the centerline.
Zone 4	25 feet to edge of grooving left of the centerline.
Zone 5	25 feet to edge of grooving right of the centerline.

At a random location within each zone, five consecutive grooves sawed by each cutting head on each piece of grooving equipment will be measured for width, depth, and spacing. The five consecutive measurements must be located about the middle blade of each cutting head plus or minus 4 inches. Measurements will be made along a line perpendicular to the grooves.

- Width or depth measurements less than 0.170-inch will be considered less than 3/16-inch.
- Width or depth measurements more than 0.330-inch will be considered more than 5/16-inch.
- Width or depth measurements more than 0.235-inch will be considered more than 1/4inch.

Production must be adjusted when more than one groove on a cutting head fails to meet the standard depth, width, or spacing in more than one zone.

METHOD OF MEASUREMENT

621-4.1 Pavement saw-cut grooves will be measured either by neat line dimensions as shown in the Plans or as a single item of work. No deductions will be made for areas skipped to avoid joints or in-pavement fixtures.

BASIS OF PAYMENT

621-5.1 Payment will be made at the contract unit price or the lump sum price for pavement saw-cut grooves accepted by the Engineer.

Payment will be made under:

Item P621.010.0000	Saw-Cut Grooves - per square yard
Item P621.020.0000	Saw-Cut Grooves - per lump sum

