

SECTION 401

PLANT MIX SURFACING

401.01 DESCRIPTION

This work is producing, furnishing, placing, and compacting plant mix asphalt pavement.

Plant mix pavement is 1 or more courses of plant mixed aggregate, hydrated lime or chemical additive when required, and bituminous material, constructed on a prepared foundation.

Warm mix surfacing (warm mix) is plant mix surfacing which has been modified with additives or processes that allow a reduction in the temperature at which plant mix surfacing is produced and placed.

401.02 MATERIALS

Provide aggregate from sources meeting the Section 106 requirements.

The Contractor is responsible for all sampling, testing and control of the aggregate. Furnish the Project Manager the quality control test results upon request.

Ensure that the aggregate, when combined at the job mix formula, meets Table 701-15, and Subsection 701.03.1.

401.02.1 Aggregate

Meet aggregate requirements in accordance with Subsection 701.03.

For commercial mix, when no aggregate size is specified, use either ½-inch (12.5 mm) or ¾-inch (19 mm) nominal aggregate sizes.

401.02.2 Hydrated Lime

Furnish hydrated lime in accordance with Subsection 713.02.

Sample fillers and hydrated lime in accordance with MT 601.

401.02.3 Asphalt Cement

Furnish asphalt cement in accordance with Section 402.

Asphalt cement modified with warm mix additives will be tested with the additives and must meet the contract requirements.

401.02.4 Additives for Warm Mix

Comply with the warm mix technology manufacturer's recommendations for incorporating additives and/or processes when producing warm mix. Comply with manufacturer's recommendations regarding receiving, storage, and delivery of warm mix additives. Mix warm mix at a minimum temperature of 220 °F (104 °C) and within the range recommended by the manufacturer and approved by the Department. Use asphalt additives listed on the QPL for the production of warm mix.

Use foaming technology that is manufactured and marketed for the purpose of producing warm mix.

Ensure a manufacturer's technical representative is present during production and placement of warm mix for at least the first 10,000 tons (10,000 MT) of mix placed and as directed by the Project Manager for the remainder of the project. This requirement may be waived if successful experience in warm mix construction is demonstrated.

In addition to the information specified in Subsection 401.03.1, provide the following information at least 30 calendar days before warm mix production:

1. Warm mix technology and/or warm mix additives information;
2. Manufacturer's established recommendations for usage;

3. Manufacturer's established target rate for water and additives, the acceptable variation for production, and documentation showing the impact of excessive production variation;
4. Warm mix technology material safety data sheets;
5. Temperature ranges for mixing and compacting;
6. Asphalt binder performance grade test data over the range of warm mix additive percentages proposed for use;
7. The warm mix design and testing sample preparation may differ from conventional hot mix asphalt. Provide manufacturer's sample preparation recommendations for warm mix design and testing; and
8. Include the binder supplier's recommendations for warm mix additive content, methods for incorporating warm mix additive into mix design samples and mixing and compaction temperature ranges.

401.02.5 Recycled Asphalt Pavement (RAP)

Up to 15% RAP by weight may be incorporated into mix used in the top 0.15-foot (45 mm) and up to 30% RAP by weight may be incorporated into mix used in lower lifts. If RAP is included in the job mix formula and the final mix, meet all of the plant mix requirements. It is recommended that at least 2 separate RAP stockpiles be produced.

401.02.6 Emulsified Asphalt

Furnish an emulsified asphalt, when required, meeting the requirements of Section 702.

401.03 CONSTRUCTION REQUIREMENTS

Produce plant mix in accordance with Table 701-15, Table 701-16 Table 701-17, Table 701-18 and form CB30QA-VM (S).

Produce plant mix in a plant capable of accurately proportioning and uniformly mixing all ingredients. Do not begin plant mix production until receiving notification that the Department's mix design verification is complete.

For commercial mix, produce plant mix with actual asphalt cement content within +/- 0.3% of the mix design or field established job mix formula.

For non-commercial mix, set the initial job mix targets before producing more than 2000 tons (2000 MT) of plant mix surfacing. Plant mix produced prior to setting initial targets is defined as start-up mix. Furnish the Project Manager copies of form CB30QA-VM (S) with the proposed job mix targets for VMA, VFA, VTM, and D/A. Once the job mix targets are set, Quality Assurance (QA) will be applied to all subsequent plant mix produced. No pay incentive or disincentive will be applied to the plant mix until the targets are set. Produce start-up mix meeting the criteria listed in accordance with the Start-Up Job Mix Range in Table 701-18. A Hamburg wheel track test (Hamburg) will be run when the produced mix does not meet all the criteria specified in accordance with the start-up job mix range in Table 701-18.

The Contractor may revise the job mix targets one time during the contract. Submit revised job mix targets no later than 2 business days following completion of plant mix production, or initial job mix targets will be used to determine payment. If more than one project is included in the contract (tied projects), the job mix targets may be revised for each project only if the projects use different mix designs. Submit to the Project Manager 4 signed copies of form CB30-QA-VM (S) with the revised job mix targets for VMA, VFA, VTM and D/A. The revised targets will be applied retroactively to all plant mix produced after the initial targets are set, and payment will be recalculated.

No monetary, time or other compensation will be allowed for Department actions required due to the setting of initial targets, (e.g. P-value shutdowns, etc.).

401.03.1 Mix Design

Submit to the Project Manager 4 copies of a plant mix design following AASHTO R 35 and meeting AASHTO M 323. Include the binder supplier's recommended mixing and compaction temperature ranges. This compaction temperature range is for testing purposes only. Choose the design air voids target to be the lowest value, within the range of 3.4 to 4.0, as long as all other criteria are met. Report the D/A for the target asphalt content. The mix design is to be produced on a total weight of mix basis. On contracts with multiple gravel sources, or combination of gravel sources, provide a mix design and meet all the requirements for each source or combination of sources and suppliers. For mix designs using RAP, furnish the asphalt content and gradation of the RAP prior to mixing and after mixing with the virgin aggregate. Furnish all specific gravities.

Furnish samples of aggregate from each stockpile to produce an 800-pound (363 kg) sample, when combined at the mix design blend ratio and 5 gallons (19 L) of the asphalt cement.

The Department has 30 calendar days from receipt of the mix design materials and signed mix design documents to review the mix design. The mix design verification consists of passing Hamburg test results and a review of the submitted mix design documents to ensure all applicable design and aggregate requirements have been met. Tensile strength ratio test results do not have to be submitted with the signed mix design documents but must be received and reviewed before a mix design will be considered verified. Contract time will be extended for the actual contract time the Contractor's paving start date was delayed, as verified by their most recent submitted schedule, and only for contract time assessed after the 30 day verification time frame. No additional compensation is allowed for these Department-caused delays. Contract time will not be extended if the delay occurs between November 1st and April 15th.

Use AASHTO T 283 to determine the mixture resistance to moisture induced damage, modified to compact the 6-inch (150 mm) diameter specimens to 3.75 inches \pm 0.20-inch (95 mm \pm 5 mm), at 7 \pm 1.0% air voids. Meet a tensile strength ratio of 0.7 or greater.

A change in the asphalt supplier or aggregate source(s) will not require a new mix design, provided no change in the established job mix targets is requested, and the aggregate and Hamburg requirements are met. Establish job mix targets immediately if changing asphalt supplier or aggregate source prior to setting initial targets on non-commercial mix projects. For commercial mix, any mix produced after a change in supplier will be considered production mix and subject to full disincentives. Provide the apparent and bulk dry specific gravities and absorption for the aggregate, and the specific gravity for asphalt cement when there are changes in the source(s).

In lieu of developing a new mix design, a previous Department verified mix design may be requested for transfer. To be eligible for transfer, the transferred mix design must utilize the same material constituents, from the same sources, and in the same proportions as the original mix design. Mix design transfers will not be considered if the design traffic warrants different mix design criteria. Approval for transferring a mix design is at the discretion of the Department and may require Hamburg testing re-verification. Proposed transfers with variations to the original mix design such as asphalt supplier or other factors such as changes to the crushing operation which could create uncertainty in the performance of the mix design will be subject to re-verification testing. When submitting a request for a mix design transfer, furnish quantities from each stockpile to produce a 300-pound (136 kg) sample if the Department determines Hamburg testing re-verification is necessary.

401.03.2 Hamburg Wheel Track Testing (Hamburg)

Provide the Project Manager a sample of plant mix surfacing material for Hamburg acceptance after initial job mix targets have been established for non-commercial mix and as

directed by the Project Manager for commercial mix. The Department may require Hamburg samples at any time, including during the production of start-up mix.

If production non-commercial plant mix fails the Hamburg, make adjustments to produce plant mix meeting the requirements specified in the contract. After a failing Hamburg no more than 300 tons (300 MT) of plant mix may be produced until passing Hamburg results are received.

When 2 consecutive Hamburg samples do not meet the requirements, suspend production and submit a revised mix design and samples for verification and Hamburg testing. The initial mix design requirements will be used for verification. Do not resume production until the revised mix design is verified and Hamburg mix design requirements are met.

Plant mix lots represented by samples that do not meet Hamburg specifications are not eligible for QA incentives including ride and density incentives.

For non-commercial mix, remove and replace any start-up plant mix represented by a failing Hamburg test. For commercial mix, remove and replace any mix represented by a failing Hamburg test. Plant mix removal and replacement is at no cost to the Department.

401.03.3 Test Procedures

Plant mix will be evaluated in accordance with the following test procedures:

MT 303 - Sampling Bituminous Materials

MT 314 - Method of Test for Bulk Specific Gravity of Compacted Bituminous Mixtures

MT 319 - Ignition Oven Burn Procedure

MT 320 - Gradation of Aggregate Recovered by MT 319

MT 321 - Maximum Specific Gravity of Bituminous Mixtures (Rice Method)

MT 328 - Method of Establishing Field Target Density for Plant Mix Surfacing Density Control

MT 332 - Gyrotory Compaction of Bituminous Mixtures

MT 334 - Wheel Tracking Test Procedure (Hamburg Device)

401.03.4 Composition of Mixtures

A. Job Mix Formula. Establish target asphalt cement and warm mix additive content (if applicable). Base the target asphalt cement content on design and field gyratory mix test results. Mix design specific gravities will be used during plant mix production unless otherwise directed by the Project Manager.

Include 1.4% hydrated lime by total weight of mix as part of the aggregate gradation.

B. Sampling. Furnish samples of plant mix surfacing in accordance with MT 601 as directed by the Project Manager. The Project Manager will randomly select when plant mix samples are taken. Sample in accordance with MT 303. A Department Inspector will witness plant mix sampling. Furnish the sample to the Inspector immediately after it is taken or deliver the sample to the Department's designated test location after the Inspector seals the sample in a tamper proof container.

Plant mix sampling will begin after the initial daily 100 tons (100 MT) of plant mix has been produced or when a hot plant is cleaned out and 100 tons (100 MT) of plant mix has been produced. No sampling delay will be permitted at any other time, unless approved by the Project Manager.

401.03.5 Acceptance Commercial Plant Mix Surfacing

The asphalt content used for calculations is determined in accordance with MT 319. The D/A is calculated in accordance with MT 319, and the gradation determined in accordance with MT 320 on the aggregate remaining after the ignition oven test.

A \$3.00/ton price reduction in the unit bid price for plant mix surfacing will be applied for any start up mix represented by a test not meeting the VMA, VFA, VTM, or D/A specified. A \$3.00/ton price reduction (\$9.00/ton maximum) in the unit bid price for plant mix surfacing will be applied to production mix for each test not meeting the VMA, VFA, VTM, or D/A specified. For commercial plant mix, startup mix is the first 1,000 tons (1,000 MT) of mix produced and production mix is all subsequent mix. Price reductions will be assessed on the quantity of material represented by each failing sample. The quantity of material represented by each sample is the total tons of material produced divided by the total number of samples representing the material.

A minimum of 1 sample will be taken on projects with a plan quantity of 500 tons (500 MT) or more and samples will be tested at a minimum rate of one per 2,000 tons (2,000 MT). Commercial plant mix will not be tested on crossovers, detours, guardrail widening, patching or where the volume is less than 500 tons (500 MT). Acceptance in these areas will be based on conformance with the established mix design proportions or agreed upon adjustments. Compact these areas to 97% of a control strip as determined necessary by the Project Manager.

401.03.6 Acceptance of Non-Commercial Plant Mix Surfacing (QA)

The properties listed in Table 701-18 for non-commercial plant mix are designated for acceptance on a lot-by-lot basis in accordance with Subsection 105.03.2. The pay factor in Table 401-1 is applied to plant mix surfacing lots for VMA, VFA, VTM and D/A. The asphalt content used for calculations is determined in accordance with MT 319. The D/A is calculated in accordance with MT 319, and the gradation determined in accordance with MT 320 on the aggregate remaining after the ignition oven test.

The approximate mix quantity represented by each sub-lot is 1,000 tons (1,000 MT). The quantity represented by 5 tests or approximately 5,000 tons (5,000 MT) of mix constitutes a lot whenever production schedules and material continuity permit. A lot represented by 3 to 7 consecutive random sub-lots will be established when there are short production runs, significant material changes, or other unusual characteristics of the work.

All other contract items are evaluated for acceptance in accordance with the applicable specifications covering those items.

Each element of a lot will be evaluated for pay adjustments.

All the individual test results in the lot for the element to be evaluated will be averaged, and the percent of price reduction for the lot determined by the applicable formula.

F is the price reduction factor to be applied for each element as shown in Table 105-2 and Table 401-1.

**TABLE 401-1
TABLE OF PAY FACTORS**

Incentive Item	"F" Factor	Maximum Pay Factor
VMA	6	1.02
VFA	2	1.02
VTM	6	1.02
D/A	30	1.02

When adjustments are being made for one of the two reasons in accordance with Subsection 105.03.2, the Department may require additional samples to test the material being produced, in addition to the planned random samples. These additional tests will be used to determine if the adjustments are effective and whether production may continue. These tests will be used to identify obviously defective sections.

401.03.7 Quality Incentive Allowance

For each element with a P value of less than 3, the incentive is calculated by subtracting the calculated P value from 3 to determine the pay factor. The maximum pay factor for each element is 2%. An additional 4% incentive will be applied to the lot payment if the sum of the pay factors for the individual elements for a lot is 6% or greater. The maximum pay factor for a lot is 12%.

401.03.8 Equipment

A. Mixing Plants. Use mixing plants that produce a mix meeting the contract requirements. Adapt the mixing plant as required by the manufacturer to introduce warm mix technology. Plant adaptations may include additional plant instrumentation, the installation of asphalt cement foaming systems and/ warm mix additive delivery systems, tuning the plant burner and adjusting the flights in order to operate at lower production temperatures and/or reduced tonnage.

B. Weigh System.

1. Automatic Weighing. Use state certified automatic weigh systems to weigh materials. Ensure the weigh accuracy is within plus or minus 0.5% of the true weight throughout the use range.

Include in the system an automatic printer that provides the following information:

- (a) Contract number
- (b) Project number (as shown in the contract)
- (c) Item name (as shown on detail estimate)
- (d) Date
- (e) Time
- (f) Ticket number (consecutive)
- (g) Haul unit number
- (h) Net tons (MT) in load (to nearest 0.05 ton)
- (i) A subtotal of tons (MT) for each haul unit since the beginning of the shift.
- (j) An accumulated total for all haul units since the beginning of the shift.

Use a pre-programmed printer or one equipped to prevent manual override of any weight information. Have the weigh system tested, certified and sealed by the State Bureau of Weights and Measures after each plant move and before production for a project. Immediately stop production should the printer malfunction or breakdown and do not resume until corrected. Delivery of material from storage or surge bins will be permitted only if the weight can be maintained within weigh specifications.

If an independent certified scale is within a 20 mile (32 km) round trip distance from either end of the project, the Project Manager will randomly re-weigh loaded vehicles at least 3 times per project.

Re-test the plant weigh system any time the difference between the re-check and the plant system exceeds $\pm \frac{1}{2}$ of 1% of the load. Any weight difference will be addressed in accordance with Subsection 109.01.1.

2. Manual Weighing. The Contractor may manually weigh and record weights instead of using an automatic weigh system. Ensure manual weighing includes platform scales in accordance with Subsection 301.03.2(C), a competent weigh person, and dump person.

Direct the weigh person to record, on Department furnished forms, weights to the nearest 100 pounds (45.4 kg) as well as the other required information regarding delivery and placement.

Certify that weights and totals furnished are a true and correct record of materials delivered and placed in the work. Deliver the records and totals to the Project Manager before 10:00 a.m. the next work day following the shift.

401.03.9 Safety Requirements

Install and maintain stairs, ladders, walkways and all other plant facilities meeting State and Federal safety requirements.

Provide access to the plant mix within the trucks for taking samples and mix temperature data.

401.03.10 Burner Fuel Restrictions

Use one of the approved fuels below to heat and dry aggregates.

- Propane
- Butane
- Natural gas
- Fuel oil (grades 1, 2, and 5 only)
- Coal

EPA Specification-used oil fuel (EPA-UOF) may be used instead of the approved burner fuels provided Table 401-2 requirements are met.

**TABLE 401-2
EPA SPECIFICATION - USED OIL FUEL REQUIREMENTS**

Physical Properties	
Property	Range
API Gravity	20-28
Viscosity at 122 °F (60 °C) (Saybolt Flurol)	10-20
Pour point	+10 °F(-12 °C)
Flash point, minimum	100 °F (37.8 °C)
Water by distillation	Under 1%
Solids by separation	Under 1%
Ash	Under 0.4%
Sulfur	Average 0.5%
Kinematic viscosity at 100 °F (37.8 °C)	54-100 (centistokes)
Kinematic viscosity at 122 °F (60 °C)	15-75 (centistokes)
Chemical Properties	
Element or Compound	Permitted Level
Vanadium	Under 100 ppm (100 mg/L)
Cadmium	Under 2 ppm (2 mg/L)
Chromium	Under 10 ppm (10 mg/L)
Lead	Under 100 ppm (100 mg/L)
Arsenic	Under 5 ppm (5 mg/L)
Total halogens	Under 1,000 ppm (1,000 mg/L)
PCB's	Under 2 ppm (2 mg/L)

Furnish a copy of certified test results from the supplier for each load of EPA-UOF delivered to the project. Furnish plant manufacturer information showing the plant burner is designed and

equipped to burn EPA-UOF or grade 5 fuel oil. Upon request, provide a 1-quart (1 L) sample of EPA-UOF from the tank on the project.

Immediately stop using EPA-UOF or grade 5 fuel oil if burner flame outs or other evidence of incomplete combustion or mix contamination is evident. Begin using one of the other approved fuels to complete the work. Remove and replace all contaminated plant mix at Contractor expense. No additional compensation will be allowed.

401.03.11 Dry Warm Mix Additive, Hydrated Lime Feed System

Introduce dry hydrated lime into drum dryer mixing plants just below the asphalt cement introduction point. Introduce dry warm mix additive as directed by manufacturer.

Ensure the system provides positive, accurate material feed and is automatically synchronized to the aggregate feed. Ensure the system indicates the weight entering the mixing unit on a time-coordinated basis.

Weigh using an automatic indicating electronic system. The lime may be weighed directly, or the storage container including lime may be weighed.

Provide a continuous digital readout showing the weight or rate of feed in tons (MT) per hour. Record the information using a production monitor/recorder system or by a de-cumulating balance ticket-printing system. Record the information at minimum 5-minute intervals or as directed.

Silo or storage container system weights are not used for acceptance during filling or transfer. Limit filling or transfer periods to one hour per three hours of plant operation. Record and furnish start and finish times for filling or transfer and the total quantity added.

Suspend mixing for erratic feeding or failure to feed hydrated lime to a minimum of 85% of the job mix formula. Do not resume until corrected or repaired.

401.03.12 Flow Rate Meter

Measure the asphalt cement and liquid warm mix additive (if applicable) discharged into the mixing unit using a flow rate meter with totalizer and temperature compensation.

Ensure the totalizer records up to 1,000,000 gallons (3,785,000 L) and is certified to $\pm 0.2\%$ of the measured quantity.

Use a flow rate meter and totalizer that automatically corrects to a temperature of 60 °F (16 °C) with an operating range of +60 to +450 °F (16 to 232 °C).

Locate the totalizer readout in the plant control room so it is readily accessible to the Inspector.

Ensure the flow rate meter automatically shuts off any time asphalt cement is diverted or stops entering the mixing unit.

Calibrate the flow rate meter and totalizer before the start of the project and as necessary during production. The Project Manager will witness the calibration.

Provide the equipment and assistance for initial and subsequent calibration checks and furnish the Project Manager a copy of all calibration checks.

Use a calibration volume of at least 3,000 gallons (11,355 L). Ensure the weigh scales have been tested and certified.

Furnish the Project Manager 1 copy of a test report showing the asphalt cement specific gravity.

Spot check failure will require re-testing and certification of the above. The Project Manager will establish the spot check interval.

401.03.13 Production Monitor Recorder

Use recording equipment that automatically monitors and records, on a time coordinated basis, the aggregate, lime, warm mix additive and asphalt cement weight entering the mixing unit. The records may be continuous (chart recorder) or digital printout.

Ensure that chart recorders clearly record asphalt cement content changes of 0.1% or more and aggregate feed rate changes of 1.5% or more.

Ensure the digital printout equipment records the day's total production at minimum 5-minute intervals, or the interval directed by the Project Manager.

Digitally display the aggregate, warm mix additives, and asphalt cement rates in tons (MT) per hour and daily totals. Display lime by tons (MT) per hour or on a de-cumulating balance.

Ensure the monitor system operates on unprocessed signals from measuring devices.

Provide the Project Manager continuous access to the recorder during production.

Submit the permanent record to the Project Manager daily.

Operate the production/monitor recorder at all times during production. Stop production when the recorder is not operational.

401.03.14 Plant Mix Preparation

Mix the aggregate, all additives and asphalt cement to produce a homogeneous mixture. Ensure all aggregates are thoroughly and uniformly coated with bitumen.

Immediately suspend operations if aggregate is not being completely dried prior to mixing.

Remove, dispose of, and replace all mix that is damaged by burning, improper mixing, or fails to meet the specifications at Contractor expense.

Maintain the mix discharge temperature within the asphalt cement manufacturer's recommended mix temperature range not exceed 355 °F (179 °C).

The discharge temperature will be periodically checked and recorded.

Remove and replace any mix produced when the mix discharge temperature exceeds the maximum temperature at Contractor expense.

401.03.15 Roadway Equipment

A. Pavers. Use self-propelled pavers that spread, shape, and finish the combined plant mix material to the specified profile and cross slope.

Immediately stop paving if the paver tears, shoves, segregates or otherwise damages the plant mix, and repair or replace the paver before resuming paving operations.

Equip the paver with a mobile grade reference system that provides a uniform pavement profile. Ensure the paver maintains the transverse slope at all times and is able to adjust the slope throughout super-elevated curves.

Ensure auger extensions are used to match the screed width.

Equip the paver with an attachment that produces joints in accordance with Subsection 401.03.19 as the plant mix is placed.

B. Trucks. Remove trucks from service that leak fluids. When directed, cover each load with canvas or other approved material to protect the mix at Contractor expense.

C. Rollers. Furnish and use rollers that compact the plant mix to the specified density.

Remove rollers that crush the paving aggregates or otherwise damage the plant mix and replace the damaged plant mix at Contractor expense.

D. Cleaning Agents. Do not use diesel fuel as a cleaning agent or as a release agent for any paving equipment or operations. Use a commercially manufactured release agent approved by the Project Manager.

401.03.16 Existing Surface Preparation

Dispose of existing bituminous surface, designated to be removed, in accordance with Subsection 202.03.3.

Re-work all existing bituminous surfaces designated to remain in place as specified.

Before placing the leveling course, clean the existing surface of dirt and loose, extraneous material. Apply a prime or tack coat of bituminous material to the cleaned surface as specified.

Correct dips, depressions, sags, excessive or nonexistent crown, and other surface irregularities using a premixed bituminous mixture. Spread the mixture in 2-inch (50 mm) compacted layers.

Correct surface irregularities exceeding 6 inches (150 mm) deep, using untreated aggregate material before leveling with a bituminous mixture.

401.03.17 Tack Coat

Apply tack coat in accordance with Section 407 and the contract.

Apply tack coat on the prepared surface, existing surfacing to be overlaid and between lifts when pavement is constructed in multiple lifts.

401.03.18 Surface Conditions, Weather Limitations and Paving Dates

Stop plant mix paving when the surface temperature is less than 35 °F (2 °C); the surface is wet; the roadbed is unstable or the Project Manager determines adverse weather conditions prevent the proper handling, finishing or compacting of the mix.

Complete all sections of plant mix surfacing, to be open to traffic during winter shut down, to the full plan width and thickness, excluding the seal and cover. Complete this work meeting the specifications before the November 1st paving cessation date.

The Project Manager will suspend time assessment between November 1st and November 16th when the next scheduled significant work item is paving and all grading, gravel and other operations affecting the safe and convenient use of the roadway by the traveling public are complete.

Submit a written request to the Project Manager and obtain written approval in order to pave after November 1st. and before April 15th.

Plant mix surfacing placed after November 1st and before April 15th is at the Contractor's risk and subject to the following conditions:

- The surface temperature to be paved is at least 35 °F (2 °C), measured by the Project Manager.
- All applicable specifications are met.

Make permanent repairs and restore partially completed pavement to the required profile, section and condition at Contractor expense before placing the remaining lifts.

This is not a waiver by the Department of any other contract requirement regarding the work sequence or traffic operation.

If the paving operation causes transverse joints spaced at less than ½-mile (805 m), suspend work until the next April 15th.

No payment is made for the plant mix or asphalt cement on progress estimates between November 1st and April 15th for partial width or thickness.

Promptly repair damage to all partial width or thickness of plant mix surfacing used by traffic during this period for any reason including suspension of work due to adverse weather.

Provide all required interim traffic striping and traffic control on partially completed pavement at Contractor expense.

Failure to promptly make repairs and provide interim striping and traffic control is cause for the Department to perform or have the work performed and deduct the cost from monies due or that may become due the Contractor.

Payment for partial width or thickness pavement in acceptable condition will be made on the estimates following the end of the period on the next April 15th.

401.03.19 Spreading and Finishing

Place and spread the mix in accordance with Table 401-3. Thinner lift thicknesses must be approved by the Project Manager.

**TABLE 401-3
MINIMUM LIFT THICKNESS**

Aggregate Size	Minimum Lift Thickness
3/8-inch (9.5 mm)	0.1-foot (30 mm)
1/2-inch (12.5 mm)	0.12-foot (36 mm)
3/4-inch (19 mm)	0.15-foot (45 mm)

Place and spread the mix to the widest practical width on the approved surface. Place shoulder-widening material with approved equipment.

Establish and maintain line control for paving. The Project Manager will furnish the Contractor the necessary information to establish these controls. Maintain the paving control line tolerance within 0.25-foot (75 mm) of a true line from the existing reference points.

Failure to maintain the paver control line within the specified tolerance is cause for corrective action or pavement removal and replacement, as directed by the Project Manager, at Contractor expense.

Include the cost of furnishing horizontal line control in the plant mix surfacing bid item.

Remove and replace segregated pavement areas behind the paver with new plant mix before initial rolling begins. Correct all segregated areas at Contractor expense.

On small or irregular areas, approaches, turnouts, around manholes, inlets, walls and on other areas not readily accessible to a paver, plant mix may be spread to the specified thickness using a specialty paver or other approved methods. Compact these areas as directed.

Remove and replace all plant mix that is segregated, loose, broken, contaminated, damaged or otherwise defective, with new plant mix that meets contract requirements at Contractor expense.

Remove any plant mix dropped from equipment onto any existing or new plant mix surfacing as directed by the Project Manager.

Roadways having a design ESAL of 100 or less may be opened to traffic or to haul units subject to the Project Manager's approval.

Roadways having a design ESAL of 100 or greater may be opened to traffic and haul units when the mat is compacted and the surface cools to 140 °F (60 °C).

401.03.20 Constructing Joints

Continuously place each lift and provide at least a 6-inch (150 mm) offset between longitudinal joints in successive lifts. Offset transverse joints in successive lifts by at least 6 feet (1.8 m).

Correct joints that do not meet the surface tolerance requirements in accordance with Subsection 401.03.23

Uniformly coat the exposed face of all joints, excluding those formed by echelon paving, with a double shot of emulsified asphalt before placing the abutting course.

Construct longitudinal joints in the top lift of plant mix at the centerline or lane line. If these locations are not practical, construct the joint outside the wheel paths as approved by the Project Manager.

Construct a vertical transverse joint the full lift depth if the mix cools below the low temperature in accordance with Subsection 401.03.21. Remove loose material, brush the joint face with asphalt, and compact the fresh mix against the joint face when paving is resumed.

Taper the end of paving lifts at bridge ends and on roadways under traffic to a minimum 50H:1V ratio. When paving of the lift resumes, remove the taper and construct the transverse joint.

Ensure transverse joints in lifts of plant mix surfacing or other lifts to be used by traffic for 15 calendar days or more do not vary more than $\frac{3}{8}$ -inch (9.5 mm) from any point on a taut 25-foot (7.6 m) string line placed parallel to centerline.

Taper the longitudinal paving joint edges at a 4H:1V to 6H:1V slope. Compact the joint between abutting passes to the specified plant mix density. Do not permit an exposed longitudinal joint length to exceed one day's paving run.

Sign the new pavement end at the close of work each day meeting the project's traffic control plan and the contract.

Construct the joints at bridge ends or other rigid structures after the existing base is prepared and compacted. Apply a coat of emulsified asphalt to the portions of structures abutting the plant mix surfacing.

401.03.21 Compaction, Compaction Control Testing, and Density Acceptance Testing

Complete compaction rolling within the temperature range recommended by the asphalt cement manufacturer included in the mix design or before the mat temperature falls below 175°F (80 °C). Compaction rolling after the temperature is below 175 °F (80 °C) is cause to suspend paving operations. Compaction rolling is rolling in the vibratory mode. The Project Manager may adjust the minimum 175 °F (80 °C) temperature if compaction rolling damages the new pavement or has received written approval from the asphalt cement manufacturer. Compact Warm Mixes in accordance with Subsection 401.02.4.

Perform all necessary density testing to control compaction.

Once the plant mix is spread, struck off, and surface irregularities are corrected, compact to the plant mix to at least 93.0% of target maximum specific gravity as determined in accordance with MT 328 with the following exceptions:

- 92.0% - $\frac{3}{8}$ -inch (9.5 mm) mixes with plan depths of less than 0.12-foot (36 mm).
- 92.0% - any mix placed directly on a crushed aggregate surfacing.

Compact plant mix placed over any typical section containing CTB to 93.0% for the full width of the typical section.

Provide core samples of the compacted plant mix from the roadway. Core locations will be randomly selected based on the tons (MT) of mix placed. Core the locations selected after all rolling is complete and before the roadway is opened to traffic. The center of the core location will not be within 12 inches (305 mm) of longitudinal paving joints, 12 inches (305 mm) of a shoulder hinge point, or where the planned nominal thickness is less than 0.10-foot (30 mm). The pavement density is determined from cores taken at randomly selected locations after all rolling is complete and before the roadway is open to traffic.

Density acceptance by cores does not apply to leveling or isolation lifts that have a depth of less than 0.10-foot (30 mm) thick.

Take cores after all rolling is complete. Provide two 4-inch (100 mm) cores the full depth of the plant mix surfacing, extracted from within a 5-inch (125 mm) radius of each designated location. Mark the core as directed.

Separate the plant mix lift to be tested from the total core. Cut the core to the actual lift thickness within \pm 0.15-inch (4 mm). The Department recommends using a saw to separate the

lift to be tested from the total core. Perform this work within the project limits or other approved location.

The Inspector will witness all of the above activities before traffic is permitted to use the plant mix lift being tested.

Furnish the core immediately to the Inspector after it is removed, marked and separated. Do not remove the cores from the Inspector's visual control at any time. Re-core as directed any time either the Contractor requirements or procedures within this section are not met. The test results of the replacement core to be used in the QA evaluation for the lot represented will be the actual relative in-place density unless it exceeds:

- 92%; then 92% will be used for the relative in-place density of that core in the QA evaluation.
- 91% for $\frac{3}{8}$ -inch (9.5mm) mixes with plan depths of less than 0.12 foot (36 mm); then 91% will be used for the relative in-place density of that core in the QA evaluation.
- 91% for any mix placed directly on a crushed aggregate surfacing; and then 91% will be used for the relative in-place density of that core in the QA evaluation.

The plant mix in the sub lot represented is considered to be not meeting density specifications.

Remove free water from each core hole; place and compact new hot plant mix, not exceeding 2-inch (50 mm) lifts, to the finished surface immediately after the core is removed. If approved by the Project Manager, fill with a commercially manufactured quick setting non-shrink grout to the finished surface. Apply a double shot of emulsified asphalt over the core holes when the patch material has set. Mark each core as directed by the Inspector witnessing the coring.

MT 328 is used to establish the target Rice density. The bulk specific gravity (MT 314) determined for each core will be divided by the target Rice density in effect at the time the plant mix was produced to determine the relative in-place density. The average of the results of the pair of cores from each location will be expressed as the percent of relative density. All results will be reported to the tenth of one percent (0.1%).

The approximate mix quantity represented by each sub-lot is 600 tons (600 MT). Additional locations and tests may be required. The quantity represented by 5 tests or approximately 3,000 tons (3,000 MT) of mix constitutes a lot whenever production schedules and material continuity permit. A lot represented by 3 to 7 consecutive random sub-lots will be established when there are short production runs, significant material changes, or other unusual characteristics of the work.

All costs of furnishing the cores will be considered incidental to the plant mix surfacing item and no separate measurement or payment will be made.

Plant mix surfacing is evaluated for density on a lot-by-lot basis in accordance with Subsection 105.03.2.

401.03.22 Pavement Repair

Cut out the defective pavement section to at least 0.15-foot (45 mm) depth or as directed by the Project Manager. Clean the sides and bottom of the repair area and apply tack coat to the surfaces. Fill the repair area with contract specified mix, level, and compact to the specified density and surface smoothness.

401.03.23 Surface Tolerance for Flexible Pavement

- A. Ride Specification.** Construct all surfacing courses to provide completed plant mix pavements that meet surface smoothness levels derived from the IRI for the category specified in the contract and that meet the surface profile requirements for the finished surface. Surface smoothness and surface profile will be analyzed from data collected by the Department using a Class I laser road profiler following Department procedures for

profiler operations. The IRI will be measured in inches/mile, regardless of the unit of measure used on the contract.

Target IRI values are determined by project category based on the opportunities for improving the ride, by the pre-paving IRI value, paving constraints or by a combination of these as follows:

1. Category I projects:

Target IRI values - 45 to 55 inches per mile

- Projects with 2 or more opportunities for improving the ride.
- Single lift overlays with a pre-paving IRI value less than 110 in/mi

2. Category II projects:

Target IRI values - 55 to 60 inches per mile

- Single lift overlays with a pre-paving IRI greater than or equal to 110 in/mi and less than 190 in/mi

3. Category III projects:

Target IRI values - 55 to 70 inches per mile

- Urban projects with a posted speed limit of 55 MPH or less and curb and gutter controlling 1 or more edges of the paving

Projects with high pre-paving IRI value:

- Projects with an average pre-paving IRI value greater than or equal to 190 in/mi and 2 or more opportunities to improve the ride are considered a Category I project.
- Projects with an average pre-paving IRI value greater than or equal to 190 in/mi and one opportunity to improve the ride must have a post-paving IRI less than or equal to 50% of the pre-paving IRI. There is no pay adjustment factor based on smoothness; corrective action is required to produce a post-paving IRI less than or equal to 50% of the pre-paving IRI at Contractor expense.

Each opportunity to improve the ride is one of the following:

- Placing a gravel base or surfacing course;
- Placing plant mix base;
- Placing cement treated base;
- Placing pulverized plant mix surfacing;
- Milling;
- Cold recycling (milling and laydown); or
- Each full 0.10-foot (30 mm) increment for $\frac{3}{8}$ -inch (9.5 mm) aggregate mix, 0.12 foot (36 mm) increment for $\frac{1}{2}$ -inch (12.5 mm) aggregate mix, and 0.15-foot (45 mm) increment for $\frac{3}{4}$ -inch (19 mm) aggregate mix of new plant mix surfacing.

Leveling and isolation lifts are not included as an opportunity to improve the ride.

Correct surface profile defects greater than 0.40 inches (10 mm) in a distance of 25 feet (7.62 m) within 30 calendar days of notification but prior to seal and cover or plant mix seal operations. Correct surface profile defects by milling and filling deficient pavement depths or by diamond grinding excess pavement depths. Corrected surface profile defects will be retested and evaluated. Pavement thickness will be measured after profile corrections are made. Ensure corrected pavements do not create a transverse height difference between adjacent lanes exceeding $\frac{1}{8}$ -inch (3 mm). Fog seal corrected areas if the roadway is not chip sealed prior to winter shutdown.

The Department will test for surface smoothness and surface profile prior to the placement of seal and cover or plant mix seal on the final lift of plant mix surfacing pavement. Testing will consist of 2 passes in each travel lane. Data collected for each

wheel path will be averaged for that lane. Tests will be performed within 10 business days (extended by rain or other inclement weather conditions) of completion of all mainline paving. The Department will test divided highways within 10 business days (extended by rain or other inclement weather conditions) of completion of mainline paving for each direction of travel. Ensure that the entire finished lane width to be tested is not impeded and is available to Department personnel at the time of testing. Test results will be furnished within 2 business days.

If the entire final lift of pavement cannot be completed before winter shutdown, data will be collected for all roadway sections paved through the final lift. Evaluation of the remaining pavement will be performed once the paving is completed.

The surface smoothness analysis will be used to determine the actual IRI for calculating pay factors for the surfacing section.

Actual IRI values will be determined on all mainline travel lanes including climbing lanes, passing lanes, and ramps that are 0.2 miles (0.30 km) or longer. Bridge decks will be included only if they are paved as part of the project.

Smoothness data will not be evaluated for the following roadway sections:

1. Climbing lanes and passing lanes less than 0.2 miles (0.30 km) long;
2. Turning lanes;
3. Acceleration and deceleration lanes less than 0.2 miles (0.30 km) long;
4. Shoulders and gore areas;
5. Road approaches;
6. Horizontal curves 900 feet (275 m) or less in centerline radius, and pavement within the super-elevation transitions of these short radius curves; or
7. Pavement within 50 feet (15 m) of bridge decks, approach slabs, and the terminal paving points of the project.

Areas requiring corrective work will be identified using the surface profile measurements of the finished surface.

Correction of profile defects will not be cause to reevaluate any section for surface smoothness except for locations identified as remove and replace as described below. Quality incentive allowances will be used to offset any price reductions on progress estimates.

Remove and replace any 0.5 mile (0.8 km) segment of roadway requiring corrective action. Remove and replace the segment by milling 0.15 feet (45 mm) or to the lift line if within 0.02 feet (6 mm), whichever is greater and replacing with new material meeting the contract requirements. Remove and replace sections of roadway less than 0.5 miles (0.8 km) that do not meet the applicable IRI requirements for the project category unless other corrective action is approved by the Project Manager. Sections requiring removal and replacement or other corrective action will be rerun once the corrective work has been performed. The maximum pay adjustment factor for the affected segment after corrective action is 1.00. Disincentives will be applied if applicable.

All work to prepare the roadway for testing, including sweeping, grinding and traffic control prior to the ride test, is incidental to the work and is not measured for payment. All work to complete any corrective action and re-testing, including but not limited to sweeping and traffic control, is incidental to the work and is not measured for payment. Include all costs and resources to prepare the roadway for surface tolerance testing in the plant mix surfacing item.

- B. Surface Smoothness.** Finish the surface of the final lift to the specified grade and cross section meeting the surfacing smoothness values for all paved areas excluded from the ride specification in accordance with Subsection 401.03.23(A). The Contractor will be

notified of sections to be corrected within 3 business days after the surface was placed. Perform all corrective work at Contractor expense. Table 401-4 values specify the maximum allowable variance and divergence from the mean constructed grade.

**TABLE 401-4
MAXIMUM ALLOWABLE VARIANCE AND DIVERGENCE**

Surface	Total Variation Per 100 feet	Rate
New plant mix	0.02-foot (6 mm)	0.20%
Plant mix overlays (\geq 90 mm)	0.03-foot (9 mm)	0.30%
Plant mix overlays ($<$ 90 mm)	0.03-foot (9 mm)	no rate

Note: The rate is applicable only to the longitudinal direction.

The mean constructed grade for each section is the planned grade or a grade parallel to plan grade, acceptable to the Project Manager.

Surfaces will be checked for compliance at joints, bridge ends, and other sections where ride characteristics or other evidence indicates the surface tolerance is outside the specifications.

Surface smoothness is measured longitudinally in 100-foot (30.5 m) sections at 10-foot (3 m) intervals, and transversely at 4-foot (1.2 m) intervals. Correct out of specification plant mix surfacing by diamond grinding, cold milling a minimum depth of 0.15 feet (45 mm) the full width of the defect but not less than the paver width, or other approved method. If removing and replacing, extend the repair area for a minimum of 50 feet (15.2 m) each side of the defective pavement and fill with like material compacted to the specified density.

Ensure the corrected pavement and adjoining surface meet the smoothness specifications.

401.03.24 Rumble Strips

Construct rumble strips when specified. Cut the rumble strips into the finished plant mix surfacing. Use a machine equipped with a rotary type cutting head capable of making the cuts to the dimensions and pattern shown in the Detailed Drawings.

Produce the rumble strips without tearing and snagging the pavement. Remove resulting debris from the roadway before opening to traffic. Do not allow debris to enter any waterways.

Establish a control line and locate the rumble strips on the shoulder 6 inches (150 mm) outside of the travel lane. The offset may be adjusted to avoid longitudinal pavement joints. Do not place rumble strips where concrete barrier rail or other roadside features prevent placement as specified.

Do not cut rumble strips if the seal and cover operation will not be completed before winter shutdown. If seal and cover is not scheduled to be completed within 10 business days after cutting rumble strips, fog seal the finished rumble strips.

Apply fog seal to finished rumble strips as follows:

1. Apply a double shot of emulsified asphalt meeting Section 407 for fog seal.
2. Keep traffic off the fog seal until the emulsion has cured to no-tack.
3. Apply the fog seal to the rumble strip for each lane in the direction of travel for that lane.

401.04 METHOD OF MEASUREMENT

401.04.1 Plant Mix Surfacing

Plant mix surfacing is measured by the ton (MT) on approved scales after complete mixing of all ingredients. The pay weight includes the asphalt cement and hydrated lime in the mixture.

401.04.2 Commercial Plant Mix Surfacing

Commercial plant mix surfacing is measured by the ton (MT) on approved scales after complete mixing of all ingredients. The pay weight includes the asphalt cement and hydrated lime in the mixture.

401.04.3 Asphalt Cement

When not included in another item, asphalt cement is measured by the ton (MT) as specified to the nearest ton (MT), in accordance with Subsection 402.04, excluding anti-stripping additive.

401.04.4 Hydrated Lime

When not included in another item, hydrated lime is measured by the ton (MT) in accordance with Subsection 109.01. Hydrated lime exceeding 1.6% by total weight of mix is not measured for payment as hydrated lime.

401.04.5 Rumble Strips

Rumble strips are measured by the mile (km) along the centerline of the roadway, less all gaps in the rumble strips due to ramp terminals, objects, etc. Each individual line of rumble strips is measured separately.

Fog seal for rumble strips is not measured for payment.

401.04.6 Tack Coat

Tack coat is incidental to the plant mix surfacing and is not measured for payment.

401.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Asphalt Cement	Ton (MT)
Commercial Plant Mix Surfacing	Ton (MT)
Hydrated Lime	Ton (MT)
Plant Mix Surfacing	Ton (MT)
Rumble Strip	Mile (km)

For commercial plant mix no separate payment will be made for asphalt cement, fillers, hydrated lime, and additives.

The contract unit price for rumble strips will be adjusted as shown in Table 401-5:

**TABLE 401-5
PRICE ADJUSTMENTS DUE TO LINE DEVIATIONS**

Line Deviation From The True Line	Price Adjustment
0.0 to 0.15-foot (0 to 45 mm) in 500 feet (152 m)	none
0.15 to 0.25-foot (45 to 75 mm) in 500 feet (152 m)	50% price reduction
greater than 0.25-foot (75 mm) in 500 feet (152 m)	correct as directed

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 402

BITUMINOUS MATERIALS

402.01 DESCRIPTION

This work is the furnishing and applying bituminous materials, on bases and surfacing.

402.02 MATERIALS

Furnish bituminous materials meeting Section 702 and the contract requirements.

402.03 CONSTRUCTION REQUIREMENTS

Mix and apply bituminous material meeting the applicable requirements in Sections 401, 406, 407, 409, and 410.

402.03.1 Materials Source

Obtain the Project Manager's approval of the bituminous source before delivering the material to the project. Do not change the source of supply once work is started, without the Project Manager's written approval.

402.03.2 Sampling

- A. General.** Take bitumen samples, other than products accepted under quality assurance, at the point of delivery on the project.

The Contractor or designated representative is responsible for sampling the bituminous materials on the project in accordance with MT 302.

Drain off and discard at least 1 gallon (3.8 L) of the bituminous material before drawing samples.

Draw 2 one-quart (0.9 L) samples from each shipment, witnessed by the Project Manager. Submit both samples to the Project Manager for testing. One sample will be tested and the 2nd sample will be retained for use in accordance with Subsection 702.02.

Equip all transport vehicles with a spigot or gate valve in the unloading line, or in the tanker at the centerline of the tank, or in the pressure line from the unloading pump, or at another approved location. The spigot or gate valve diameter must be between $\frac{3}{8}$ and $\frac{3}{4}$ -inch (9.5 and 19 mm). Locate the spigot or valve to prevent plant dust or other sample contamination.

- B. Asphalt Sampling (Quality Assurance Sampling).** Sample asphalt cement for plant mix surfacing and base and plant mix seal course using a sampling device located in the line between the storage facilities and the mixing plant.

Provide a sample of the asphalt cement entering the mixing plant. One approved in-line sampling device is shown in AASHTO T 40.

Place the samples in Department furnished containers. Give the samples to the Project Manager immediately after sampling.

The Project Manager will randomly designate the time of sampling based on the tons (MT) of asphalt cement incorporated into the completed mix produced. The approximate quantity of asphalt cement represented by each sample is 25 tons (25 MT). The Project Manager may require additional samples and testing.

Six samples represent approximately 150 tons (150 MT) of asphalt cement and constitute a lot whenever production schedules or material continuity permit. The Project Manager may establish a lot consisting of the quantity represented by any number of consecutive random samples, from 3 to 7 inclusive, when necessary to represent short production runs, significant material changes, or other unusual characteristics of the work.

402.03.3 Shipping

Ship the bituminous material in clean, uncontaminated, fully insulated cars or trucks, sealed by the supplier after loading.

402.03.4 Testing

Bituminous materials are accepted on the test results of samples selected and tested in accordance with Subsection 702.02 by the Department or its authorized representative.

402.03.5 Acceptance

- A. General.** Provide the Project Manager a copy of the original bill of lading and a copy of the certificate of compliance, with each shipment. Ensure the certificate is signed by the supplier's representative and attests that the bituminous material meets the Department's specifications for the type and grade of material provided and that the shipping container was inspected and found free of contamination. The certificate of compliance is the basis for tentative material acceptance and use.
- B. Failures.** If a shipment of bituminous material fails to meet any of the specifications the material will be accepted at a 10% price reduction of the bituminous material cost if the test results are within the tolerances shown in Table 402-1.

If a shipment fails to meet any one of the specifications after twice the allowable tolerances have been applied, the price reduction will be 25% of the unit price bid for bituminous material when it is paid as a separate item or the invoice price when it is part of a bid item.

If a shipment fails to meet any one of the specifications after triple the allowable tolerances have been applied, the Project Manager may reject the material and require its removal from the work, or the Project Manager may accept the material at a 50% price reduction of the cost of the bituminous material.

The cost of the bituminous material for calculating price reductions is the material's contract unit price.

If a shipment fails more than one of the specifications, the failure causing the largest percentage price reduction is assessed.

**TABLE 402-1
SCHEDULE OF TOLERANCES**

Test	Allowable Variation		Remarks
	From Min. Specification Requirement	From Max. Specification Requirement	
Penetration distillation residues	-10%	+10%	
% Residue from distillation	-5%		% of total distillate: 2 mL may be added or subtracted at any distillation temp. before calculating the % recovered
Viscosity cutback asphalts emulsified asphalts	-10% -5%	+10% +25%	
Ductility	-10%		
Flash test cutback asphalt	-10%		
Particle charge	NO TOLERANCE - Materials in violation of spec. and any aggregate used in conjunction with its use will, at the Project Manager's discretion, be either rejected or paid for at a unit rate not to exceed 50% of the cost of the materials.		

402.03.6 Loading and Application Temperatures

The Project Manager will designate the recommended application temperature ranges in accordance with Table 402-2.

Do not heat bituminous mix any higher than is necessary for proper hauling and placing.

Do not introduce aggregate into a mixer higher than 25 °F (14 °C) above the bituminous material temperature.

Furnish the Project Manager with data on the temperature-viscosity relationship of each asphalt to be used on the project. The data must cover the recommended temperature range and viscosities at which the asphalt may be used. The Project Manager will use this data to specify the temperature at which the material will be used.

**TABLE 402-2
RECOMMENDED APPLICATION TEMPERATURES
FOR BITUMINOUS MATERIALS**

Liquid Asphalts - RC, MC and SC				
Grade	Loading Temp. Max. ¹ °F (°C)	Spraying Temperature	Mixing Temp. of Aggregates for MC & SC Liquid Asphalts	
			Min. °F (°C)	Max. °F (°C)
70	195 (91)	As required to achieve viscosity of 50-200 centistokes (25-100 Sec. Saybolt Furol) ²	90 (32)	155 (68)
250	245 (118)		125 (52)	200 (93)
800	275 (135)		160 (71)	225 (107)
3000	310 (154)		200 (93)	260 (127)

Emulsified Asphalts				
Grade	Mixing Temperature		Spraying Temperature	
	Min. °F (°C)	Max. °F (°C)	Min. °F (°C)	Max. °F (°C)
slow and medium setting	50 (10)	130 (54)	50 (10)	130 (54)
rapid setting	125 (52)	185 (85)	120 (49)	160 (71)

Asphalt Cements		
Grade	Mixing Temperature	Spraying Temperature
		Max. °F (°C)
all penetration grades	established by Project Manager	350 (177)

Notes:

1. Line temperatures
2. Temperature – viscosity charts provided by manufacturer

402.03.7 Alternate Type or Grade of Bituminous Materials

The Engineer may change or substitute, in writing, the type and grade of bituminous material specified.

Payment for the changed or substituted bituminous material is the contract unit price for the type and grade of bituminous material plus or minus the difference in Contractor's cost at the refinery between the specified and substitute type and grade.

402.03.8 Performance Graded Asphalt Binder (PGAB)

Furnish PGAB meeting Table 702-2 requirements for the binder specified in the contract. PG 64-28, PG 64-34 and PG 70-28 binders, after aging in the rolling thin film oven, and testing in accordance with AASHTO T 51 must meet the following:

- Pull Rate: 2 inches per minute (5 cm per minute);
- Sample Temperature: 77 °F (25 °C); and
- Ductility: 1-foot (30 cm) minimum.

Notify the Project Manager in writing before making changes to the PGAB components.

- A. PGAB Shipping, Handling, and Storage.** Ship, handle, and store the PGAB following the supplier's requirements. Furnish a copy of the requirements before delivering the PGAB to the project. Ensure that the supplier's requirements are consistent with the material manufacturers. PGAB exhibiting separation, crusting, or foaming during delivery or in storage tanks will be rejected.
- B. Sampling.** Sample the PGAB in accordance with Subsection 402.03.2(B). A sample is 2 one-pint (two 500 mL) containers of PGAB.
- C. Acceptance.** The Department will grade samples representing each lot in accordance with the PGAB grading system, and Table 702-2, with duplicate containers retained for testing in case of dispute. PGAB is accepted in accordance with Subsection 105.03.2 using an "F" factor of 4. The "P" value is determined for the high temperature components of the resulting grade (e.g. 64, 58, etc.) using the formula:

$$P = (TL + aR - Xn) \times F$$

The "P" value is determined for the low temperature component of the resulting grade (e.g. -34, -28, etc.) using the formula:

$$P = (Xn + aR - Tu) \times F$$

Positive "P" value is added to determine the lot's total price reduction. No disincentive will be assessed for "P" values less than 13, based upon the Department's initial grading. This disincentive exclusion in "P" value will not be applied to averaged results described below.

If the calculation results in a price reduction ("P" value of 13 or greater), the Contractor may make a written request for an independent laboratory to grade the duplicates for the lot in question. Ensure the Department receives the written request within 30 calendar days of the notification of price reduction. The Contractor and the Department will agree upon the choice of independent laboratory before release of the duplicate samples for testing. The independent laboratory results will be averaged with the results provided by the Department. The averaged results are binding on both parties for acceptance and payment of the material in question. The "P" value will be calculated based upon the averaged results, with no exclusion allowed for results less than 13. Pay the cost of the duplicate testing, on a per lot basis, if the price reduction is confirmed or increased. The Department will pay the cost of the duplicate testing, on a per lot basis, if the price reduction is reduced.

The ductility requirement has no tolerance. Immediately stop paving if the binder fails the ductility requirement. Do not start paving until binder meeting the specifications is furnished.

402.04 METHOD OF MEASUREMENT

Bituminous material is measured by the gallon (L) or the ton (MT), as specified in the contract.

If measured by the gallon (L), the volume of bituminous material is determined at a temperature of 60 °F (15.6 °C) or corrected to this using the appropriate group table designated in the ASTM D1250 volume correction tables. Transport bituminous materials measured by the gallon (L) in tanks certified as to capacity. Provide a measuring rod and calibration card with each tank. Railroad tank cars must have available inage and outage tables and dome capacity charts.

When measured by the ton (MT), the bituminous material weight is measured on scales furnished by the supplier or on public scales close to the source. Weigh each transporting vehicle for bituminous materials, other than railroad tank cars, empty and loaded. The weight

difference is used for computing the tonnage (metric tonnage). Furnish an approved scale that can weigh the transporting unit in an unbroken operation. Test and seal the scales at Contractor expense when directed.

For plant mix operations, the bituminous material may be weighed by the plant scales, if approved.

If railroad tank cars transport the bituminous materials, the railroad car weights may be used for computing the weight of bituminous material, if the loaded cars are weighed over track scales. The stenciled tare on the car used for determining the net weight is subject to verification.

Use flow rate meters in accordance with Subsection 401.03.2(D)(7), to measure the material. Document meter readings by invoices. The Project Manager may take tank stabs for verification purposes.

402.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Bituminous Material	Gallon (L) or Ton (MT)

Payment includes all costs to furnish, deliver, heat, haul, and apply the bituminous material.

For plant mix operations, the maximum volume of bituminous material eligible for payment on a shift basis is the target bituminous content plus 0.3%.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

**SECTION 403
CRACK SEALING**

403.01 DESCRIPTION

This work consists of routing, cleaning and sealing the transverse and specified longitudinal cracks in accordance with Subsection 403.03.1 in the roadway surface with the specified sealant.

403.02 MATERIALS

- A. Crack Sealant.** Use a sealant that is listed on the QPL and in accordance with Table 403-1.

**TABLE 403-1
CRACK SEALANT SPECIFICATIONS**

Property	Requirement
Cone penetration, 77 °F (25 °C), dmm (ASTM D5329)	100-150
Cone penetration, 0 °F (-18 °C), dmm (ASTM D5329 modified)	25 min.
Flow, 140 °F (60 °C), 5h (ASTM D5329)	0.4-inch (10mm) max.
Resilience, 77 °F (25 °C), (ASTM D5329)	30% to 60%
Bond, -20 °F (-29 °C), 200% ext. (ASTM D5329)	pass 3 cycles
Recommended pour temperature	380 °F (193 °C)
Safe heating temperature	410 °F (210 °C)
Asphalt compatibility (ASTM D5329)	pass

Submit a 30 pound (13.6 kg) sample for the first lot of the sealer proposed for project use to the Helena Materials Bureau for testing at least 20 calendar days before its intended application. Submit the sample in its original packaging with the batch number legible.

Do not use the first lot of sealant before it is approved.

The Department will take 1 random sample from each additional lot for testing.

- B. Backer Rod.** Furnish backer rod that is listed on the QPL. The backer rod must be compatible with the crack sealant placement temperature listed in Table 403-1, and also meet ASTM D5249, Type 1, sized for cracks in accordance with Subsection 403.03.4.
- C. Blotter Material.** Use toilet paper or an approved liquid blotter material. The liquid blotter must be a commercially manufactured surfactant. Provide blotter that is not detrimental to the crack sealant or the surfacing material.

403.03 CONSTRUCTION REQUIREMENTS

403.03.1 General

Work half of the roadway at a time.

Limit routing and crack sealing work to 1 maximum 2.0-mile (3 km) work area.

Submit the type of blotter material and application rates to be used to the Project Manager 10 calendar days before beginning crack seal operations. The application rate must be sufficient to protect the crack sealant material.

403.03.2 Routing

Rout all existing cracks that are between 1/8 and 1-inch (3 and 25 mm) wide.

Rout all longitudinal cracks to produce straight 3/4-inch (19 mm) vertical walls and a 3/4-inch (19 mm) wide flat bottom reservoir.

Rout the transverse cracks to produce straight ½-inch (13 mm) vertical walls and a 1½-inch (38 mm) wide flat bottom reservoir.

Rout when the roadway is dry.

Remove and dispose of the routed material from the roadway before opening the roadway to traffic.

403.03.3 Cleaning

The reservoir and crack must be dry and free of dust, dirt and loose materials immediately before placing the backer rod, if applicable, and applying the sealant.

403.03.4 Sealing

Install backer rod in cracks 1½-inch (38 mm) wide and larger. Place sealant material as soon as practicable after the routed cracks are deemed clean and dry. Do not rout further than sealant can be placed during the same day's shift.

Follow the sealant manufacturer's handling, mixing and application temperature requirements. Meet the following requirements:

- Ensure no moisture is present in cracks or reservoirs to prevent bubbling and non-adhesion of sealant during installation;
- Apply sealant filling the reservoir flush to the top using a pressure type applicator;
- Do not allow sealant to collect or pool at the low end of crack or reservoir elevation;
- Open the completed work to traffic once the sealant does not track; and
- Repair or replace all seal work damaged by traffic at Contractor expense.

Seal previously repaired cracks to restore water resistance. Spread and smooth the sealant as required to seal the reservoir, but do not exceed 2 inches of spread sealant on the roadway.

Apply blotter material to all sealed cracks.

403.03.5 Temperature Limitations

Do not rout when the mat temperature is below 35 °F (2 °C).

Apply the sealant when the roadway surface temperature is between 35 and 120 °F (2 and 49 °C).

403.04 METHOD OF MEASUREMENT

Crack sealing is measured by the pound (kg) of material placed.

Blotter material is not measured separately.

403.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Crack Sealing	Pound (kg)

Blotter material is included in the contract unit price and is not paid for separately.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 407

TACK COAT

407.01 DESCRIPTION

The work is furnishing and applying emulsified asphalt to a prepared aggregate, constructed bituminous or concrete surface before placing bituminous surfacing.

407.02 MATERIALS

407.02.1 Bituminous Material

Furnish emulsified asphalt meeting Section 702 requirements for the type and grade specified.

The Project Manager may change or substitute the type and grade of emulsified asphalt to be used in accordance with Subsection 402.03.7.

A one step change in grade will not change the contract unit price.

The Contractor may substitute CSS-1 emulsified asphalt for SS-1 emulsified asphalt for tack coat.

407.03 CONSTRUCTION REQUIREMENTS

407.03.1 Weather Limitations

Apply tack coat to a dry surface.

Apply the tack coat when the ambient temperature is 50 °F (10 °C) or higher, or when the surface temperature is 35 °F (2 °C) and rising.

Do not place plant mix on any surface with a tack coat until the tack coat has cured (breaks) as determined by the Project Manager.

Apply the tack coat after the Project Manager has approved the surface to receive the bituminous material.

Apply tack coat subject to the surface conditions and weather limitations in accordance with Subsection 401.03.18.

407.03.2 Equipment

Use equipment in accordance with Subsection 410.03.1.

407.03.3 Application of Emulsified Materials

Dilute emulsified asphalt to a 50-50 ratio with water, unless other approved proportions are directed by the Project Manager. Apply diluted emulsified asphalt for tack coat as specified by the Project Manager at a minimum rate of 0.1 gallon per square yard (0.45 L/m²).

When a double shot of emulsion is called for in the contract, apply 2 applications at the minimum rate specified above. Ensure the first shot is cured prior to applying the second.

407.03.4 Maintenance of Surface

Maintain tack coated surface until covering with subsequent surfacing.

Repair all defects, deterioration or disintegration of the underlying surfacing course or courses as directed.

407.03.5 Traffic Control and Protection of Highway Structures

Furnish traffic control meeting the approved traffic control plan and Section 618.

Furnish highway structure protection in accordance with Subsection 410.03.9.

407.04 METHOD OF MEASUREMENT

Emulsified asphalt is measured by the gallon (L).

When not specified as a contract pay item, emulsified asphalt is not measured or paid for but is incidental to and included in the payment for other items of work. Water for diluting emulsified asphalt used in the work is not measured for payment.

407.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Emulsified Asphalt	Gallon (L)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract. The emulsified asphalt quantities in the contract are estimated and may be increased or decreased with no adjustment of the contract unit prices.

SECTION 409

SEAL COAT

409.01 DESCRIPTION

Seal coat is the application of a bituminous material, covered with aggregate on an existing roadway surface.

409.01.1 Contract Time

In cases where seal coat and pavement marking application are the only remaining items of work, contract time will be charged in accordance with Subsection 108.07.3 beginning the first working day following the July 4th (Independence Day) holiday.

Submit written notice to perform seal coat work prior to the July 4th (Independence Day) holiday or holiday weekend.

Time charges in accordance with Subsection 108.07.3 for seal coat work performed prior to the July 4th (Independence Day) holiday will commence on the date indicated in the Contractor's written notice.

In cases where seal coat and pavement marking application are the only remaining items of work as of August 21st, contract time will not be charged after August 20th if seal coat work is not performed. Contract time will be charged in accordance with Subsection 108.07.3, beginning on the day seal coat work begins, from August 21st through August 31st if seal coat work is performed.

Submit written notice to perform seal coat work from August 21st through August 31st.

409.02 MATERIALS

409.02.1 General

Furnish aggregate and bituminous materials that are compatible. Submit compatibility test results for each aggregate source for informational purposes. One recommended compatibility test method is MT 322.

409.02.2 Bituminous Material

Furnish material in accordance with Table 702-3.

409.02.3 Cover Aggregate

Furnish cover aggregate in accordance with Subsection 701.02.8.

The responsibility for furnishing the aggregate source is specified in the contract.

409.03 CONSTRUCTION REQUIREMENTS

409.03.1 Sampling, Testing, and Acceptance

The Project Manager will randomly select samples taken by the Contractor and witnessed by an Inspector, for gradation and fracture testing. Sample from the belt on the chip spreader, in accordance with AASHTO T 2 procedures, or at another location approved by the Project Manager.

The following acceptance tests are used:

MT 202	Gradation
MT 217	Mechanical Fracture

The quantity of material placed in 192,500 square yards (178,500 m²) is considered equivalent to a 2,500-ton (2,500 MT) lot, and the quantity of material placed in 38,500 square yards (35,700 m²) is considered equivalent to a 500-ton (500 MT) subplot for the purposes of aggregate analysis and acceptance.

The quantity represented by 5 samples is a lot when production schedules and material continuity permit. The Project Manager may establish a lot consisting of a quantity represented

by 3 to 7 consecutive random samples when there are short production runs, significant material changes, or other unusual characteristics of the work.

Surfacing aggregates are evaluated for gradation and mechanical fracture, on a lot-by-lot basis. The upper and lower limits in the gradation table, Table 701-12 are the upper and lower limits in the evaluation formulas. The specified minimum fracture values are the lower limit. Acceptance is made in accordance with Subsection 105.03.2.

409.03.2 Aggregate and Bituminous Material Application Rates

Determine the application rates for aggregate and bituminous material used to complete a test section and the project. Submit the following for informational purposes before starting full production or any time the source of aggregate or bituminous material changes:

1. Aggregate and bituminous material application rates;
2. Bituminous materials supplier's recommended ambient and pavement surface temperatures;
3. Bituminous material supplier's recommended application temperature range; and
4. Elapsed time between the application of the bituminous material and the cover aggregate.

Before starting full production or after changing sources of either aggregate or bituminous material, complete a test section at least 2,000 feet (0.6 km) long to verify the following:

1. Optimum bituminous material and aggregate application rates;
2. Time frame to complete each phase of the seal coat operation to meet the requirements for opening the roadway to traffic; and
3. Roller type, number of passes and pattern of rolling operations.

Do not begin production seal coat work until the test section has been placed and approved by the Project Manager.

409.03.3 Seal Coat Limitations

The following conditions govern seal coat work:

1. Perform seal coat operations between May 1st and August 31st.
2. Do not perform seal coat work during the 48-hour period immediately preceding a holiday or a holiday weekend except for pilot car operation in accordance with Subsection 618.03.11.
3. Perform seal coat work when both the ambient and pavement surface temperatures meet the bituminous material supplier's recommended temperatures.
4. Stop seal coat work at least ½ hour before sunset, to include equipment off of the roadway and placement of traffic control devices for non-construction activities.
5. Do not apply bituminous material to damp or wet roadway surfaces.
6. Do not apply bituminous material to plant mix pavement which has been placed, in accordance with the contract, within the previous 72 hours.

409.03.4 Protection of Traffic and Highway Structures

Provide traffic control meeting Section 618 and the approved traffic control plan. Provide highway structure protection in accordance with Subsection 410.03.9(B). Provide dust control during sweeping and brooming.

409.03.5 Surface Preparation

Do not apply bituminous material unless the roadway surface is free of all dust, dirt, and foreign material. Remove excess crack seal blotter material placed in accordance with the contract prior to seal coat operations.

409.03.6 Reserved

409.03.7 Application of Seal Coat Materials

Apply bituminous material at the rate established by the test section. Apply the bituminous material within the bituminous material supplier's recommended temperature range.

Ensure that transverse and longitudinal joints are smooth and match the adjacent surfaces. Keep meet lines to a minimum. Locate longitudinal joints at the centerline or lane line. Obtain approval from the Project Manager to construct the joint at any other location.

For requests to apply full roadway width bituminous and aggregate applications in a single, continuous operation, provide the Project Manager 2 copies of a sequencing plan that ensures the least traffic impact for approval, at least 5 business days before the planned operation.

Uniformly apply the cover aggregate on the bituminous material at the rate established by the test section. When constructing longitudinal joints, one recommended method is to cover the joint with aggregate and sweep the aggregate back before applying adjacent bituminous material. When longitudinal joints are covered to permit vehicle cross over, sweep back the cover aggregate to expose the joint before applying adjacent bituminous material.

409.03.8 Warranty

The Contractor warrants the seal coat work. If the seal coat experiences chip loss, tracking, flushing or bleeding, at any time between the date the seal coat is completed and the 1st Wednesday in December of the same calendar year, perform repairs to the seal coat, and replace pavement markings covered by the repairs at no additional cost to the Department. Areas of cover material loss determined to result from means beyond the Contractor's control (snow plow damage, tire chain damage, or others) are not considered under these warranty requirements. Final determination regarding cover material loss will be made by the Engineer. When repairs are deemed necessary, reference is made to the Department's *Seal Coat Warranty Administration Guide*. Submit a detailed repair plan to the Project Manager for approval within 14 calendar days of notification of required repairs. The repair plan must address the area of failure and transitions required to ensure a uniformly bonded, smooth surface. Make warranty repairs in accordance with the provisions of this specification when performing warranty work. Furnish traffic control meeting Section 618 requirements at no additional cost to the Department.

409.03.9 Application of Blotter Material

Monitor the finished seal coat and apply blotter material on live oil areas throughout the specified warranty period. Live oil is defined as bituminous materials that have not fully set or bonded to cover material particles. Live oil has a glossy appearance and is present in tracking, flushing and bleeding conditions. Failure to apply blotter material within 24 hours of written notification by the Project Manager will be cause for the Department to have the work performed. Costs incurred by the Department associated with application of blotter material will be deducted from subsequent progress estimates.

409.03.10 Sweeping and Brooming

Provide a roadway free of loose cover material. In curb and gutter and guardrail sections, remove and dispose of all loose cover material from the roadway and sidewalks. Do not allow material to get into the storm drain system or any aquatic resource.

Correct surface irregularities affecting the ride quality at the Contractor's expense.

- A. Initial Sweeping and Brooming.** Remove all loose cover material before terminating pilot car use, dispose of the material if required. If pavement markings are not placed within 72 hours of completion of the seal coat work, the Department may have work performed and deduct the costs from monies due to the Contractor. Traffic control

beyond these 72 hours, unless ordered by the Project Manager is at the Contractor's expense.

Apply final pavement markings as specified elsewhere in the contract.

- B. Final Sweeping and Brooming.** Perform final sweeping and brooming operations to remove excess loose material no sooner than 5 calendar days before final pavement markings.

409.04 METHOD OF MEASUREMENT

409.04.1 Bituminous Material

Bituminous material used for seal coat work is measured by the gallon (L) or by the ton (MT) in accordance with Subsection 402.04.

409.04.2 Cover Aggregate

Aggregate for "Cover - Type 1" and aggregate for "Cover - Type 2" is measured by the square yard (m²), based on the length and width of seal coat placed and accepted.

409.04.3 Fog Seal

Bituminous material used for fog seal is measured by the gallon (L) or by the ton (MT) in accordance with Subsection 402.04.

409.04.4 Traffic Control

Traffic control is measured in accordance with Subsection 618.04.

409.04.5 Rolling

Rolling is not measured for payment.

409.04.6 Sweeping and Brooming

Initial sweeping and brooming and the disposal of excess material necessary for traffic control operations as outlined in accordance with Subsection 409.03.10(A) are not measured for payment.

Final sweeping and brooming operation is measured by the course mile (CR km). A course mile (CR km) is defined as a roadway portion consisting of 2 travel lanes and adjacent shoulders or turn lanes for a 1 mile (km) length. Roadways with additional travel lanes or that require less than full width sweeping will be prorated. Traffic control from an approved plan necessary for final sweeping and brooming is measured in accordance with Section 618.

409.04.7 Water

Water used for dust control or wetting chips is not measured for payment.

409.04.8 Blotter Material

Blotter material is not measured for payment.

409.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Bituminous Material	Gallon (L) or Ton (MT)
Cover - Type 1	Square Yard (m ²)
Cover - Type 2	Square Yard (m ²)
Final Sweep and Broom	Course Mile (CR km)
Traffic Control	See Subsection 618.05

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

409.05.1 Excess Crushed Cover Aggregate

Sale of excess crushed cover aggregate is the Contractor's option. The Contractor cannot sell material from Department-owned or Department-optioned sources without a written agreement establishing and providing royalty refunds to the Department.

The Department may purchase acceptable unused crushed cover aggregate remaining in the stockpile, if the quantity exceeds 100 tons (100 MT). The conditions of purchase are described in Subsection 109.07.

Haul from the stockpile site to the site selected by the Project Manager will be by the most practical route as determined by the Project Manager. Payment for haul is 15 cents per ton-mile (0.907 MT per 1.6 km) for distances exceeding 2,000 feet (610 m).

SECTION 410

BITUMINOUS SURFACE TREATMENT

410.01 DESCRIPTION

This work is applying 1 or more coats of bituminous material on a prepared aggregate roadway surface, covering each application with aggregate surfacing material.

410.02 MATERIALS

410.02.1 Bituminous Material

Furnish the specified bituminous material in accordance with Section 702.

410.02.2 Aggregate

Furnish the specified aggregate in accordance with Section 701.

410.03 CONSTRUCTION REQUIREMENTS

410.03.1 Equipment

Maintain the following equipment on the project throughout the work.

A. Distributor. One pressure distributor for bituminous material with a minimum 1,000-gallon (3785 L) capacity insulated tank, internally heated.

Equip the distributor with a full-circulating spray bar:

1. At least 9 feet (2.8 m) long;
2. Capable of 1-foot (305 mm) incremental length adjustments up to 16 feet (4.9 m);
3. Having vertical nozzle adjustment that conforms to the roadway crown;
4. Capable of lateral shifting of the entire spray bar while operating; and
5. With vertical height adjustment capable of maintaining a preset height above the road surface.

Use spray bars and flat-slotted nozzles designed to not clog during intermittent operation and provide positive cutoff of the bituminous material. Use positive-acting flow control valves to produce a uniform, unbroken spread of bituminous material.

Remove or repair distributors not uniformly distributing the bituminous material.

Ensure the distributor has devices and charts to provide for accurate, rapid determination and quantity control of the bituminous material application.

Equip the distributor with a pressure pump, pressure gauge, thermometer well, thermometer, and a calibrated fluid content gauge.

Use pneumatic-tired distributors meeting legal load requirements.

B. Rollers. Furnish pneumatic tired rollers in accordance with Subsection 210.03.4(D).

C. Aggregate Spreader. Provide one self-propelled aggregate spreader:

1. Equipped with at least 4 pneumatic tired wheels on 2 axles;
2. Capable of uniformly spreading the material over the full width of the bituminous material; and
3. The spreader application rate being independent of motive power.

D. Cleaning Equipment. Use power brooms, blowers, or hand brooms.

E. Watering Stockpiles. Provide equipment for wetting the cover aggregate stockpiles, when required.

F. Watering Equipment. Furnish water-distributing equipment in accordance with Subsection 210.03.5.

G. Scales. Furnish scales in accordance with Subsection 301.03.2(C).

410.03.2 Existing Surface Preparation

Prepare the aggregate to receive bituminous surface treatment to the requirements and tolerances found elsewhere in the contract.

When required, apply a light, uniform water application to the roadway surface just before applying the bituminous material. Do not exceed 3% moisture by weight in the top 2 inches (50 mm) of the aggregate course.

When required, apply an aggregate treatment at the rate directed before the initial application of bituminous surface treatment. Apply the aggregate in accordance with Section 301.

410.03.3 Sweeping

Clean the roadway surface of all dust, dirt, and foreign material before applying the bituminous material.

410.03.4 Application of Bituminous Material

Apply the bituminous material with a maximum allowable variation of 0.02 gallon per square yard (0.4 L/m²) from the specified application rate.

Apply bituminous material only with the Project Manager's approval. Apply the material when the surface temperature is at or above 60 °F (16 °C).

Do not work when rain, wind, or temperatures would prevent obtaining the specified results.

Uniformly apply the bituminous material at the temperature and rate specified. Provide uniform surface cover and true lines.

Ensure high viscosity bituminous materials are covered with aggregate within 5 minutes.

Apply bituminous material to produce smooth and consistent transverse and longitudinal joints in successive applications with the adjacent completed surfaces.

Longitudinal joints may be from 6 to 10 inches (150 to 255 mm) wide but not overlap at the application ends. Prevent lapping at transverse joints by inserting a drip pan under the nozzles if necessary. Before continuing the application, spread protective sheets over the treated surface on the cover aggregate to provide bituminous coverage at the joint.

Apply the material to keep meet lines to a minimum.

The Project Manager may approve full width application of bituminous material and cover aggregate in a single, continuous operation.

Re-apply bituminous material at joints where the uncovered bituminous material has set and does not bond the aggregate at Contractor expense.

410.03.5 Application of Cover Material

When directed, water the stockpiled cover aggregate before spreading it on the bituminous material.

Cover the first bituminous material application within 60 minutes. Uniformly cover all bituminous material with cover aggregate at the specified rate. When directed, use brooms to uniformly distribute the cover aggregate. Avoid displacement or loosening of the cover aggregate.

Do not permit haul trucks and traffic to drive on any uncovered bituminous material. Furnish traffic control for fresh spread cover aggregate areas as specified in the traffic control plan.

Before applying the adjacent bituminous material, broom all joints the full width to remove loose aggregate.

410.03.6 Rolling

Roll the cover aggregate immediately after spreading within 30 minutes of spreading.

Use self-propelled pneumatic-tired rollers with a ground contact pressure of between 50 psi (345 kPa) and 95 psi (656 kPa). Provide 2 rollers for each aggregate spreader used.

Roll parallel to the centerline, starting on the low side of the lane and working towards the crown or high side. Overlap roller passes at least 6 inches (150 mm).

Continue rolling until a smooth, compacted surface is produced.

Avoid displacing or loosening the cover material while rolling.

410.03.7 Curing and Cleaning

When the rolling is completed on each surface course and the surface is accepted, it may be opened to traffic.

Allow the surface to cure for at least 5 calendar days.

Repair all surface defects in the treated surface immediately with the specified bituminous material or use a pre-mix bituminous aggregate at Contractor expense.

Cover areas of excess bituminous material with aggregate and roll at Contractor expense.

When the Project Manager determines the first course of bituminous material and cover aggregate has cured and set, all repairs have been accepted, all excess cover aggregate is removed, clean the surface of dirt, dust, and foreign materials.

Begin construction of the succeeding course on the cleaned surface.

410.03.8 Completion

When the final course is complete, open the surface to traffic for 3 days, using the specified traffic control. During this time, broom and roll the surface as required.

Repair all surface defects in accordance with Subsection 410.03.7.

Cover all areas exhibiting excess bituminous material with aggregate and roll it.

410.03.9 Protection of Traffic and Highway Structures

A. Traffic Control. Furnish traffic control meeting the contract requirements and Section 618.

B. Structure Protection. Cover exposed bridge elements, culverts, curbs, gutters, guard fences, road signs, and other roadside structures to protect them from splash or spray when applying bituminous material.

Clean these same items of all bituminous material, dirt, or other material caused by the Contractor's operations.

Repair all Contractor caused damage to the highway or structures at Contractor expense.

410.04 METHOD OF MEASUREMENT

410.04.1 Bituminous Material

Bituminous material is measured by the gallon (L) or the ton (MT) in accordance with Subsection 402.04.

410.04.2 Cover Aggregate

Cover aggregate is measured by the ton (MT) or the cubic yard (m³) measured in the vehicle at the point of delivery on the roadway, as specified in the contract and in accordance with Subsection 301.04.1.

410.04.3 Traffic Control

Traffic control is measured in accordance with Subsection 618.04.

410.04.4 Existing Surface Preparation

Where base construction is a part of the contract with bituminous surface treatment, the items of work for surface preparation are incidental to and included in payment for the base construction.

Where bituminous surface treatment is applied to an existing aggregate surface, the work for existing surface preparation is incidental to and included in payment for the bituminous surface treatment.

410.04.5 Rolling and Watering

Rolling and watering are incidental to other items of the contract and not measured for payment.

410.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Bituminous Material	Gallon (L) or Ton (MT)
Cover Aggregate	Cubic Yard (m ³) or Ton (MT)
Traffic Control	See Subsection 618.05

Surface sweeping or cleaning, watering of aggregate stockpiles and the roadway surface, repairing damaged surfaces or surfaces with excess bituminous material, and protection and repair of structures specified in accordance with Subsection 410.03.9 are incidental to and included in payment for other items of the contract.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 411

COLD MILLING

411.01 DESCRIPTION

This work is the removal of existing bituminous pavement at the locations and depth specified in the contract or designated by the Project Manager.

411.02 RESERVED

411.03 CONSTRUCTION REQUIREMENTS

411.03.1 Equipment

Use a power-operated cold milling machine equipped to control cross slope and to establish profile grade from the existing pavement or an external reference.

411.03.2 General

Do not start cold milling until the surfacing plant is fully operational.

Starting at the center of the road, begin milling on a longitudinal line parallel to the centerline with succeeding passes progressing to the outer edge of the pavement, unless approved by the Project Manager.

Remove all thin delaminated or loose layers of existing pavement left after cold milling.

Replace the milled pavement at bridge ends and cattle guards with new bituminous surfacing the same day leaving no transverse joints in the milled areas.

If new surfacing cannot be placed on the milled area the same day, transition at no less than a 50H:1V to the original surface. The completed milled surface is to be free from transverse and longitudinal irregularities exceeding ¼-inch (6 mm) when measured with a 10-foot (3 m) straightedge. Each successive pass will be pulled even with the previous and not staggered.

After cold milling, do not leave the remaining pavement exposed to traffic more than 72 hours before placing the plant mix surfacing. The 72 hour duration may be modified by the project manager depending on the durability of the milled surface.

The Contractor will be responsible to repair any damage that occurs to the roadway prior to plant mix paving. Do not proceed with paving without the approval of the Project Manager.

Replacing existing pavement is a separate operation from any succeeding overlay or lift.

411.03.3 Milling

A. Connections. Mill the existing bituminous surfacing from bridge decks, bridge approaches, cattle guards, and project connections at the locations specified in the contract or as directed by the Project Manager.

1. Bridge Decks.

- Mill the depth shown in the contract or as adjusted to meet field conditions.

2. Bridge Ends.

- Mill full depth from the bridge end out for a distance of 30 feet (10 m) prior to the milling taper.
- For milling depths less than or equal to 0.35 feet (105 mm), mill a taper distance of 200 feet (60 m).
- For milling depths greater than 0.35 feet (105 mm), mill a taper distance based on a rate of 30 feet per 0.05 feet (10 m per 15 mm) of milling depth.

3. Cattle Guards or Railroad Crossings.

- Mill full depth from the cattle guard or railroad crossing out for a distance of 15 feet (5 m) prior to the milling taper.
- Mill a taper distance of 50 feet (15 m).

4. Project Connections.

- For milling depths less than or equal to 0.35 feet (105 mm), mill a taper distance of 200 feet (60 m).
- For milling depths greater than 0.35 feet (105 mm), mill a taper distance based on a rate of 30 feet per 0.05 feet (10 m per 15 mm) of milling depth.

B. Milling at Other Designated Areas. Mill the existing pavement at the locations, widths and depths specified. The depth is measured below the existing pavement plane projected from points on un-distorted pavement near the centerline and the edge of the driving lane.

C. Cold Milling for Seal and Cover. Meet the following requirements when seal and cover goes directly on the cold mill surface:

1. Use a cold milling cutting head having maximum ¼-inch (6 mm) tooth spacing.
2. Equip the milling machine with automatic controls and sensors on both sides to maintain the specified grade and transverse slope.
3. Do not operate the milling machine in excess of 75 feet/minute (23 m/minute) unless it can be demonstrated to the Project Manager that the milled surface can meet the plant mix overlay surface tolerance specified in accordance with Subsection 401.03.23(B).
4. Do not begin placing the seal and cover until all cold millwork is complete.

411.03.4 Salvage of Pavement Millings

Salvage, haul, and stockpile the milled pavement to the specified site.

Milled pavement is the Contractor's property when specified and must be removed from the project.

411.03.5 Replacing Removed Pavement

Pave all milled areas in the contract with the specified bituminous mixture, placed to the specified depth.

Grades will be provided at 50-foot (15 m) intervals for placing the new pavement for 250 feet (75 m) from each bridge end and 100 feet (30 m) from cattle guards. Set a wire line for grade control with intermediate supports to prevent wire deflection exceeding $\frac{3}{16}$ -inch (5 mm). Stop paving if the deflection exceeds $\frac{3}{16}$ -inch (5 mm) and make appropriate corrections.

Apply a tack coat on all milled areas before paving.

411.03.6 Traffic Control

Furnish traffic control in accordance with Section 618.

411.04 METHOD OF MEASUREMENT

Cold milling is measured by the square yard (m^2) of pavement removed to the specified depth.

411.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Cold Milling	Square Yard (m^2)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

The contract unit price may be adjusted if the Project Manager issues a written order to increase or decrease the milling depth.