## SPECIFICATION 401 – HOT PLANT-MIX BITUMINOUS PAVEMENT

### 401-1 DESCRIPTION

#### 401-1.01 Scope

a. This work shall consist of constructing one or more courses of hot plant-mix bituminous pavement on a prepared foundation in accordance with these specifications, and in conformance with the lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer. Courses will be identified as base, leveling and surface.

b. The work shall also include the application of any required tack and prime coats as specified in Specifications 407 and 408 respectively.

### 401-2 MATERIALS

**401-2.01 Bituminous Materials** - The bituminous material shall be an asphalt performance graded binder PG 64-22, PG 70-16 or PG 70-22 as per AASHTO MP-1, unless otherwise specified in the contract documents. The Contractor shall submit all the physical properties data certified by an AASHTO Accredited LAB (AAP R18) on the asphalt performance graded binders indicated above. The Authority's Materials Testing Office reserve the right to take samples of the asphalt binder in any location deemed necessary to verify the quality of the product being served.

**401-2.02 Aggregates** - Aggregates, including mineral filler, shall meet the requirements of Section 703-3 of Specification 703 - Aggregates. The job-mix formula plus and minus the gradation tolerances must remain within the overall gradation requirements of section 703-3. If the job mix plus or minus the gradation tolerances exceed the Section 703-3 limits, then the Section 703-3 limit shall constitute the absolute permitted limit and, therefore, the material represented by that lot will be rejected.

**SPECIFICATION 401 – HOT PLANT-MIX BITUMINOUS PAVEMENT**

a. Reclaimed Asphalt Pavement (RAP) – The use of Reclaimed Asphalt Pavement (RAP) in the construction of hot plant-mix bituminous pavement courses (S-1, S-2, B-1, B-2, L-1 and L-2) will be allowed as a replacement material of aggregates subject to the following conditions and restrictions:

1. The contractor shall submit a new mix design for mixes containing RAP following the regular procedures established by the Materials Testing Office. The percent (%) of RAP used shall be clearly stated in the mix design and it shall contain all of the data as a regular source of aggregates.

2. All of the requirements and conditions established and all of the reference documents stated herein shall be met regardless of the use of RAP. All of the deductions and/or penalties called for in the contract documents will be applied to deficient materials or lots.

3. It shall be the contractor's responsibility to design the new mix containing RAP in accordance with the Asphalt Institute's Manual MS-2 so that it meets all of the requirements of hot-plant bituminous pavement mix indicated in the contract documents.

4. The contractor shall submit for approval of the Materials Testing Office, prior to the production of RAP, the proposed method in which he intends to incorporate it into the mix.

5. All of the sampling, testing and acceptance will be performed following the requirements indicated herein and in other contract documents.

6. The maximum percentage of RAP allowed to be incorporated in surface courses (S-1 and S-2) shall be 5% by weight of total mix.

7. The maximum percentage of RAP allowed to be incorporated in base and leveling courses (B-1, B-2, L-1 and L-2) shall be 10% by weight of total mix.

8. The Highway Authority's personnel shall have access at all times to the plant's control tower to verify the actual percentages of RAP being produced at the time. At the end of each day, the contractor shall submit a copy of the computer printouts containing the percentages of each of the materials being used or a notarized certification indicating the percentage of RAP used during that day.

9. The Highway and Transportation Authority reserves the right to prohibit immediately the use of RAP in this contract if contractor does not comply with any of the above conditions and restrictions and if the hot-plant bituminous mix with RAP does not exhibit appropriate behavior or performance in the field, as determined by the Authority. The removal and replacement of any tonnage of hot plant bituminous mix in non-compliance with all of the above shall be the contractor's responsibility and at no cost to the Authority.

**401-2.03 Hydrated Lime** - Hydrated lime shall meet the requirements of Section 712-3 of Specification 712 – Miscellaneous Materials. The Contractor shall submit certified laboratory reports on tests of the hydrated lime to be used showing its compliance with the specifications.

**401-2.04 Other Additives** – Anti-stripping agents, when required, may be liquid additives to the asphalt performed graded

binder or pulverent solids such as fly ash, hydrated lime or Portland cement added to the aggregates. The proposed additives shall be submitted to the Authority for approval prior to use.

### 401-2.05 Composition of Mixtures

a. General - The bituminous plant mix shall consist of a mixture of aggregates, asphalt performed graded binder, and anti-stripping additives, if required. The various mixes are as indicated below. The number in parenthesis refers to the applicable number of hammer blows to be used in the Marshall Test (AASHTO T 245) for each mix as called for in the contract documents. If the number of hammer blows is not specified, a value of 75 shall be used for all mixes on primary and secondary roads, and a value of 50 for municipal and tertiary roads as determined by the Authority.

1. Base Courses - B-1 (50 or 75), B-2 (50 or 75)
2. Leveling Courses - L-1 (50 or 75), L-2 (50 or 75)
3. Surface Course - S-1 (50 or 75), S-2 (50 or 75)

b. Job-Mix Formula - The Contractor shall submit in writing for the Engineer's approval, at least three weeks in advance of the date he intends to start paving operations, a job-mix formula for each type of mixture to be used in the project. Each job-mix formula shall be supported by certified laboratory test data and the design charts used. The submission shall also identify the proposed sources of the asphalt cement, aggregates and the specific additives, if any, to be used. When requested by the authority, the Contractor shall submit samples of any of the materials proposed for use in the mix for checking the mix design. The three-week lead requirement may be waived where the Contractor proposes to use a job-mix and mix components which have been previously approved by the Authority. The submittal shall show the compliance of the proposed job-mix formula with the requirements specified below.

c. Mix Requirements - Each mix shall be designed according to the Marshall Mix Design Method as described in the Asphalt Institute Manual MS-2 and shall meet the following requirements:

1. Stability as determined by AASHTO T 245 - 1200 lbs. minimum for 50 blows, 1500 lbs. minimum for 75 blows, and 3500 lbs. maximum for all mixes except that for the B-1 and L-1 mixes the maximum shall be 4500 lbs. For the purposes of this specification, the last sentence of Section 1.1 of AASHTO T 245 shall be disregarded and the Marshall Test will be applicable to all mixes (B-1, B-2, L-1, L-2, S-1, S-2) regardless of maximum aggregate size specified.

2. Flow, 0.01 inch (25 mm) as per AASHTO T 245 – 8 minimum to 16 maximum.

3. Residual stability as determined by Specification 719 - 75% minimum. If the mix fails to meet this residual stability requirement, the aggregate source shall be changed or hydrated lime, or other anti-stripping agent, shall be added to attain the 75% requirement.

4. Percent air voids in the mix as determined by AASHTO T 166, T 209 and T 269 - 3% minimum to 8% maximum for B-1 and L-1 mixes, and 3% minimum to 5% maximum for other mixes.

5. Voids in the mineral aggregate (VMA) as determined by the Asphalt Institute Method shall be as follows:

| Nominal Maximum Size Of Aggregate in Mix (inches) | Minimum Voids in Percent |
|---|---|
| 1/2 | 15 |
| 3/4 | 14 |
| 1 | 13 |
| 1 1/2 | 12 |

6. Dust-asphalt ratio, computed by dividing the percentage of material passing the 200 sieve by the percent of asphalt performed graded binder in the mix, both determined from extraction tests made on mix samples - 1.2 maximum.

7. Mixing temperature - The temperature at which the asphalt will have a viscosity of 170 +/- 20 Cs as determined from the temperature/viscosity chart for the asphalt to be used. This mixing temperature will be for laboratory use only.

8. Compacting Temperature - The temperature at which asphalt will have attained a viscosity of 280 +/- 30 Cs. This compacting temperature will be for laboratory use only.

The Authority will take, at its discretion, random samples of the mix being produced to test for compliance with the above mix requirements to assure the quality of the mix. If at any time, the results of these random tests show a failure or non-compliance to meet any requirements of the specification, the Authority reserves the right to refuse further deliveries of mixes from the plant until the deficiencies have been corrected including the submission of a new job mix formula, if required.

d. Mix Values - Each job-mix formula submitted shall propose definite values for:

1. Single percentage of aggregates passing each required sieve size.

2. Single percentage of asphalt performed graded binder to be added based on total weight of the mixture.

3. The kind and percentage of additives to be used, if any

4. The kind and percentage of mineral filler to be used, if any

5. The plant mixing temperature and the temperature at which the mixture is to be delivered at the point of placement.

6. The laboratory density of the bituminous mixture.

e. Mix Tolerances - After the job-mix formula is approved, all mixtures furnished for the project shall conform to the following ranges of allowable deviations from target values:

1. Aggregate passing the 3/4", 1/2" or 3/8"…… ± 5%

2. Aggregate passing the No. 4 sieve…….. ± 5%

3. Aggregate passing the No. 30 sieve…… ± 4%

4. Aggregate passing the No. 100 sieve…….. ± 3%

5. Aggregate passing the No. 200 sieve…….. ± 2%

6. Amount of performance graded binder……... $\pm$ 0.4%

7. Mixing Temperature…… $\pm$ 20$^{o}$ F

f. Mix Changes - Should a change in sources of materials occur or be proposed, or should a job-mix formula prove unsatisfactory as determined by the Engineer, a new job-mix formula shall be developed and submitted by the Contractor for approval prior to production and use. Acceptance of any tonnage of bituminous mix produced under an approved job mix is subject to appropriate behavior of the mix in the field as determined by the Authority. Failure of the approved mix to exhibit appropriate behavior in the field will be cause for its rejection.

**401-2.06 Sampling and Testing**

a. All sampling and testing will be performed by the Authority, except as noted below. Samples will remain in the custody of the Authority at all times. The Contractor or his authorized representative may be present, if so desired, when these sampling and testing operations are being performed. All testing will be done at a laboratory of the Authority. However, the Authority may, at its discretion, perform the testing at the producer's plant laboratory provided it meets the requirements specified in paragraph 401-2.06c below to the satisfaction of the Authority's Materials Testing Office.

b. The Contractor shall provide the following sampling and testing equipment and their operators:

1. Coring machine and personnel at the project site to take full depth 4" diameter cores from the in-place bituminous pavement as required for testing and acceptance.

2. Scoops, insulated working gloves, plain kraft paper, string or tape for the taking, packaging and transporting of samples of the mix taken at the plant for testing by the Authority at its laboratory.

3. A nuclear density meter, capable of measuring the density of compacted bituminous mixes and of limiting the depth of reading to the required layer thickness, an operator to use it, included in the Authority's Materials Testing Office certified list by the type of meter to be used. The meter shall be calibrated at least once a year by a licensed firm and copies of these calibration certificates shall be submitted to the Engineer and to the Materials Testing Office. This nuclear density meter will be used to check the density of the in-place compacted bituminous concrete when paving operations are in progress, to guide the Contractor on the adequacy of his compaction efforts. In accordance with the calibration certificate, the nuclear density reading time shall be at least 1.00 minute. The Authority reserves the right to verify the calibration of any of the nuclear gages used by the Contractor using the calibration blocks property of the Authority. Nuclear gages which fail such calibration and are not in compliance with ASTM D-2922 and ASTM D-2905 shall not be used in the project. All of the above shall be considered subsidiary obligation.

c. The Contractor shall provide at the mixing plant, for quality control, a laboratory and all the equipment, tools, supplies and other apparatus required for sampling the mix, preparing specimens and testing for compliance of the mix being produced and its components with all the requirements specified in Article 401-2.05.

1. The equipment listed below shall be provided as a minimum at the plant laboratory. This equipment

shall comply with the requirements of the AASHTO or ASTM specification indicated, or be equal or similar to the specific equipment indicated.

(a) Automatic Bituminous Compactor - ASTM D 1559
(b) Specimen Ejector – ASTM D 1559
(c) Asphalt Centrifuge Extractor with Filter Disks- AASHTO T 164, modified for the use of biodegradable solvents (terpene)
(d) Oven (392 degrees F) - Soiltest L-5B
(e) Compaction Molds (4 inches) - ASTM D 1559
(f) Paper Disks for Compaction Molds - ASTM D 1559
(g) Water Bath - ASTM D-1559, at its discretion the Authority may require the bath to be enclosed in an approved cage with padlock.
(h) Marshall Test Set - AASHTO T 245
(i) Asphalt Flow Indicator - ASTM D 1559
(j) Triple Beam Scale (with clamp and rod support for specific gravity weighing) - AASHTO M 231
(k) 12 inch Standard Sieve Set (2 inch to #200) - ASTM E 11
(l) Wet Sieve Set - ASTM E 11
(m) Six Stainless Steel Pans – 20” X 12” X 4” deep
(n) Six Stainless Steel Mixing Bowls -5 qts.
(o) Round Mouth Scoop
(p) Laboratory Tongs
(q) Heat Resistant Gloves
(r) Trowel
(s) Spatulas (10” L X 1 1/4” W)
(t) Calipers

(u) Laboratory Thermometers (temp. range 0 - 200 degrees F) - Soiltest G-171.or G-178
(v) Armored Thermometer (temp. range 0-500 degrees F) - Soiltest G-185 or G-191
(w) Aprons
(x) Biodegradable solvents for asphalt (terpene) - AASHTO T 164

2. The plant laboratory testing equipment shall be calibrated and certified at least once a year by an independent laboratory qualified to perform such calibration.

3. The plant laboratory shall be available to the Authority, upon request, to perform such tests on the mix being prepared, or being delivered to the project, as may be considered necessary by the Engineer.

d. The Authority will take, at its discretion, random samples of the asphalt performed graded binder and the aggregates at the plant, prior to and during mix production, to test for the compliance of these materials with their specifications requirements. If at any time the results of these random tests show a failure of the asphalt performed graded binder or the aggregates to meet the requirements of the specification, the Authority reserves the right to refuse further deliveries of mixes from the plant until the deficiencies have been corrected including the submission of a new job-mix formula, if required.

e. Samples of the mix material being produced for delivery to the project will be taken by the Engineer at the plant for testing by the Authority for compliance with the aggregates grading and asphalt content and, at its discretion other specification requirements. The control unit for sampling, testing and acceptance purposes will be a lot which is defined as 300 tons of bituminous mix or fraction thereof. At the discretion of the Materials Testing Office, if at the end

of the production there are still 90 tons or less not included in any lot, said material could be added to the last lot. Samples will consist of 3 specimens of at least 2000 grams each taken at random from each lot. The Authority may, at its discretion, take samples of the mix being delivered to the project site for testing.

1. The specimens will be taken from the delivery trucks and wrapped in kraft paper for delivery to the Authority's laboratory, as soon as possible, for testing by Authority personnel.

2. Extraction tests will be performed on one of these specimens, selected at random, to determine aggregate sizes, percentage of asphalt in the mix and at the discretion of the Authority, the viscosity of the recovered asphalt. Testing for percentage of aggregate passing the No. 200 sieve will be at the discretion of the Authority.

3. If the tested specimen meets all requirements of the specification, the other two specimens will be disposed of without testing.

4. If the tested specimen fails in any of the specification requirements, the other two samples will be tested and the average results of all three specimens of the lot will be used for comparing with the specification requirements for acceptance purposes.

f. Ten (10) nuclear density readings will be taken at random locations for each 300-ton lot, or fraction thereof, of bituminous mix placed and compacted for testing for compliance with the density requirements. The Contractor's nuclear gage operator and the inspector will witness the nuclear gage readings and report and certify their veracity by

signing the appropriate forms provided by the Authority for such purposes. This lot will not necessarily coincide with the 300-ton specified in paragraph "e" above. In addition, a core will be taken by the contractor under Authority's supervision at one of the nuclear density reading location selected at random. The Materials Testing Office, at its discretion, will inspect the density readings taken at the field.

1. The core shall be 4" in diameter and extend for the full depth of the pavement layer being tested. It shall not be taken until at least 72 hours have elapsed since placing the mix but not later than 144 hours after placing. At his risk, the Contractor may elect to take cores prior to the minimum 72 hours period established. The Authority will not accept extracted core samples that do not meet the above requirements.

2. The computed density of the core will be compared with the nuclear density meter reading for verification purposes.

3. The other nuclear readings will be corrected as required and an average of all the corrected readings will be computed. This average will be used to compare the density of the lot being tested with the laboratory density. At its discretion and after a statistical analysis of the veracity of the nuclear meter and operator the Authority may wave the testing of the core and base acceptance of the lot solely upon nuclear readings.

g. Leveling courses of less than 3.8 centimeters thickness will be exempt from coring and nuclear density testing.

## SPECIFICATION 401 – HOT PLANT-MIX BITUMINOUS PAVEMENT

### 401-2.07 Basis of Acceptance

a. The acceptability of the quality of the hot plant-mix bituminous pavement will be based on the results of the sampling and testing performed as called for in Article 401-2.06 above as compared to the mix requirements for aggregates, asphalt content and compacted density specified in Article 401-2.05 and the tolerances and conditions provided in subsequent paragraphs herein.

b. Asphalt Content - Mixes with asphalt performance graded binder content exceeding the specified tolerance of +/- 0.4% will be rejected. However, at the discretion of the Authority, mixes within +/- 0.52% of the approved job-mix formula asphalt performance graded binder content may be accepted but subject to payment at a reduced unit price as specified in Articles 401-5.01 and 401-5.02. Mixes with asphalt content deviating in excess of +/- 0.52% of the specified asphalt will be rejected and shall be removed from the project at the Contractor's expense and replaced with a suitable mix. However, the Contractor may propose corrective measures to be made at his expense for consideration by the Authority. If these are accepted by the Authority the mix may remain in place subject to such price reductions as may be determined by the Authority but not to exceed 90%. If the corrective measures are not accepted, the deficient mix shall be removed at the Contractor's expense and replaced with acceptable mix.

c. Aggregate Grading - Mixes with aggregates grading exceeding the range of allowable deviations from the job-mix formula specified in paragraph "e" of Article 401-2.05 will be rejected. However, at the discretion of the Authority, mixes with aggregate within the ranges of deviation indicated below may be accepted but subject to payment at a reduced unit price as specified in Articles 401-5.01 and 401-5.02. Mixes exceeding these deviations will be rejected and shall be removed from the project at the Contractor's expense and

replaced with suitable mix. The job-mix formula plus or minus the gradation tolerances must remain within the overall gradation requirements of section 703-3. If the job mix plus or minus the gradation tolerances exceed the Section 703-3 limits, then the Section 703-3 limits shall constitute the absolute permitted limit and, therefore, the material represented by that lot will be rejected (see exception to the above in note 1 below). However, the Contractor may propose corrective measures to be made at his expense for consideration by the Authority. If these are accepted by the Authority, the mix may remain in place but subject to such price reductions as may be determined by the Authority but not to exceed the maximum values specified in paragraph 401-5.02b. If the corrective measures are not accepted, the deficient mix shall be removed at the Contractor's expense and replaced with acceptable mix.

| Aggregate Passing | Deviation from Target Value |
|---|---|
| 3/4" Sieve | +/- 7.0% (B-1 7 L-1) |
| 1/2" Sieve | +/- 7.0% (S-2) |
| 3/8" Sieve | +/- 7.0% (B-2, L-2 & S-1) |
| No. 4 Sieve | +/- 7.0 % (All mixes) |
| No. 30 Sieve | +/- 6.0 % (All mixes) |
| No. 100 Sieve | +/- 3.8 % (All mixes) |

Note 1:Exception is made with the No. 100 sieve in which an additional 2.5% below the overall limit indicated in table 703-3 will be considered acceptable.

d. When it is determined from the test results that the in place mix has such deficiencies in asphalt content and/or aggregate grading that it should be removed, the Authority may at its discretion, when so requested by the Contractor, evaluate the mix to determine whether it may allow it to remain in place but at reduced payment to be established by the Authority, which deduction will be at least 50 percent of the contract unit price.

e. Mix Density - The compacted bituminous mix shall have a density of at least 97% of the laboratory density for the specified job-mix. Compacted mixes that fail to attain this 97% value but have at least 92% of the density will be accepted, if otherwise acceptable, but subject to a reduced payment as specified in Article 401-5.02. Compacted mixes with less than 92% of the laboratory density will be rejected and shall be removed from the project at the Contractor's expense and replaced. However, the Authority may, at its discretion, allow such failing mixes to remain in place but at a payment of only 50 percent of the contract unit price.

f. Intentionally omitted

g. Thickness - Acceptance for thickness will be as provided in Article 401-3.14.

h. Retesting - When an in-place mix is accepted subject to reduced payment or is rejected and ordered removed under the above provisions, the Contractor may request retesting of the rejected lot. Such request must be made in writing within 30 days of notification by the Authority of the mix deficiencies. All of the retesting described above will be performed by the Materials Testing Office. Such retesting will be conducted as follows:

1. Three squares of the full depth of the pavement layer and weighing approximately 4,000 grams will be saw cut or core out by the Contractor, at his expense, under the supervision of the Engineer for each 300 ton lot being retested.

2. Extraction tests will be performed by the Authority on each specimen to determine the asphalt content and the aggregate grading. These values will supersede and replace the values previously obtained

for the initial specimens taken under the provisions of paragraph d of Article 401-2.06.

3. The average of the results of the three new specimens will be compared with approved job-mix values for acceptance purposes under the requirements of paragraphs b and c of this Article 401-2.07.

4. Retesting for compliance with the density requirements will be performed by repeating the nuclear testing and core extraction, at the Contractor's expense, described in Article 401-2.06f at ten new locations selected at random. These values will supersede and replace the initial readings. The average of the new readings, corrected as may be necessary, will be compared with the laboratory density for acceptance purposes under the provisions of Article 401-2.07e. At the discretion of the Authority, if a retesting layer of an approved mix is already below the final surface course, the contractor shall drill a core through both surfaces and remove the material from the surface course. In said case the original 10 nuclear readings will be used for acceptance purposes. The retesting will be performed by personnel from the Materials Testing Office. The Authority reserves the rights of taking the core extraction. If no core extraction is taken, the average of the 10 nuclear readings will be the retesting density.

i. The results of the retesting made under paragraph "h" above will be considered final for acceptance purposes and no further retesting will be performed.

**401-2.08 Sampling Repairs** - The Contractor shall, at his expense, refill all core holes and other sampling cuts in the pavement courses which are accepted with mix of the appropriate type, placed and compacted to the satisfaction of the Engineer. On roadways

open to traffic, the repairs shall be made on the same day the cuts and cores are taken.

## 401-3 CONSTRUCTION REQUIREMENTS

**401-3.01 Bituminous Mixing Plant** - Plants used for the preparation of bituminous mixes shall conform to AASHTO M 156 modified and supplemented as follows:

a. For verification of weights and measures, character of materials and determination of temperatures used in the preparation of the paving mix, the Engineer, or his authorized representative, shall have access, at all times, to all portions of the mixing plant, aggregates plant, storage yards, and other facilities for producing and processing the mix materials.

b. Scales shall be inspected and sealed as often as the Engineer may deem necessary, but not less than once a year, to assure their continued accuracy, by the Division of Weights and Measures of the Commonwealth Department of Commerce. Any cost involved in the inspection and sealing of the scales shall be at the Contractor's expense.

c. All projects involving 2,000 Tons or more of bituminous mixture shall be served by a plant having automatic controls which coordinate the proportioning, timing and discharge of the mixture.

d. All plants shall have silos and shall be equipped with air pollution control devices which meet the requirements of the Environmental Quality Board.

e. The completed bituminous mixture may be weighed on approved scales furnished by the Contractor at his expense. The scales shall be inspected and calibrated at least once a year by an independent entity.

f. As specified in Article 401-2.06c, the plant shall have a laboratory adequately equipped and staffed to perform AASHTO T 245 and all other testing required for quality control. The producer's laboratory technician shall be present during periods of mix production. The producer's technician may participate in the testing under the supervision of Authority's personnel. If he participates, the producer's technician will sign the appropriate test reports along side the Authority's representative. Refusal to sign on part of the producer's technician will disqualify him from participating in the testing and sampling procedures and may only be present as an observer.

**401-3.02 Hauling Equipment** - Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds which have been thinly coated with a minimum amount of paraffin oil, lime solution or other approved material to prevent the mixture from adhering to the beds. No gas oil or diesel fuel will be allowed for preventing the mixture adhering to the truck bed. Each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture and for use during hauling operations. No truck will be allowed to leave the plant without covering the mix with the cover of canvas.

**401-3.03 Delivery Trucks** - Before unloading at the site of the work the bituminous mix supplier shall furnish to the Engineer a delivery tickets containing the following information concerning the bituminous mix in the truck:

a. Name of bituminous mixing plant
b. Serial number of ticket
c. Date, time and truck number
d. Name of Contractor
e. Specific designation of job (name, number and location)
f. Type of mix
g. Weight of mix in the truck

h. Space for signature of Authority's inspector at the paving site and at the scales

i. Temperature of the asphalt mix measured at the plant.

j. Temperature of the asphalt mix measured at the site

**401-3.04 Bituminous Pavers**

a. Bituminous pavers shall be self-contained, power-propelled units with a vibrating or tamper screed and strike-off assembly covering the full laydown width, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material which will meet the specified typical section, thickness, smoothness, and grade. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant mix material in the widths shown on the plans.

b. The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. The screed and strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

c. The paver shall be capable of operating at forward speeds consistent with satisfactory laying of the mixture.

d. The paver shall be equipped with a grade and slope control system capable of automatically maintaining the screed elevation as specified herein. The control system shall be automatically actuated from either a reference line or surface through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. When directed, the transverse slope control system shall be made

inoperative and the screed shall be controlled by sensor directed automatic mechanisms which will independently control the elevation of each end of the screed from the reference lines or surfaces. The controls shall work in conjunction with any of the following attachments:

1. Ski-type device, floating beam of not less than 30 feet (9.14 m) in length or as directed by the Engineer.

2. Short ski or shoe to match adjoining lanes either fresh or old.

3. Taut string line wire set by the Contractor to the specified grade.

e. The Contractor shall furnish the long ski and the short ski or shoe, or furnish and install all required stakes and wire for a taut string line. Should the automatic control system become inoperative during the days work, the Contractor will be permitted to finish the day's paving work using manual controls. However, work shall not be resumed thereafter until the automatic control system has been made operative.

f. The Contractor may be exempt from the use of the automatic control system at locations where the Engineer determines that pavement geometry or widths makes its use impracticable.

**401-3.05 Rollers** - Rollers may be of the vibratory or tandem steel wheel type. Pneumatic-tired rollers may be used in conjunction with either of the steel wheel types. Rollers shall be in good condition, be capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density without

detrimentally affecting the compacted material. For leveling courses, at least one pneumatic tire roller shall be used.

**401-3.06 Weather Limitations** - Bituminous plant mix shall not be placed on any wet surface or when weather conditions prevent the proper handling or finishing of the bituminous mixture.

**401-3.07 Preparation of Surface to be Paved**

a. The surface to be paved shall be true to line and grade, dry and free from loose or deleterious material immediately before the placing of bituminous mixture. If necessary, the surface shall be cleaned by brooming or other approved means.

b. When the surface of an existing pavement or old base to be paved is irregular, it shall be brought to uniform grade and cross section by a leveling course as directed, which shall be compacted to the satisfaction of the Engineer before placing subsequent paving courses.

c. When a leveling course is not required, all depressions and other irregularities shall be patched or corrected in a manner satisfactory to the Engineer. All fatty and unsuitable patches, excess crack or joint filler, and all surplus bituminous material, shall be removed from the area to be paved. Blotting of excessive deposits of asphalt with sand or stone will not be permitted.

d. Where the area to be paved is an untreated soil or aggregate, it shall be compacted to the required density and then primed in accordance with the provisions of Specification 408 - Bituminous Prime Coat. The prime coat shall be allowed to cure properly in accordance with the provisions of Specification 408 before any further operations are permitted on the primed area. No prime coat will be

required for single bituminous mix course 7.5 cm. or more in compacted thickness.

e. Before spreading the mixture upon a portland cement concrete surface or a bituminous surface older than 3 months or excessively dirty, a tack coat in accordance with the provisions of Specification 407 - Bituminous Tack Coat shall be applied. No tack is required on bituminous surfaces which are less than 3 months old if they can be cleaned to the satisfaction of the Engineer.

f. Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a thin, uniform coating of bituminous material as specified for the tack coat prior to the bituminous mixture being placed against them.

**401-3.08 Preparation of Bituminous Material** - The bituminous material shall be heated to the temperature specified in Table 702-1 of Specification 702 - Bituminous Materials. The bituminous material shall be heated in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. Asphalt cement shall not be used while it is foaming nor shall it be heated above 350 degrees F at any time after delivery to the plant.

**401-3.09 Mixing**

a. The aggregates shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula. The materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured.

b. No mix will be allowed to leave the plant with a temperature lower or higher than the +/- 20 degrees F of the production temperature indicated in the job mix. Failure to comply with the above requirement will be cause for rejection of the mix contained in the truck.

c. All mixes shall be delivered at the paving site at a temperature of no less than 225 degrees F.

**401-3.10 Transporting, Spreading and Finishing**

a. The mixture shall be transported from the mixing plant to the paving site in vehicles conforming to the requirements of Article 401-3.02. The required protective cover shall be placed over the mix prior to departing the plant and retained in place until the mix is delivered. Failure to comply with the above requirement will be cause for rejection of the mix contained in the truck.

b. The bituminous mixture shall be laid upon an approved clean surface, spread and struck off to the established grade and elevation. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

c. The longitudinal joint in one layer shall be offset from that in the layer immediately below by approximately 15 centimeters; however, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises two lanes of width, or at lane lines if the roadway is more than two lanes in width, unless otherwise directed. Failure of the Contractor to observe the above dispositions and the placement of the longitudinal joint at the wheel path will allow the Authority to reject the mix or to accept the same at a 50% reduction in price.

d. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture may be spread and finished by hand tools. For such areas the mixture shall be dumped, spread and screeded to provide the required section and compacted thickness. The Contractor shall provide suitable heating equipment for keeping hand tools free from asphalt. The temperature of the tools when used shall not be greater than the temperature of the mix placed. Only heat shall be used for cleaning hand tools. The use of petroleum oils, diesel fuels or volatiles will not be permitted.

e. The mixtures shall be placed in layers as indicated on the plans. No single layer shall exceed 10 cm. (4”) in compacted thickness.

**401-3.11 Compaction**

a. Immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in workable condition. The sequence of rolling operations and the selection of roller types shall be such as to provide the required pavement density of at least 97% of the laboratory density. However, the use of pneumatic tire rollers is mandatory for compacting L-1 and L-2 leveling courses.

b. Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, gradually progressing to the crown of the road. Trip overlaps of the roller shall not exceed 6 inches (15 cm.). When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the

regular rolling procedure. On super-elevated curves the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.

c. Rollers shall move at a slow but uniform speed with the drive roll or wheels nearest the paver except when rolling an incline, then the procedure is reversed.

d. Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material.

e. Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers. On depressed areas, a trench or small vibratory roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

f. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous mix material shall be corrected to the satisfaction of the Engineer.

**401-3.12 Joints, Trimming Edges and Cleanup**

a. Placing of the bituminous mix shall be as continuous as possible. Rollers shall not pass over the unprotected end of

a freshly laid mixture unless authorized by the Engineer. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. When directed by the Engineer, a brush coat of bituminous material of the type being used in the mix shall be used on the contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

b. At the beginning or end of a project connecting to an existing pavement the feathering of the new surface course to match the existing grade of the old pavement will not be permitted. To transition and match the grades, the old pavement shall be undercut to a depth equal to the compacted depth of the new surface course being connected to it. This work shall be a subsidiary obligation of the Contractor under the new pavement pay items.

c. Material trimmed from the edges and any other discarded bituminous mixture shall be removed from the roadway and disposed of by the Contractor outside the project limits or in an approved area out of sight from the road.

**401-3.13 Surface Requirements**

a. The Contractor shall provide a 3-meter (10-foot) rolling straight edge, to be operated by the Engineer, that automatically marks, in colored dye, the length of surface variations which exceed a tolerance of 0.5 centimeter (3/16 inch) in 3 meters (10 feet) for testing the top surface of mainline pavements in a longitudinal direction, or a similar instrument, acceptable to the Authority, that will identify surface variations. In addition, the Contractor shall provide a 3-meter portable aluminum straightedge for testing mainline surfaces transversely and for testing base course surfaces, ramps, frontage roads and other miscellaneous surfaces.

b. The surfaces of new aggregate and bituminous base courses will be tested with a 3-meter straightedge. Any depressions in excess of 1.25 cm. (1/2") shall be corrected with leveling or surface course material.

c. Each lane of new surface course placed on mainline pavement and over a base course of uniform thickness will be tested longitudinally, approximately along the lane wheel path, with the rolling straightedge to determine the length of surface variations which exceeds the permissible tolerance of 0.5 centimeter in 3 meters. The percent of defective length in the total lane measured length will be computed.

d. The top surface course of mainline pavement will be accepted as is when the percentage of defective length does not exceed 4.0% in any 300-meter sections selected by the Engineer. When the percentage of deficient surface length in a lane in such sections exceeds 4.0%, the deficient sections shall be removed or shall be corrected to the satisfaction of the Engineer at the Contractor's expense.

e. The top surface of ramps, frontage roads, and miscellaneous travel ways other than the main line lanes may be tested by the Engineer at random locations using the rolling straightedge or the portable 3-meter straightedge to check for conformance with the 0.5 centimeters surface variation tolerance.

f. During placement of the surface course, random control testing will be performed with the 3-meter straightedge to ascertain the capability of the paving equipment and operations to meet the surface requirements.

**401-3.14 Testing Pavement Thickness**

a. The cores taken to determine the in-place density shall be used to determine the pavement thickness.

b. For surface courses no core shall be deficient by more than 0.6 cm. and the average of all cores must be not less than the thickness specified in the plans.

c. Base courses shall be checked in the same manner as for surface course in paragraph "a" above, except that the tolerance shall be 1.2 cm. for thicknesses in excess of 10 cm.

d. In addition, if the average total thickness for each course exceeds the plan thickness by more than 15%, the excess tonnage equivalent to the excess in average thickness over 115% of plan thickness will not be compensated.

e. Material which is used for a leveling course will not be considered in pavement thickness determinations.

**401-3.15 Protection of Pavement** - Sections of newly finished work shall be protected from traffic of any kind until the mixture has become properly hardened by cooling. In no case will traffic be permitted less than 6 hours after completion of the pavement unless a shorter period is authorized or directed by the Engineer in emergencies or in reconstruction work.

## 401-4 METHOD OF MEASUREMENT

**401-4.01** Plant-mix bituminous pavement courses will be measured by the ton of compacted mixture placed in the accepted work, as called for in the contract documents. Measurement will be by weighing the delivery trucks at approved scales. Batch weights will not be accepted as a method of measurement.

**401-4.02** Any excess tonnage due to excess thickness, determined as provided in Article 401-3.14d, will be deducted from the measurement for payment.

**401-4.03** Due to possible variations in the specific gravity of the aggregates, the tonnage used may vary from the contract

quantities and no adjustment in the contract unit price will be made because of such variation.

**401-4.04** Work prescribed under Article 401-3.07, Preparation of Surface to be Paved, except for the leveling course and mix material used for patching and correcting irregularities in old surfaces, will not be measured directly for payment, but will be considered as a subsidiary obligation of the Contractor under the various items of hot plant-mix bituminous pavement. Hot plant-mix material used for patching and leveling in this work will be measured for payment under the respective unit prices.

## 401-5 BASIS OF PAYMENT

**401-5.01** The completed and accepted quantities of each class of hot plant mix pavement, measured as provided above, will be paid for at the contract unit price per unit of measurement except as specified in Article 401-5.02 below. Such prices and payment shall constitute full compensation for the cost of preparation of the surface to be paved; the furnishing and placing of any required prime or tack coat; and the furnishing, placing, compacting and finishing of all required materials for the pavement; and for all labor, equipment, tools and incidentals necessary to complete each item of work as required by the plans and specifications.

**401-5.02** Pavement found to be deficient as to asphalt content, aggregate gradation or compacted density but allowed to remain in place under the provisions of Article 401-2.07 will be paid for at a reduced unit price as follows:

a. For asphalt content:

| Deviation in Asphalt Content From Design Value | Percent Reduction in Unit Price |
|---|---|
| +/- 0.4 % | 0 |
| +/- 0.41 % to 0.44 % | 3 |
| +/- 0.45 % to 0.48 % | 6 |

| | |
|---|---|
| +/- 0.48 % to 0.52 % | 10 |
| Over +/- 0.52 % | See Arts. 2.07b and d |

b. For aggregate grading:

| Sieve Size | Deviation in % Passing From Design Value | Percent Reduction In Unit Price |
|---|---|---|
| 3/4" (B-1, L-1) | +/- 5.0 | 0 |
| Or | +/- 5.1 to 5.5 | 2 |
| 3/8" (B-2, L-2, | +/- 5.6 to 6.0 | 4 |
| & S-1) | +/- 6.1 to 6.5 | 7 |
| Or | +/- 6.6 to 7.0 | 10 |
| 1/2" (S-2) | Over 7.0 | See Arts. 2.07 c and d |
| No. 4 | +/- 5.0 | 0 |
| | +/- 5.1 to 5.5 | 2 |
| | +/- 5.6 to 6.0 | 4 |
| | +/- 6.1 to 6.5 | 7 |
| | +/- 6.6 to 7.0 | 10 |
| | Over 7.0 | See Arts. 2.07 c and d |
| No. 30 | +/- 4.0 | 0 |
| | +/- 4.1 to 4.5 | 2 |
| | +/- 4.6 to 5.0 | 4 |
| | +/- 5.1 to 5.5 | 7 |
| | +/- 5.6 to 6.0 | 10 |
| | Over 6.0 | See Arts. 2.07 c and d |
| No. 100 | +/- 3.0 | 0 |
| | +/- 3.1 to 3.3 | 3 |
| | +/- 3.4 to 3.6 | 6 |
| | +/- 3.7 to 3.8 | 10 |
| | Over 3.8 | See Arts. 2.07 c and d |

Where the aggregate is deficient in more than one sieve, the reductions in unit price for aggregate failure

will be applied on the basis of the largest deduction only.

c. For in place density:

| Percent of Laboratory Density Attained | Percent Reduction In Unit Price |
|---|---|
| 97 and over | 0 |
| 96.0 to 96.9 | 3 |
| 95.0 to 95.9 | 6 |
| 94.0 to 94.9 | 9 |
| 93.0 to 93.9 | 12 |
| 92.0 to 92.9 | 15 |
| Less than 92 | See Art. 2.07 e |

d. The total percentage deduction in unit price for deficiencies will be determined by adding the percentage reduction due to deficiency in asphalt content, if any, to the highest percentage reduction due to deficiencies in aggregate grading in any of the sieve sizes, and to the percentage reduction due to density deficiencies. However, the total percentage deduction to be applied for these three combined causes shall not exceed 25%. Such reduction will be in addition to any reduction in payment for excess tonnage in pavement thickness provided under Article 401-3.14.

**401-5.03** Payment will be made under:

| Pay Item | Pay Unit |
|---|---|
| Hot Plant-Mix Bituminous Pavement Mix S-1 (50 or 75)*…. | Ton |
| Hot Plant-Mix Bituminous Pavement Mix S-2 (50 or 75)*…. | Ton |
| Hot Plant-Mix Bituminous Pavement Mix L-1 (50 or 75)*…. | Ton |
| Hot Plant-Mix Bituminous Pavement Mix L-2 (50 or 75)*…. | Ton |

**SPECIFICATION 401 – HOT PLANT-MIX BITUMINOUS PAVEMENT**

| Pay Item | Pay Unit |
|---|---|
| Hot Plant-Mix Bituminous Pavement Mix B-1 (50 or 75)*…. | Ton |
| Hot Plant-Mix Bituminous Pavement Mix B-2 (50 or 75)*…. | Ton |

* Indicate the number of applicable hammer blows (AASHTO T 245)

## SPECIFICATION 402–REHABILITATION OF BITUMINOUS CONCRETE PAVEMENT

### 402-1 DESCRIPTION

**402-1.01 Scope** - This work shall consist of the rehabilitation of existing bituminous concrete pavement to correct undesirable conditions such as rutting, bleeding, cracking, rough surfaces and lack of stability. The work shall be performed at the locations shown on the plans or indicated by the Engineer, in accordance with these specifications, and in conformity with the lines, grades, cross sections and details shown on the plans or established by the Engineer.

### 402-2 MATERIALS

**402-2.01** Replacement material for subgrade or subbase shall meet the requirements of Specification 301 - Subbase Course.

**402-2.02** Replacement material for aggregate base course shall meet the requirements of Specification 304 - Aggregate Base Course.

**402-2.03** Bituminous plant mix material shall meet the applicable requirements of Specification 401 - Hot Plant-Mix Bituminous Pavement for the specific mixes called for in the plans or ordered by the Engineer.

**402-2.04** The bituminous material for prime and tack coats shall meet the requirements of Specifications 407 and 408 respectively.

### 402-3 CONSTRUCTION REQUIREMENTS

#### 402-3.01 General

a. The construction work will include any one or more of the rehabilitation operations described herein at the locations shown on the plans or indicated by the Engineer.

b. Test cores, 4 inches in diameter, will be drilled by the Contractor at the locations selected by and under the

supervision of the Engineer to ascertain the depth and condition of the existing bituminous concrete pavement. The cores shall be identified as to location and date taken, and delivered to the Engineer for evaluation. When so ordered by the Engineer, the test core shall be extended through the existing aggregate base and subbase courses, and the subgrade material, to an additional depth not exceeding 60 centimeters, to ascertain the condition of these materials. If feasible, these core extensions may be drilled using a hand auger.

c. Test pits into the aggregate base, subbase and subgrade will be excavated at the locations selected by and under the supervision of the Engineer to ascertain the condition of the in place materials. The test pits shall be approximately 45 centimeters by 45 centimeters in area and extend to a depth not exceeding 60 centimeters below the bottom of the bituminous concrete pavement courses.

d. Rollers

1. Pneumatic and steel wheeled rollers shall have a minimum operating weight of 8 tons.

2. Vibrating rollers shall have a minimum operating weight of 2.25 tons, a frequency of 3300 vibrations per minute, an amplitude of 0.022 inches, and a centrifugal force per drum of 4600 pounds.

e. The work shall be performed in a manner that causes a minimum of inconvenience to public traffic and in conformance with all maintenance and protection of traffic requirements as provided in the General Provisions, in Specification 638 and on the plans.

**402-3.02 Construction Sequence** - The rehabilitation operations shall be conducted one lane at a time. Unless otherwise

specified or ordered by the Engineer, the operations shall be performed in the following sequence:

a. Measurement as required of the existing cross sections and cross slopes under the provisions of Specification 150 - Survey and Stakeout.

b. Drilling of test cores in the existing pavement when required.

c. Repair of pavement areas where full depth removal of the existing pavement and possible removal and replacement of base, subbase and subgrade material is required. This includes the removal of the existing pavement within the limits specified or ordered by the Engineer, the investigation of the condition of the existing base, subbase and subgrade including the excavation of such test pits as may be ordered by the Engineer, and the removal and replacement of such base, subbase and subgrade material as may be specified or ordered by the Engineer.

d. Initial adjustment of existing manholes, inlets, valve boxes, junction boxes, pull boxes and miscellaneous structures as required to perform cold milling operations.

e. Partial depth removal of existing bituminous concrete pavement by the cold milling process, under the provisions of Specification 403, when required in the rehabilitation process of rutted, bleeding, unstable and other deficient pavement sections.

f. The following construction items, when included, shall be performed after milling operations and the placing of the leveling course have been completed:

1. Longitudinal slotted pipe drains.

2. Concrete barriers abutting on the pavement being milled.

3. Placing of frames and covers on grates of any manholes, inlets or similar structures which will abut or be located within the pavement.

## 402-3.03 Removal of Existing Pavement

a. All required partial depth removal of existing bituminous concrete pavement shall be performed and paid for by the cold milling process under Specification 403 except where otherwise specifically authorized in the contract documents, or by the Engineer, because of physical or geometric restraints that preclude the use of the milling equipment.

b. Where either full depth removal of bituminous pavement is required or partial depth removal by other than cold milling is authorized, the edges of each area to be removed shall be saw cut to a depth of at least 5 centimeters. The bituminous material may then be removed by any method selected by the Contractor provided that the adjacent and underlying materials to remain are not disturbed or damaged in any way by the removal procedure. Any such damage shall be repaired by the Contractor, at his expense, in a manner approved by the Engineer.

## 402-3.04 Rehabilitation of Rutted Pavements

a. The rehabilitation of rutted pavements shall be performed at the locations and by the procedure indicated on the plans which may be either one of the following:

1. Partial removal of the surface layers of the existing pavement by cold milling to the width and depth indicated on the plans or established by the

Engineer and then resurfacing with one or more courses of bituminous plant-mix of the classes and thicknesses shown on the plans. The partial removal and resurfacing of any rutted area shall be completed the same day.

2. Filling the ruts with a bituminous leveling mix of the class indicated in the contract documents and then placing an overlay of one or more courses of bituminous plant-mix of the classes and thicknesses shown on the plans.

b. The use of pneumatic tired rollers to compact each bituminous plant-mix course placed is mandatory in all of the above cases.

c. All patch areas which are to be overlaid by a final surface course, shall be finished to a compacted elevation 0.25 to 0.35 centimeters above the adjacent existing pavement surfaces to remain.

**402-3.05 Rehabilitation of Bleeding and Unstable Pavement Surfaces**

a. The areas to be repaired by partial or full depth pavement removal under these procedures are identified on the plans. Additional areas may be selected by the Engineer at his discretion.

b. The depth of existing bituminous plant mix pavement surface courses to be removed will be as indicated on the plans but may be revised by the Engineer, at his discretion, on the basis of core data and inspection of areas where pavement has been removed.

c. The partial depth removal of bleeding and unstable pavement surfaces shall be by cold milling under

Specification 403 except that small isolated areas may be removed as specified in paragraph 402-3.03b.

d. Pavement patch areas where plant mix has been partially removed shall be back filled the same day with bituminous plant mix of the class specified in the contract documents, to the depth indicated on the plans, and compacted as required in Specification 401. The use of pneumatic tired rollers for this compaction is mandatory. When the bituminous plant mix for backfilling is not specified, mix type B-1 shall be used for depths in excess of 7.5 centimeters and mix type B-2 for depths of up to 7.5 centimeters.

e. When called for in the contract documents, the total pavement section shall be overlaid with one or more courses of bituminous plant mix of the classes indicated on the plans.

f. When the Engineer determines that the full depth of the existing bituminous plant mix pavement originally scheduled for partial depth removal has to be removed down to the aggregate base or subbase or subgrade, the rehabilitation work shall follow the procedures specified under Article 402-3.06 for full depth removal.

### 402-3.06 Rehabilitation of Cracked Pavements

a. Cracked bituminous plant mix surfaces normally reflect deficient base and/or subgrade conditions. In the areas of cracked pavement indicated on the plans or selected by the Engineer, the full depth bituminous concrete pavement structure shall be removed down to the untreated aggregate base course, if one is present, or to subgrade elevation if there is no aggregate base course.

b. Each repair area will be inspected by the Engineer after the existing pavement has been removed to determine

the condition and adequacy of the base, subbase, and subgrade material. The contractor shall excavate test pits at the locations and to the depth, not to exceed 60 centimeters, ordered by the Engineer. If the existing material under the pavement is determined to be suitable to remain, the Contractor shall backfill the test pit with replacement subbase and aggregate base course material to the satisfaction of the Engineer.

c. Where the Engineer determines that the existing material under the pavement is unsuitable, the Contractor shall excavate and remove such unsuitable material within the area and to the depth established by the Engineer.

d. The removed unsuitable material shall be replaced by the Contractor with approved subbase and base materials to the depths shown on the plans or ordered by the Engineer. This backfill material shall be placed in layers not exceeding 15 centimeters in thickness and each layer compacted with vibratory rollers to the requirements of Specification 301 for subbase materials and Specification 304 for aggregate base course materials.

e. Any exposed aggregate base or subbase courses which are to remain in place under full depth pavement removal shall be thoroughly recompacted with vibratory rollers prior to placing any new bituminous plant mix material over them.

f. The removal of existing pavement and underlying materials and the placement of all required replacement materials, including the various bituminous plant mix pavement courses in any individual repair area, shall be completed on the same day. The Contractor shall maintain stockpiles of aggregate base course material and subbase material at the project site to insure their ready availability when needed.

g. Where, in addition to correcting cracked pavement areas as indicated above, the complete pavement section is to be partially removed by cold milling under Specification 403, all the partial and full depth repair work shall be completed prior to the cold milling removal operations.

**402-3.07 Adjustment of Structures** - The initial and/or final adjustment of existing manholes, inlets, valve boxes and other structures within or abutting the pavement that may be required by the rehabilitation operations and to meet final grade requirements, shall be performed and paid for under the provisions of Specification 604 - Manholes, Inlets and Catch Basins.

**402-3.08 Disposal of Removed Material** - The bituminous pavement material and the base and subgrade materials removed from the repair areas shall be disposed of by the Contractor at his expense. To the extent shown on the plans or approved by the Engineer, the removed material may be used to flatten existing road section slopes. Removed material which is not allowed to be used within the project limits shall be disposed of outside the project right-of-way in areas selected by the Contractor. Copies of all permits authorizing the use of the selected disposal areas shall be furnished by the Contractor to the Engineer.

**402-3.09 Protection of Patch Areas**

a. The Contractor shall protect from rainfall with sheet plastic material the areas being worked on to minimize the penetration of water into the aggregate base and subgrade prior to placing the new pavement. Any damages to open patch areas left uncovered shall be repaired at the Contractor's expense.

b. Temporary drainage trenches to dispose of any water accumulated in the work areas shall be constructed by the Contractor as shown on the plans or ordered by the Engineer.

## SPECIFICATION 402–REHABILITATION OF BITUMINOUS CONCRETE PAVEMENT

This work shall be a subsidiary obligation of the Contractor under the pavement removal pay item.

### 402-3.10 Bituminous Plant-Mix Overlays

a. The construction of bituminous plant-mix overlays shall be performed in accordance with all the requirements of Specification 401 - Hot Plant-Mix Bituminous Pavement except as specifically modified by this specification.

b. Bituminous plant mix shall be placed in courses of the thicknesses and widths shown on the plans or as directed by the Engineer.

c. In non-contiguous patch areas of less than 10 square meters, the bituminous mixes may be laid and spread with graders and shall be compacted with pneumatic wheel rollers.

### 402-4 METHOD OF MEASUREMENT

**402-4.01** Test cores of the bituminous concrete pavement included in the contract documents or ordered by the Engineer will be measured by the number of cores acceptably drilled and delivered to the Engineer. When the Engineer orders that a core be extended through the aggregate base and subbase, and the subgrade, to an additional depth of up to 60 centimeters as per paragraph 402-3.01b, such core shall be counted as two cores for measurement and payment purposes.

**402-4.02** The partial depth removal and disposal of bituminous concrete pavement by cold milling will be measured and paid for by the square meter of pavement acceptably removed and disposed of under Specification 403.

**402-4.03** The full depth removal and disposal of bituminous concrete pavement will be measured by the cubic meter of pavement acceptably removed and disposed of. Any pavement area in which

both partial depth removal by cold milling and full depth removal is performed will be included for payment under both pay items.

**402-4.04** Test pits ordered by the Engineer to be excavated into the aggregate base, subbase and subgrade, will be measured by the number of such pits excavated.

**402-4.05** The removal and disposal of unsuitable aggregate base course, subbase and subgrade material ordered by the Engineer will not be measured for direct payment. This work shall be a subsidiary obligation of the Contractor under the pay items of subbase and aggregate base course materials used to replace the removed materials.

**402-4.06** The subbase and aggregate base course materials used to replace removed subgrade, subbase and aggregate base materials will be measured by the cubic meter of each class of compacted material accepted in final position.

**402-4.07** Bituminous hot-plant mix for filling ruts, replacing removed bituminous concrete, and placed in overlays will be measured and paid for as provided in Specification 401 - Hot Plant-Mix Bituminous Pavement.

**402-4.08** The adjustment of existing manholes, inlets, valve boxes and other structures within or abutting the pavement will be measured and paid for under the respective pay items under Specification 604 - Manholes, Inlets and Catch Basins.

## 402-5 BASIS OF PAYMENT

**402-5.01** The accepted quantity of test cores, determined as provided above, will be paid for at the contract unit price. Such price and payment shall constitute full compensation for drilling the cores, including any extensions ordered, disposing of the removed material, and backfilling the hole where required.

**SPECIFICATION 402–REHABILITATION OF BITUMINOUS CONCRETE PAVEMENT**

**402-5.02** The accepted quantity of full depth removal of bituminous concrete pavement, determined as provided above, will be paid for at the contract unit price. Such price and payment shall constitute full compensation for excavating the pavement and disposing of the excavated material.

**404-5.03** The accepted quantity of test pits, determined as provided above, will be paid for at the contract unit price. Such price and payment shall constitute full compensation for excavating the test pits, disposing of the excavated materials and backfilling the pits when no further removal and replacement of the material underlying the pavement is performed.

**402-5.04** The accepted quantities of replacement of subbase and aggregate base course material, determined as provided above, will be paid for at the respective contract unit prices. Such prices and payment shall constitute full compensation for the excavation and disposal of unsuitable base, subbase and subgrade material and the furnishing, placing, compacting and finishing of the specified replacement materials.

**402-5.05** In addition to the above, payment under the unit prices listed below shall constitute full compensation for all materials, equipment, tools, labor and incidentals necessary to complete each item as required by the plans and specifications.

**402-5.06** Payment will be made under:

| Pay Item | Pay Unit |
|---|---|
| Test Cores…… | Each |
| Test Pits……... | Each |
| Replacement Subbase Material……... | Cubic Meter |
| Replacement Aggregate Base Course……. | Cubic Meter |
| Full Depth Removal of Bituminous Concrete Pavement……. | Cubic Meter |

## SPECIFICATION 403 – COLD MILLING OF BITUMINOUS CONCRETE PAVEMENT

### 403-1 DESCRIPTION

**403-1.01 Scope** - This work shall consist of the partial-depth removal of existing bituminous concrete pavement by cold milling in accordance with these specifications and in conformity with the lines, grades, dimensions and cross sections shown on the plans or established by the Engineer. This work is normally performed to remove excess or deteriorated pavement and to provide the desired road profile and cross section prior to laying a new bituminous concrete surface.

### 403-2 MATERIALS

**403-2.01** No materials are specified.

### 403-3 CONSTRUCTION REQUIREMENTS

**403-3.01 Milling Equipment**

a. The cold milling shall be accomplished by a power driven, self-propelled machine which is specifically designed for automatically controlled removal to a specified depth of bituminous concrete pavement or removed to a specified grade line. The equipment shall be of such size, shape and dimensions as will allow it to operate on a full traffic lane 3.65 M (12 ft) wide without restricting the safe passage of traffic in adjacent lanes.

b. The milling machine shall be equipped with automatic grade and slope controls operating from a string line or a ski not less than 20 feet long and shall be capable of removing pavement to an accuracy of $\pm$ 1/8 inch from the control depth or grade line. The automatic controls shall provide for accurately establishing profile grades at each edge of the machine by referencing from an independent grade reference.

c. There shall also be available a small milling machine with a short turning radius for use in milling around manholes and at other irregular or confined areas.

d. Power driven conveyors capable of side, rear or front loading shall be provided together with the necessary equipment to transfer the milled material from the roadway to a truck.

e. The machine shall be equipped with a system to effectively control the dust generated by the cutting operations so as to minimize the dust emissions and air contamination.

f. The equipment shall be furnished with a lighting system adequate for night work.

**403-3.02 Construction Sequence**

a. Partial depth removal of bituminous concrete pavement by the cold milling procedure shall be performed within the appropriate place in the sequence of pavement rehabilitation operations provided in Article 402-3.02 of Specification 402 - Rehabilitation of Bituminous Concrete Pavement.

b. No cold milling operations shall be performed on a cracked pavement until any required full depth repairs in marked areas have been completed.

**403-3.03 Milling and Disposal Operations**

a. The bituminous concrete pavement shall be removed by cold milling to the depth, width, grade and cross section shown on the plans or ordered by the Engineer. The number of equipment passes required to achieve the specified width

and depth of cut, profile grade and cross slope shall be determined by the Contractor.

b. The milling operations shall be so scheduled as to proceed in a manner that will produce a uniform finished surface, maintaining a constant cross slope between lane edges.

c. In the event the entire width of a pavement along a section has not been milled by the end of a work period, resulting in a vertical longitudinal face to be exposed to traffic, the maximum deviation between the two adjacent surfaces shall not exceed 3.8 centimeters (1 1/2 in.).

d. Vertical cuts along a gutter line will be allowed at the end of a work period. However, should the depth of the cut exceed 7.5 centimeters (3 in.) the Contractor shall erect, at his expense, signing and warning devices in accordance with the requirements of Part VI of the DTPW's "Manual de Dispositivos Uniformes para el Control de Tránsito en las Vías Públicas de Puerto Rico".

e. When the leveling and final surface courses are not to be placed on the same day that the milling operation is performed, the Contractor shall construct temporary openings to existing drainage structures to facilitate the removal of runoff from the pavement. This work shall be a subsidiary obligation of the Contractor under the cold milling pay item.

f. Transverse vertical edges in the pavement produced by the removal operations shall be tapered at the end of the work period prior to opening to traffic. The taper shall extend at least one meter per each 2.5 centimeters of vertical difference.

g. Adequate loading, sweeping, dust control and hauling equipment shall be provided by the Contractor to remove all

milled pavement material on a daily basis. Unless otherwise provided in the contract documents, the pavement materials removed shall become the property of the Contractor.

h. At locations where the bituminous concrete pavement cannot be removed by the power driven milling machines because of physical or geometrical restraints that preclude the use of the equipment, the pavement may be removed by other methods acceptable to the Engineer. However, in such cases, the edges of the areas to be removed shall be saw cut to a depth of at least 5 centimeters.

i. Patch areas where the existing bituminous pavement has been only partially removed shall be resurfaced on the same day as required under Specification 402.

j. Where same day resurfacing is not mandatory, such as in full width partial depth pavement removal, the placing of leveling and final surfaces courses shall be completed as soon as possible, but not later than five days, after the milling operations have been completed.

**403-3.04 Surface Tolerances**

a. The cold milling operations shall produce a pavement surface that is true to line, grade and cross-section, and of uniform texture.

b. The milled pavement surface will be subject to visual and straight edge inspection. The Contractor shall provide a 3-meter aluminum straightedge for testing. The milled surface shall not deviate more than 0.6 centimeter (1/4 in.) when tested longitudinally and transversely with the 3-meter straightedge.

c. The transverse slope of the milled surface shall conform to the specified slope within 0.25 percent.

d. All irregularities in excess of the specified tolerance shall be corrected at the Contractor's expense.

## 403-4 METHOD OF MEASUREMENT

**403-4.01** Cold milling of bituminous concrete pavement will be measured by the square meter of pavement acceptably milled to the grades and areas specified on the contract documents or established by the Engineer.

a. For each strip of existing pavement removed by the cold milling process, the volume removed will be determined by multiplying the average depth removed, measured to the nearest millimeter, by the length and width of the strip measured to the nearest centimeter.

b. The average depth of each strip will be determined by measuring the depth removed at the lip along the longitudinal edge of the strip, every 6.0 meters or fraction thereof, and averaging these measurements.

c. Pavement removed in excess of the depth, cross section or profile grade specified in the plans, or ordered by the Engineer, will not be included in the measurement for payment.

**403-4.02** Dust control and the loading, hauling and disposal of the milled pavement material will not be measured for direct payment but shall be a subsidiary obligation of the Contractor under the cold milling pay item.

## 403-5 BASIS OF PAYMENT

**403-5.01** The accepted volume of bituminous concrete pavement milled, measured as provided above, will be paid for at the contract unit price. Such price and payment shall constitute full compensation for all materials, equipment, tools, labor and

incidentals necessary to complete the work as required by the plans and specifications.

**403-5.02** Payment will be made under:

| Pay Item | Pay Unit |
|---|---|
| Cold Milling Bituminous Concrete Pavement… | Square Meter |

## SPECIFICATION 407 – BITUMINOUS TACK COAT

### 407-1 DESCRIPTION

**407-1.01 Scope** - This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material, in order to receive a superimposed bituminous mix course, in accordance with these specifications and in conformity with the lines shown on the plans or established by the Engineer.

### 407-2 MATERIALS

**407-2.01** Unless a specific type or grade of material is called for in the contract documents, the bituminous material used for tack coat may be any of the following meeting the applicable requirements of Specification 702 - Bituminous Materials:

a. Emulsified Asphalt Grades SS-1, SS-1h, CSS-1 or CSS-1h diluted in equal proportions with water.

b. Emulsified Asphalt Grades MS-1, MS-2 or CMS-2 diluted as required but not to exceed 4 parts of water to 6 parts of emulsified asphalt.

**407-2.02** The bituminous material will be accepted on the basis of certified test reports to be submitted by the Contractor. The diluted bituminous material may be sampled by the Engineer at the point of delivery at the project, at his discretion, for testing by the Authority.

### 407-3 CONSTRUCTION REQUIREMENTS

#### 407-3.01 Equipment

a. The Contractor shall provide suitable equipment for cleaning the surface to be treated, for heating the bituminous material, and a distributor for applying the tack coat.

b. The distributor shall be so designed, equipped, maintained and operated that bituminous material at even temperature may be applied uniformly on variable widths of surface up to 4.5 meters at readily determined and controlled

rates from 0.06 to 2.5 gallons per square meter, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.025 gallon per square meter. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

c. Smaller power spray units or hand-held spray equipment may be used where the Engineer determines that the use of the distributor is impractical.

**407-3.02 Preparation of Surface to be Treated**

The existing surface shall be broomed and cleaned to permit the adhesion of the bituminous material.

**407-3.03 Application of Tack Coat**

a. The bituminous material shall be uniformly applied with a pressure distributor at a rate of between 0.08 and 0.12 gallon per square meter. The actual rate of application, temperature and areas to be treated shall be approved by the Engineer prior to application.

b. The tack coat shall be applied in such manner as to offer the least inconvenience to traffic and to permit one-way traffic, where practicable, without pickup or tracking of the bituminous material. It shall not be applied during wet weather, after sunset, or to a wet surface. The surfaces of structures and trees adjacent to the area being treated shall be protected with heavy paper in such manner as to prevent their being spattered or marred.

c. The bituminous material shall be applied only so far in advance of the surface course placement as is necessary to allow it to dry and attain the proper condition of tackiness.

## SPECIFICATION 407 – BITUMINOUS TACK COAT

### 407-4 METHOD OF MEASUREMENT

**407-4.01** The bituminous tack will not be measured for direct payment.

### 407-5 BASIS OF PAYMENT

**407-5.01** No payment will be made for the furnishing and application of the bituminous tack coat as this work shall be a subsidiary obligation of the Contractor under the corresponding pay items of hot plant-mix bituminous pavement under Specification 401.

## SPECIFICATION 408 – BITUMINOUS PRIME COAT

### 408-1 DESCRIPTION

**408-1.01 Scope** - This work shall consist of preparing and treating an existing aggregate or soil surface with bituminous material, and blotter material if required, in order to receive a superimposed bituminous mix course, in accordance with these specifications and in conformity with the lines shown on the plans or established by the Engineer.

### 408-2 MATERIALS

**408-2.01 Bituminous Material** - Unless a specific type and grade of material is called for in the contract documents, the bituminous material used for prime coat may be any of the following meeting the applicable requirements of Specification 702 - Bituminous Materials:

a. Emulsified Asphalt Grades SS-1, SS-1h, CSS-1 or CSS-1h diluted in equal proportion with water.

b. Emulsified Asphalt Grades MS-1, MS-2 or CMS-2 diluted as required but not to exceed 4 parts of water to 6 parts of emulsified asphalt.

c. Cut-Back Asphalt Grade RC-70 or RC-250.

**408-2.02 Blotter Material** - Shall be rock screenings or sand conforming to the gradation requirements of AASHTO M 43, Size No. 10, and shall be non-plastic and free from organic matter or other deleterious material.

**408-2.03** Bituminous and blotter materials will be accepted on the basis of certified test reports to be submitted by the Contractor. In addition, the Engineer, at his discretion, may sample the materials at the point of delivery at the project for testing by the Authority.

## SPECIFICATION 408 – BITUMINOUS PRIME COAT

### 408-3 CONSTRUCTION REQUIREMENTS

#### 408-3.01 Equipment

a. The Contractor shall provide suitable equipment for cleaning and preparing the surface to be treated, for heating the bituminous material and a distributor for applying the prime coat.

b. The distributor shall be so designed, equipped, maintained and operated that bituminous material at even temperature may be applied uniformly on variable widths of surface up to 4.5 meters at readily determined and controlled rates form 0.06 to 2.5 gallons per square meter, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.025 gallon per square meter. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

c. Smaller power spray units or hand-held spray equipment may be used where the Engineer determines that the use of the distributor is impractical.

#### 408-3.02 Preparation of Surface to be Treated

a. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material or other irregularities and shall be uniformly compacted. Delays in priming will necessitate reprocessing or reshaping to provide a smooth compacted surface.

b. Before any bituminous material is applied, all loose material, dust, caked clay and any other foreign material shall be removed for the full width of the application.

## SPECIFICATION 408 – BITUMINOUS PRIME COAT

### 408-3.03 Application of Prime Coat

a. Bituminous material shall not be applied on a wet surface or when weather conditions would prevent the proper construction of the prime coat. The moisture content of the base to be primed shall not exceed 90 percent of the optimum moisture.

b. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread, at a rate of between 0.4 to 0.7 gallons per square meter. The actual rate and temperature of application shall be as approved by the Engineer and will be dependent on the character of the surface to be primed. It shall be sufficient to coat the surface thoroughly and uniformly but with no excess.

c. When traffic is maintained, not more than 1/2 of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected. Building paper shall be placed over the end of the previous applications and the joining application shall start on the building paper. Building paper used shall be removed and satisfactorily disposed of.

d. The primed surface shall not be opened to traffic until bituminous material has been absorbed by the base. At least 4 hours of penetration time shall be allowed before opening to traffic or placing a bituminous mix course on the primed surface.

**408-3.04 Application of Blotter Material** - If, after the application of the prime coat, the bituminous material fails to penetrate within the time specified and the roadway must be used by

traffic, blotter material shall be spread in the amounts required to absorb any excess bituminous material.

## 408-4 METHOD OF MEASUREMENT

**408-4.01** The bituminous prime coat will not be measured for direct payment.

## 408-5 BASIS OF PAYMENT

**408-5.01** No payment will be made for the furnishing and application of the bituminous prime coat as this work shall be a subsidiary obligation of the Contractor under the corresponding pay items of hot plant-mix bituminous pavement under Specification 401.

## SPECIFICATION 409 – BITUMINOUS SURFACE TREATMENTS

### 409-1 DESCRIPTION

#### 409-1.01 Scope

a. This work shall consist of the construction of a wearing surface composed of separate applications of bituminous material covered with aggregate, either in a single (seal coat) or a double application, in accordance with these specifications and in conformity with the lines and grades shown on the plans or established by the Engineer.

b. The approximate quantities of materials and the sequence of applications and spreadings shall meet the requirements set forth in these specifications applicable to the type of surface treatment called for in the contract documents.

### 409-2 MATERIALS

**409-2.01 Bituminous Materials** - Unless otherwise specified in the plans, the bituminous materials shall be an emulsified asphalt RS-2 or CRS-2 meeting the applicable requirements of Specification 702 - Bituminous Materials, but with an asphalt residue between 0.65 and 0.69.

#### 409-2.02 Aggregates

a. Aggregate for surface treatments shall meet the requirements of Section 703-6 of Specification 703 - Aggregates for the grading class specified in the plans.

b. Sand and fine screenings shall conform to paragraph 703-6.03 of Specification 703.

c. Blotter material shall conform to the requirement of Section 703-7 of Specification 703.

## SPECIFICATION 409 – BITUMINOUS SURFACE TREATMENTS

### 409-2.03 Composition and Proportioning

a. Coats - the composition and proportioning for the various classes of seal coats and multiple course surface treatments shall be as shown in Table 409-1. The bituminous materials and aggregates shall be applied at the rates and sequence shown in Table 409-1 for the class of treatment called for in the contract documents. The quantities of bituminous material given in Table 409-1 are approximate and the exact quantity will be set by the Engineer for each application and spreading as necessary to fit conditions.

b. The weights given in Table 409-1 are for aggregates having a bulk specific gravity of 2.65 as determined by AASHTO T 84 and T 85. Proportionate corrections of the table values will be made when the aggregate furnished by the Contractor has a bulk specific gravity above 2.75 or below 2.55. The corrected amount shall be the table weight multiplied by the ratio of the bulk specific gravity of the aggregate to 2.65.

c. Where a bituminous material other than an emulsified asphalt is called for, the rates of application shall be as specified in the contract documents.

## SPECIFICATION 409 – BITUMINOUS SURFACE TREATMENTS

### TABLE 409-1

### CLASSES OF SURFACE TREATMENTS
### Approximate Quantities of Material per Square Meter

### (Using Emulsified Asphalt)

| Aggregate Gradings & Sequence Operations | Treatment Class | | | | |
|---|---|---|---|---|---|
| | **SC-1** | **SC-2** | **BST-40** | **BST-60** | **BST-85** |
| First Course: | | | | | |
| Bitumin. Material (gal) | 0.18-0.27 | 0.24-0.42 | 0.25-0.33 | 0.32-0.40 | 0.50-0.60 |
| Aggregate Cover (lbs) | | | | | |
| Sand & Fine Screening | 12-18 | - | - | - | - |
| Grading D | - | 18-30 | - | - | - |
| Grading C | - | - | 28 | - | - |
| Grading B | - | - | - | 42 | - |
| Grading A | - | - | - | - | 60 |
| Second Course: | | | | | |
| Bitumin. Material (gal) | - | - | 0.16-0.22 | 0.32-.040 | 0.50-0.60 |
| Aggregate Cover (lbs) | | | | | |
| Grading D | - | - | 12 | 18 | - |
| Grading C | - | - | - | - | 25 |
| Totals: | | | | | |
| Bitumin. Material (gal) | 0.18-0.27 | 0.24-0.42 | 0.41-0.55 | 0.64-0.80 | 1.00-1.20 |
| Aggregate (lbs) | 12-18 | 18-30 | 40 | 60 | 85 |

## SPECIFICATION 409 – BITUMINOUS SURFACE TREATMENTS

### 409-3 CONSTRUCTION REQUIREMENTS

**409-3.01 Equipment** - The Contractor shall have available and shall use the following equipment or its equivalent as required for the class of surface treatment to be constructed.

a. A self-propelled pressure distributor so designed, equipped, maintained and operated that bituminous material at the specified temperature may be applied uniformly, through spray nozzles mounted on a spray bar, on variable widths of surface up to 4.5 meters at readily determined and controlled rates from 0.06 to 2.0 gallons per square meter, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.025 gallon per square meter. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically. Smaller power spray units may be used where the Engineer determines that the use of the distributor is impractical.

b. Sufficient trucks and aggregate spreaders to insure continuous spreading of the aggregate on the uncovered bituminous material. The spreaders shall be of the mechanical type, shall be self-supported (towed) or self-propelled, and shall be capable of producing a smooth, uniform distribution of the cover material. Spreaders of the type attached directly to the rear of the truck body (tail gate spreaders) shall not be used.

c. A sufficient number of approved pneumatic-tire rollers shall be available to completely roll in one pass the full width of the aggregate spread. Pneumatic-tire rollers shall be operated at a maximum speed of 5 miles per hour. With multiple treatments, an approved steel-wheeled roller shall be

used to correct surface irregularities. Steel-wheeled rollers shall be operated at a maximum speed of 3 miles per hour.

d. A rotary power broom and/or power blower.

e. Other equipment of proven performance may be used by the Contractor in addition to or in lieu of the specified equipment when approved by the Engineer.

**409-3.02 Weather Limitations** - Bituminous material shall be applied only when the surface to be treated is dry or only slightly damp. No bituminous material or aggregate shall be placed during rainy weather or upon surfaces containing pockets of free water.

**409-3.03 Preparation of Road Surface**

a. The surface to be treated shall be uniformly compacted, smooth, clean, free from loose spots and in conformance with the typical section shown on the plans or established by the Engineer.

b. Where a prime coat has previously been applied to the surface no bituminous material shall be applied until the prime coat has become thoroughly cured, as determined by the Engineer. Surface treatment shall not be applied over any pavement mixture when, due to heat from the sun or insufficient length of the curing period, the stability of the existing pavement is such as to allow penetration or displacement of the existing surface by the cover material during the rolling operations.

c. Bituminous surfaces to be treated shall be swept clean with a power broom or power blower supplemented by hand sweeping as required to remove all loose material and deleterious matter.

**409-3.04 Protection of Adjacent Surfaces** - Where bituminous surface treatments are applied adjacent to curb and gutter, gutters, or

any other concrete surface, the concrete surfaces shall be covered with heavy paper or protected otherwise as approved by the Engineer, while the bituminous material is being applied. Any bituminous material deposited on such concrete surfaces shall be removed immediately. Manhole covers, inlets, catch basins and any other structure within the roadway area shall be similarly protected during the applications of surface treatment materials.

### 409-3.05 Application of Bituminous Material

a. After the surface to be treated has been prepared and cleaned to the satisfaction of the Engineer, the bituminous material shall be uniformly applied at the specified temperature with an approved pressure distributor. However, no bituminous material shall be placed until the aggregate spreading equipment, rollers and an adequate supply of the required aggregate are available at the site.

b. The area to be covered by any one application of bituminous material shall be not greater than can be covered with the available aggregate and spreading equipment without interruption.

c. Care shall be exercised in setting the angle of the spray nozzles and the spray bar height so that the spray fans will not interfere with each other. The spray nozzle angle, measured from the spray bar axis, shall be from 15 to 30 degrees. To ensure uniformity of spread, the spray bar shall be set at the proper height above the pavement surface to achieve as closely as possible a complete double coverage.

d. Special precautions shall be observed to assure that an even and uniform distribution of bituminous material will be obtained, and the distributor shall be so adjusted and operated as to maintain uniform, even distribution of the type of material being applied. Excessive deposits of bituminous material upon the road surface, caused by stopping or starting the distributor, by leakage, or otherwise, shall be immediately

removed. Skipped areas or deficiencies in distribution shall also be immediately corrected.

e. Distribution pressure shall be maintained at no less than 20 but not more than 75 pounds per square inch at the nozzles.

### 409-3.06 Application of Aggregate Cover

a. General

1. Aggregate of the designated gradation shall be applied with the approved spreading equipment at the rate set forth in this specification or established by the Engineer. During the spreading, excesses and deficiencies shall be corrected by the addition of aggregate until a uniform texture is achieved. Hand methods may be required in areas not accessible to power equipment. Brooming and rolling equipment shall be at the site of the application prior to spreading aggregate. Vehicles spreading aggregate shall be operated so the bituminous material will be covered before wheels pass over it.

2. Each layer of aggregate shall be initially rolled with pneumatic rollers the full width of the aggregate spreader. Additional rolling as necessary shall be accomplished to adequately seat the cover aggregate, and in no case shall the rolling be less than three complete coverages. For multiple treatments, a final coverage with a steel-wheeled roller may be required by the Engineer to improve rideability.

3. During part-width construction, a strip of bituminous material approximately 15 centimeters wide shall be left uncovered to permit a slight overlap of the bituminous material.

b. Seal Coat

1. Seal coats consist of applying a bituminous material onto an existing bituminous pavement immediately followed by a single, uniform application of cover aggregate, at the rates indicated for the specified class.

2. Spreading of cover aggregate and pneumatic rolling shall immediately follow application of the bituminous material and shall be completed on the same day.

3. The completed aggregate surface shall be lightly broomed and maintained for a period of 4 days or as directed. Maintenance of the surface shall include the distribution of additional cover aggregate or blotter material over the surface to absorb any free bituminous material and cover any areas deficient in aggregate. The maintenance shall be conducted so as not to displace imbedded material. Excess material shall be swept from the entire surface by means of rotary brooms. The surface shall be swept at the time determined by the Engineer.

c. Double Course Surface Treatments

1. Double course surface treatments consist of sequential application of bituminous material and cover aggregate onto a prepared surface at the rates indicated for the class selected.

2. The first application of cover material shall be broomed and rolled as required for seal coats and shall then be allowed to cure for at least 24 hours before the second course is placed.

3. The second and final course shall be completed and maintained as specified for seal coats in paragraph 409-3.06b(3) above.

**409-3.07 Surface Requirements** - The finished surface shall be uniform and shall conform to the lines, grades, and typical cross section shown in the plans. Any portions of the completed surface which are defective, not properly finished, have fat joints, or are not in reasonably close conformance with these specifications, shall be replaced with a satisfactory surface laid in accordance with these specifications. In this case no compensation will be made for the replaced surface.

**409-3.08 Maintenance of Traffic**

a. Surface treatment on existing roads open to traffic shall be constructed in a manner to offer the least inconvenience to public traffic and to permit one-way traffic when the roadbed width permits it without pickup or tracking of the bituminous material being applied.

b. When one-way traffic is maintained on the untreated portion of the roadbed, the Contractor shall take all necessary precaution, including providing adequate barricades and traffic control devices, to prevent traffic from encroaching on the freshly applied bituminous material until the cover material has been placed, thoroughly rolled, and allowed to cure adequately.

c. When it is impractical to keep traffic off the finished surface for the desired period, traffic shall be restricted to 10 miles per hour speed during the first two hours and to 20 miles per hour for the remainder of the curing period. The Contractor shall provide the necessary traffic control, including pilot cars and drivers, to maintain these speed limits.

d. During part-width construction, the spread of bituminous material shall not be more than 15 centimeters wider than the width of aggregate cover that can be provided by the spreading device.

## 409-4 METHOD OF MEASUREMENT

### 409-4.01 Bituminous Materials

a. Bituminous materials will be measured by the gallon of material of each type and grade specified, applied on the road and accepted. The quantities shall be determined by measurement in the distributor tank immediately before and immediately after each application.

b. When the aggregate to be furnished by the Contractor requires the use of anti-striping additives in the bituminous material to meet the requirements of paragraph 703-6.02 of Specification 703 - Aggregates, no direct measurement for payment of such additives will be made but they shall be considered subsidiary obligation of the Contractor.

### 409-4.02 Aggregates

a. Cover aggregates of each class specified, applied and accepted will be measured by the dry ton weighed in the vehicle at the producer's plant scale or at the point of delivery utilizing suitable scales furnished by the Contractor and approved by the Engineer.

b. At the option of the Engineer, the cover aggregate may be measured by volume in the truck at the point of delivery and converted to weight in tons based on the density of the loose volume in the truck.

## SPECIFICATION 409 – BITUMINOUS SURFACE TREATMENTS

### 409-5 BASIS OF PAYMENT

**409-5.01** The accepted quantities, determined as provided above for each of the pay items listed below which is included in the contract, will be paid for at the contract unit price per unit of measurement. Such prices and payments shall constitute full compensation for preparing the surface to be treated; furnishing and placing any required prime coat; furnishing and placing the bituminous material; furnishing, placing, rolling and brooming the cover aggregates, removing the excess loose material; and for all equipment, tools, labor and incidentals necessary to complete each item of the work as required by the plans and specifications.

**409-5.02** Payment will be made under:

| Pay Item | Pay Unit |
|---|---|
| Bituminous Material …… | Gallon |
| Seal Coat Aggregate, Class * …… | Tons |
| BST Aggregate Grading Class ** …… | Tons |

* Indicate SC class number. See Table 409-1

** Indicate Grading Class A, B, C, or D. See Tables 409-1 and 703-5.

## SPECIFICATION 410 - HOT PLANT-MIX BITUMINOUS PAVEMENT SMOOTHNESS

### 410-1 DESCRIPTION

**410-1.01 Scope** - This work shall consist in measuring the roughness for bituminous pavement lots acceptance. The work shall be performed at the locations shown in the plans or indicated by the Engineer, in accordance with these specifications, and in conformance with the lines, grades and details shown on the plans or established by the Engineer.

a. The Contractor will accomplish roughness test during the construction process to evaluate the performed work and to ease the correction procedures.

b. The Authority will perform the final measurements of surface roughness for the acceptance or rejection of the bituminous pavement lots.

### 410-1.02 Equipment

a. Pavement smoothness will be measured based upon the Profile Index (PI) as determined by the 25 feet computerized California type profilograph (non-uniformly spaced wheels), or a compatible device that correlates its results with the California type profilograph. The provided equipment shall comply with the ASTM E-1274, or the ASTM E-950 (Class I) in case the compatible device is selected. All pavement lanes and ramps shall be tested.

b. The PI will be determined using the equipment's software. The PI units will be setup in inches per mile and will be carried out to one decimal point. The profilogram is the graph that presents the roughness profile and it will be recorded using a vertical scale of one inch equal one inch, or full scale, vertically. The equipment will be setup using a blanking band of 0.2 inches and a "must correct" bump or depression limit of 0.4 inches in a length of 25 feet for the purpose of the PI computations. Motive power may be manual or by a propulsion unit attached to the assembly. The

equipment will be moved longitudinally at the right wheel path along the pavement, in the direction of traffic, at a speed no greater than 3 MPH.

c. A bituminous pavement lot is defined as 528 feet (0.1-mile) pavement lane. Bituminous pavement lots will begin or end with the equipment's measuring wheel at the abutment end wall, at the change in pavement type, or at 528 feet (0.1-mile) pavement lot limit or fraction. For lanes with 12-feet width or less, the wheel path is located at 3 feet from and parallel to the right edge of pavement. For lanes with greater width than 12 feet, the profile will be taken on the right edge from the approximate lane marking. Manhole covers, drainage grates, pavement markings, signal detection slabs, and any other appurtenances in the wheel path will be included in the measurement of the profile index.

## 410-1.03 Surface and Tolerances Requirements

a. The Contractor shall furnish paving equipment and employ methods that produce a riding surface having a Profile Index (PI) within the acceptance zone presented in Table1. The equipment will be calibrated and operated by qualified technical personnel in compliance with the equipment's manufacturer recommendations and protocols. Initially, the Contractor shall provide a test section equivalent to three (3) lots for evaluation of the paving methods and equipment for smoothness purposes. Prior to the initial paving operations, or after a long shutdown period, the Contractor shall provide a test section for smoothness evaluation purposes. The smoothness evaluation will be done with the Contractor's equipment as soon as the final rolling has been completed and the required density has been attained. After the initial pavement smoothness evaluation, if paving methods and paving equipment are acceptable to the Engineer, the Contractor may proceed with the paving operation.

b. During the construction stages, the Contractor shall verify the PI every ten (10) lots of production. The Contractor may submit correction proposal for those lots with PI falling in the penalties zone as stated in Table 1. The Authority may reject the Contractor's correction proposal and the bituminous pavement lots will remain with the penalty. If the Authority accepts the correction to take place, the affected lot will be measured and a new PI established. No penalties will be applied to the Contractor until the final evaluation takes place. Lots with a PI falling in the rejected zone stated in Table 1, will be immediately removed and replaced, at the Contractor's, expense prior to continuing the paving operation. All PI measurements will be handled to the Engineer and will be included in every monthly payment request.

c. The final smoothness evaluation will be measured with the Authority's profilograph. The profilograph will be calibrated and operated by qualified technical personnel in conformance with the profilograph manufacturer recommendations and protocols. During testing operations, it will be the Contractor's responsibility to provide traffic control, as it will be to furnish survey services and reference points tied to the stationing system of the project. No compensation will be provided for these services.

d. The acceptance criteria will be in conformance with Table 1. On roadway lots less than 528 feet in length, the penalties will be reduced proportionally with the actual length of the lot. Segments shorter than 15 feet will not be considered for penalties.

## 410-1.04 Penalties and Credits

a. Penalties will be computed according to the values of Table 1 from the results of the final measurements of surface roughness tests performed by the Authority.

b. Credits, to reduce the amount of the penalties computed as per paragraph a. above, will be computed according to the values of Table 1 from the results of the final measurements of surface roughness tests performed by the Authority.

c. The net amount of the penalty will be computed by the difference between the computed penalties and credits. The net amount of the penalty will be deducted from any monies due or that may become due to the Contractor. No additional payment will be made when the amount of credits exceeds the penalties.

**Table 1**
**Acceptance Criteria for Bituminous Pavements Lots**

| Acceptance | | | | Rejection | |
|---|---|---|---|---|---|
| PI | Credit | PI | Penalty | PI | Penalty |
| $\leq 15$ | Credit of $200 per every PI equal or under 15 | $15 < PI \leq 40$ | Penalty of $200 per every PI above 15 | $> 40$ | Remove and replace |